LUND UNIVERSITY
School of Economics and Management

Value Creation Or Value Destruction?

"A Study of Cash Flow Volatility's Relation with Firm Value"

Supervisor:

Maria Gårdängen

Authors:

Fanding Li

Bo Cheng

Acknowledgments

This is the first empirical study we've ever done. During the last two months, we met with a lot of difficulties. Fortunately, with the help of our teachers, friends and classmates, we now successfully completed this thesis. We would like to give sincerest thanks to our supervisor Maria Gårdängen. She is always encouraging us whenever we meet with frustrations and it is impossible for us to achieve our success without her dedicated help. We also want to thank for Måns Kjellsson, who gave us great help with the final part of this study.

Fanding Li, Bo Cheng

2011-5-23

At Lund University

Abstract

Title:	Value Creating or Value Destroying? A Study of Cash Flow Volatility's Relation with Firm Value
Seminar date:	2011-06-01
Course:	BUSM36, Degree Project Master level in Corporate and Financial Management, Business Administration Master level, 15 University Credit Points (15 ECTS)
Authors:	Fanding Li, Bo Cheng
Advisor:	Maria Gårdängen
Five key words:	Cash flow volatility, firm value, growth option, earning management, U.S. healthcare sector
Purpose:	This study develops prior academic finding from Brian, James and George (2008) by specific empirical tests in two comparable industries – U.S. Pharmaceutical and Biotechnology.
Methodology:	Quantitative approach using multiple regression tests
Theoretical Perspectives:	The theoretical frameworks cover the theories underlying earning management and risk management, mainly regarding cash flow volatility, earnings volatility, accruals management, and valuations. We also present the conflicts between prior empirical studies and Merton model and using an eclectic approach to explain both sides and eliminate the conflicts.
Empirical foundation:	Samples contains all U.S. pharmaceutical and biotechnology firms from 2001 to 2010 with missing data no more than two years, the number of samples are 70 and 83 separately.
Conclusions:	The cash flow volatility could be either value destroying or value creating. It is also meaningful to classify the firms by growth options when analysis the firm value. These results develop the prior study to a more specification condition. Managers should focus on real cash flow management and the effects of firm's earning management should also be measured by cash flow rather than accruals.

TABLE OF CONTENTS

Part I. Introduction

1.1. Background

Earning management is a shadow behind the shining numbers of financial reports. Although it is hard to say if it is beneficial to every stakeholder, the masked numbers keep us away from the truth. There are many researchers make effort to detect the trace of them from accounting tricks and measure the effects of them to get a better understand of the true value of the firms. There are evidences showing that cash flow volatility, accruals and earning volatility could be signs for earning management. In other words, the volatility could be a key to discover the trick of earning management. On the other hand, our world becomes much more uncertain in recent ten years, and so does the business world. The terrorist attack on September 11th 2001 in U.S. led world airline industry into the largest crisis it has ever met. The war in Iraq in 2003 highly raised the fuel price and deeply hurt industries related to it like energy and car manufactory. In 2005, the terrible earth quake and tsunami badly affected the economies of Southeast Asia. The failure of U.S. house sector in 2008 and overusing of financial derivatives heavily struck the global economy once again. Not yet recovering from the last global financial crisis, the earthquake in Japan in 2011 and the followed explosion at the world largest nuclear power plant Fukushima hurt global food, tourism, fishing and energy market again. Challenged by these uncertainties, nowadays firms are meeting with more volatility, and so does their performances. Thus these leave more motivations and flexibilities for firms to manipulate their earnings. It is questionable if the earning management behaves differently under such uncertain background recent years when compared with late 20th century. Moreover, accounting standard and information transparency is developing quickly in recent, people question more on earning management activities these years. There are still quite a lot of unknown spaces for us to explore and exploit in the field of volatility and earning management.

1.2. Problem Discussion

As one of the most important measurements for investors' decisions making, volatility has been studied for a long time. There are different kinds of volatility, in which cash flow volatility is widely used in theoretical studies as a measurement. Nowaday's corporate risk management theory prefers that firms with less volatility supervise companies with high volatility from many aspects. For instance, following the Pecking Order Theory, Froot, Scharfstein and Stein(1993) found that smooth cash flow firm could rely on a more stable internal finance when facing attractive investment opportunities thus reducing the cost of external finance. John and Clifford(1999) illustrated that hedging, through reducing volatility, could help firm to lower its expected tax liability largely. Smooth cash flow firms are more unlikely to meet with financial distress thus reduce the risk of bankruptcy. They are also preferred by investors due to the ability to repay debt as schedule and being more able to bear potential strikes. Investors, credit rating companies and analysts also prefer smooth cash flow companies since less volatile represents less risk (Badrinath, Gay, and Kale 1989). Thus companies with smooth performance will have a relatively higher value due to lower discounting rate and lower weight average cost of capital (Trueman and Titman, 1988; J.Peter Ferderer 1993).

However, there are also other arguements that support value creation from volatility. One important theoretical model is Merton Model. Merton(1974) illustrated that equity could be considered as a call option of firm's total assets, and the volatility reflects potential growth of the assets in this model. In this way, volatility should be value enhancing. Merton Model has significant influence on later researches yet still no empirical study could directly reject this result. There are also other researches like Pastor and Veronesi(2003) argue that volatilities reflect firm's future potential growth opportunities and higher volatility is related with higher potential growth, thus volatility could create value.

Brian, James and George (2008), focusing on over 4,000 U.S. listed firm, checked the relations between cash flow volatility and firm value by using multiple regression tests. This is the first research that directly examined the quantitative relations between volatility and enterprise value since former studies focused on this topic from other perspectives like hedging or taxation. However, the results showed that cash flow volatility is negatively related with firm value while systematic risk is positively related with firm value. In this way, the results could not directly reject that volatility could create value. From our point of view, we think that there exist both value creation and destruction, but value destruction from volatility is larger than the value creation from potential growth in their study. While different opinions are held by researchers, still no enough evidence could illustrate which opinion is right or wrong. Thus one purpose of our study is to examine whether volatility is value creating or value destroying, or as our expectation, both at the same time.

Brian, James and George (2008) also contributed to theories of earning management. Traditionally, researchers think that managers could use accruals to reduce volatility which is preferred by investors thus it creates value. In this way, only financial statements volatilities after accruals matter. However, this is challenged by some recent studies like Leuz, Nanda and Wysochi(2003). In Brian, James and George (2008), they found that earning managements could only create value by real cash flow managements but not through accruals and reservations. Thus, this research illustrated that cash flow volatility has direct impact on firm value, but not through accruals. However, there are also some studies argue that the real effect of accruals could only be examined by samples within same industry but not from a general level.

Since few studies has been done to study the quantitative relations between cash flow volatility and firm value within specific industries and, as mentioned above, it is necessary to check accruals' influence on firm value on an industry basis, the other two purposes of our study are (1)to examine different industries in U.S. market to

check the relations between earnings volatility, cash flow volatility, accruals volatility and firm value and (2) to see if these relations differs between industries, or to be more exactly, between mature industries (which are usually assets-intensive) and high growth industries (which are usually non-assets-intensive and highly volatile). To compare these two industries, we also expected to check the effect of possibly volatility behaviors between assets-intensive and non-assets-intensive, mature and high growth companies.

We also observed one knowledge gap which lays in today's corporate risk management theories. Although most of the studies illustrated that there are correlations between volatilities and firm value, few empirical studies have been down to check how the value is influenced. Thus, in our study, we also follow the theoretical framework to check two possible ways for cash flow volatility to affect firm value: taxation and possible financial distress.

1.3. Research Purpose

As mentioned above, we identify some gaps and conflicts lying in different theoretical frameworks and empirical studies. The purpose of this study is to examine the following four questions:

(1) Whether cash flow volatility has different impacts on mature and high growth industries?
(2) Whether cash flow volatility has direct influence on firm value but not through accruals management?
(3) Whether volatility creates value or destruct value?
(4) If cash flow volatility destroy value, how? (This do not deny possible value creation)

These four questions are highly related to each other and all point to a study basing

on an industry level. We think that we are able to examine all four questions with our sample at the same time, and only do we examine all these factors could we get access to integrated answers of cash flow volatility's effect on firm. Our estimations and their potential relations are:

(1) We believe that Merton(1974) should be right since no empirical study could directly challenge the result till now. Thus we expect to see different impacts from cash flow volatility on industries with different growth option. We expect to see a positive or at least a less negative coefficient in high growth industry than in mature industry.
(2) If our assumption that there exist differences between industries is right, then we could further observe whether volatility is value creating or value destroying. We expect to see both at the same time since we believe that Merton Model is right. Further explanations could be found in section 2.5.
(3) If our estimation (2) is right, then we need to check again whether accrual creates value or not. Since there are argues that accrual's effect could only be examined on an industry level, we estimate that there might exists difference between our study and former studies like Brian, James and George (2008).
(4) We believe that cash flow volatility has impacts on firm value. However, we are also curious about factors besides accruals which may affect this influence. Thus we add new variables and test whetheer there is any improvement of the model or not. We expected to see an improvement by introducing variables like tax rate and annual interest payments.

1.4. Delimitations

The major delimitations of this paper are: (1) Sample size: compared with former studies, we focus on relations of cash flows, accruals and firm value in specific industries (U.S. biotechnology and pharmaceutical industries). Following Brian, James and George (2008), we also use strict criteria to select samples. These two reasons

lead to a large reduction of the size of sample base: total 602 firms in our study when compared with over 4000 firms in Brian, James and George (2008). We believe that the results are robust within U.S. healthcare market. Although our samples also contain foreign firms that are listed in U.S., it is hard to infer whether the results are generally correct in other countries and other markets due to the sample selection. (2) Time period: when compared with Brian, James and George (2008), we choose a more recent time period to examine if there are any new changes in results. However, this means that we could not exclude the influences from global financial crisis, terrorist attacks etc. which are treated as "potential severe serial correlation" in Brian, James and George (2008). However, we think that these factors better reflect the real situation of today's world, thus could be treated as an irreversible change in firms' systematic and idiosyncratic risks.

1.5. Thesis Outline

Our study is organized as follow: In Chapter II, we review both theoretical and empirical literatures related to this topic, mainly focus on the relations among cash flow, accruals, and firm value. We introduce readers about the gaps and conflicts lying among different theoretical frameworks and empirical studies and present how we come up with our research questions. Chapter III describes our sample selections and methodology to support the research together with explaining the choice of variables, the robustness of models we used and our expectations. Chapter IV presents our tests of relations among cash flow, accruals and enterprise value. In this chapter we also discuss the results and provide readers reasonable answers to our questions. Chapter V summarizes the study and gives conclusions. In Appendix, we give out Pearson correlation tests and selected multiple regression results that are highly meaningful.

Part II. Literature review

2.1. Introduction for earning management

Earning is an important object of management and manipulation. Joshua and Varda (2008) present three approaches to state that: the contracting approach, the decision making approach, and the legal approach. The contracting approach states that, earnings provide summary information which is used for designing the contract among different stakeholders. The decision making approach states earning provides valuable information for making decision. The legal approach states earning provide valuable information for shareholders to control management more effectively. To sum up, we conclude that earning is essential for different stakeholders. There are many business activities referring to earning as a critical measurement. Since earning is important, management has various motivations to manipulate earnings. The term earning management is introduced to describe the activities of manipulating financial report in order to smooth the earning. The target could be various, but the ultimate target is to provide the "twisted" information for certain purpose. There are several important studies that defined earning management:

Healy and Wahlen (1999, p. 368) defined earning management as follows:

> *Earnings management occurs when managers use judgment in financial reporting and in structuring transactions to alter financial reports to either mislead some stakeholders about the underlying economic performance of the company or to influence contractual out comes that depend on reported accounting numbers.*

However, Joshua and Varda (2008, p. 27) point out two weaknesses against Healy and Wahlen. First, it does not set a clear boundary between earnings management and normal activities whose output is earnings. Second, not all earnings management is misleading. Therefore, they developed the definition as follows:

Earnings management is a collection of managerial decisions that result in not reporting the true short-term, value-maximizing earnings as known to management.

Earnings management can be

Beneficial: it signals long-term value;

Pernicious: it conceals short- or long-term value;

Neutral: it reveals the short-term true performance.

The managed earnings result from taking production/investment actions before earnings are realized, or making accounting choices that affect the earnings numbers and their interpretation after the true earnings are realized.

Based on the definition above, earning management should not only be fraud like and harmful for investors, but also be beneficial to either management or investors. In our study, we concentrate more on the final outcome based on our empirical evidence under certain conditions, rather than discuss the overall framework of the nature of earning management. We expect such a study will enhance or challenge the explanation of certain feature of earning management. Regardless the confusion between earning management and normal activities, we also expect to investigate the value creation by earning management under our assumptions which we will discuss later.

2.2. The methods of earning management

On practical level, earning managements require a variety of accounting and financial technics. Vast number of studies has summarized earning management through following methods[1]:

[1] Joshua Ronen and Varda Yaari (2008). *EARNINGS MANAGEMENT*. New York: Springer Science+Business Media, LLC. 31-33.

(1) Accounting choice under GAAP, such as LIFO versus FIFO for inventory valuation, depreciation.
(2) The timing of the adoption of a new standard.
(3) The estimates required by GAAP, such as depreciation, the allowance for bad debt, assets valuation, pension accounting and asset write offs.
(4) A classification of items as above or below the line of operating earnings.
(5) Structuring transactions to achieve desired accounting outcomes.
(6) Timing the recognition of revenues and expenses.
(7) A real production and investment decision, such as reducing research and development expenditures and affecting selling and adminsitrative expenses.
(8) Managing the transparency of the presentation.
(9) Managing the informativeness of earnings through various means.

Through the previous studies, we sum up that the most common accounting method of earing management is either report the future income in present period or manipulate the cost reported. And the most common real smooth is making investment. As we mentioned before, we have no ambition to describe the detailed process of earning management. Instead, we could at least speculate that cash flow and abnormal accruals are the focuses for our study to investigate since the accounting method is expected to create a time gap between cash flow and accounting recognition and the real smooth is expected to influence the relation between cash flow and economic earning.

2.3. Detecting earning management

There are many studies made effort to detect earning management. The most common used method is detecting the abnormal accruals. One of the most important contributions is the method developed by Jones (1991) which is to detect the abnormal accrual between estimation stage and event stage. Dechow, Sloan, and Sweeney (1995), Dechow, Richardson, and Tuna (2003), Kang and Sivaramakrishnan (1995), Dechow and Dichev (2002), Leone, and Wasley (2005), Ye (2006) developed

and modified Jones model by either adding controls or addressing non-linear relationship.

However, there still exists the basic problem which is to distinguish earning management from normal activities. Elgers, Pfeiffer, and Porter (2003, p. 406) state, "*A fundamental issue in assessing earnings management is the unobservability of the managed and un-managed components of reported earnings.*"

Sloan (1996), Collins and Hribar (2000), and Core, Guay, Richardson, and Verdi (2006), found that the market do not distinguish between cash flow and accruals. Further studies from Bradshaw, Richardson, and Sloan (2001), Ahmed, Nainar, and Zhou (2005), indicated that even the analysts and auditors also do not distinguish them correctly. To explain the mispricing problem, Beneish and Nichols (2005), indicated that since investors cannot pierce the veil of accruals, they perceive the inflated earnings (as reflected in high accruals) as a signal of future high earnings instead of a warning of a reversal that will lead to a decline in reported earnings.[2] Beneish and Vargus (2002) explain the mispricing by insider trading which suggest that the investors cannot distinguish positive accruals from abnormal trading.

Fairfield, Whisenant, and Yohn (2002) examined the relationships between accruals and cash flows and assets. They found that accruals are less persistent than operating cash flows in predicting 1-year-ahead return on assets, while accruals and cash flows have equivalent associations with 1-year-ahead operating income. The studies from Desai, Rajgopal, and Venkatachalam (2004), Papanastasopoulos, Thomakos, and Wang (2007), discussed the issue further and consider the mispricing is the result of a more broadly anomaly reason. Dechow, Richardson, and Sloan (2006), showed that the payments to equity holders have a more important role. Atwood and Xie (2005) showed that *accruals and special items are strongly positively related. However, special items affect the extent to which the market overprices*

[2] Joshua Ronen and Varda Yaari (2008). *EARNINGS MANAGEMENT*. New York: Springer Science+Business Media, LLC. 385.

accruals with negative special items aggravating and positive special items alleviating accruals overpricing.

To sum up, using accruals as the measurement of earning management is not precisely enough. Further measurements should be introduced to describe the earning management activities more accuracy and lead to less misunderstanding for the investors. To discover that, it is rational to test the reaction from investors and the controls select as the proxies of earning management. The market value of the firms could be a proper proxy as the reaction from investors in certain market.

2.4. Arguments of cash flow volatility

Since the market does not react to the earning management as we expected, we consider that it is more important to concentrate on the direct relations between accruals, cash flow, and market. One of the purposes of detecting earning management is to discover the real information to support the investment decision for investors. Studies which indicate the direct relationship between objective items, such as cash flow, and market should be more helpful for this purpose and as long as we could not clearly describe the relationship between accruals and market, it is worth to try another way.

Generally speaking, since the detection of earning management is done by abnormal accruals, the relationship between cash flow and accruals comes firstly. Day and Fahey (1988) mentioned that cash flow volatility is one of the drivers of shareholder value. The empirical evidence from Keith and Mark (1993) also indicate significant coefficient between cash flow and market value. These two studies indicate the market would response to the cash flow by either positive or negative, and Tobin's q should relate to the cash flow as well.

Wang et al. (1993) discovered that the earnings response coefficient is smaller when earnings contain a large change in total accruals. Alister, Susan and Terry (2000) conclude the lower earnings volatility is associated with higher market value by a

sample of 2225 firms from 1983 to 1992. They also conclude that earnings volatility is informative to cash flow volatility, as well as the accruals. Randolph, Paul and Tuomo (2002) mentioned that there are many literatures suggest the stock prices of firms are "underreact" to the news of future cash flow. In their research they couldn't reject this conclusion, but they do provide evidence that market response positively to the positive cash flow news. By summarizing above mentioned studies, the market response, or Tobin's q should prefer less risky conditions which could present as lower cash flow volatility rather than the accruals. It is probably consistent with the finding from Shin and Stulz (2000), which is Tobin's q is negatively correlated to the total equity risk. The less total equity risk could also lead to a lower volatility of the firm equity, which could also have lower cash flow volatility.

Furthermore, Dechow (1994) notes that there is a strong negative correlation between accruals and cash flows and build a model to explain that. It could be a sign of earning management which is the cash flow would be converted to earnings in order to smooth the report. Their study also enlightens the researchers to better specification the accrual models such as Jone's.

Leuz, Nanda, and Wysocki (2003) further note that *the more negative the correlation between cash flows and accruals the more smoothing the firm is doing via accruals, which does not necessarily reflect the underlying economic performance of the firm.* We could speculate that the change of cash flows will effect on the accruals, which will further lead to potential earning management. However, there are still vast number of studies mentioned above indicated the mispricing problems, which suggest the accruals may not indicate the correct market response. As a result, the value creation is also questionable since the market response may not support that.

All of the studies mentioned above lead to a same direction. To discover the relation between the market response and possibly earning management activities, it is better to examine the direct linkage between cash flow and market value of the firms. Some of studies also confirm the relationship between cash flow volatility and firm

value. Froot, Scharfstein, and Stein (1993) illustrates that low cash flows volatility can create value. There are evidence points towards investors preferring smooth cash flows in making capital allocation decisions (Brian, James and George, 2008).

Moreover, Brian, James and George (2008) show empirical evidence of cash flow volatility is negatively valued by investors. And the earnings smoothing via accruals does not add value. This study suggest we could ignore distinguish between cash flow and accruals. The managers create market premiums through smooth real cash flow rather than smooth accruals.

The study of Brian, James and George (2008) is essential. It directly relate the cash flow to firm value, and deny the value creation through accruals. It suggests we should focus on smooth cash flow rather than smooth earning through smooth accruals. However, they use the cross section samples which could be questioned. The accruals measured among different industries may neutralize since the level of accruals are different. Therefore, their conclusion that the accruals will not create value is questionable. It is also questionable if the specification of firms is necessary for the research of relationship between cash flow and firm value.

Furthermore, Gul, Leung, and Srinidhi (2002), find that managers of firms with greater investment opportunities use earnings management to signal future opportunities for growth. There rises further question that as long as the behavior of high growth firms is different, is there any neutralize problem? Is the research on high growth firms different from Brian, James and George's conclusion?

2.5. Arguments of relations between cash flow volatility and firm value

Cash flow volatility is widely used in theoretical studies as a measure of risk. As one of the most important measurement for investors' decisions making, volatility has been studied for long time. However, there exist conflicts and gaps between different studies and researches about relations between cash flow volatility and firm value. In 1974, Robert C. Merton published his model to measuring credit risks. In this model,

equity is treated as a call option of assets while volatility measures potential assets growth. In this way volatility should be value enhancing. Pastor and Veronesi(2003) argues that volatility reflects future potential growth opportunities, which means that companies with higher volatilities should growth faster thus have higher value since the firm value consist of assets in place and growth opportunities. Thus in their study, there exists positive correlation between volatility and firm value.

However, these results are challenged, although not directly, by some recent empirical studies like Froot, Scharfstein and Stein(1993), John and Clifford(1999), Shin and Stulz (2000) and Brian, James and George (2008). The former two studies illustrates that firm could create value through methods like hedging that could reduce volatility. In the latter two studies, the volatilities from integrated risks are negatively correlated with firm value[3] when using Tobin's Q as proxy of EV.

However, no direct and "powerful" explanation is given out yet from those studies. Froot, Scharfstein and Stein(1993) and John and Clifford(1999) only proved that lowering volatility could create value, however it is not so logic to derive from this result to say high volatility must destruct value, one could argue that higher volatility could also create value but lower volatility creates more. When it comes to Shin and Stulz (2000), the results highly relied on regression specification and did not apply to largest companies. While Brian, James and George (2008)'s result is quite robust regardless of regression specification, it could not directly "reject the positive effect of volatility on firm value as argued by Merton (1974) or Pastor and Veronesi(2003)"[4]. One possible answer is that there exist both value creation and destruction at the

[3] It means the integrated effect on EV from both systematic and non-systematic risks. In both Shin and Stulz (2000) and Brian, James and George (2008), they found positive correlations between changes in systematic risk and changes in Tobin's Q while a negative correlation between changes in unsystematic risk and changes in Q and finally leads to a negative correlation between integrated risk, which includes systematic and non-systematic risks, and the changes in Tobin's Q, mainly due to that idiosyncratic risks are generally larger than systematic risks.

[4] See Brian, James and George (2008), "Do investors value smooth performance?", Page 249

same time however the value destruction from cash flow volatility is much larger than the value creation from growth opportunities (see figure 2). In our tests, we will examine if this is true.

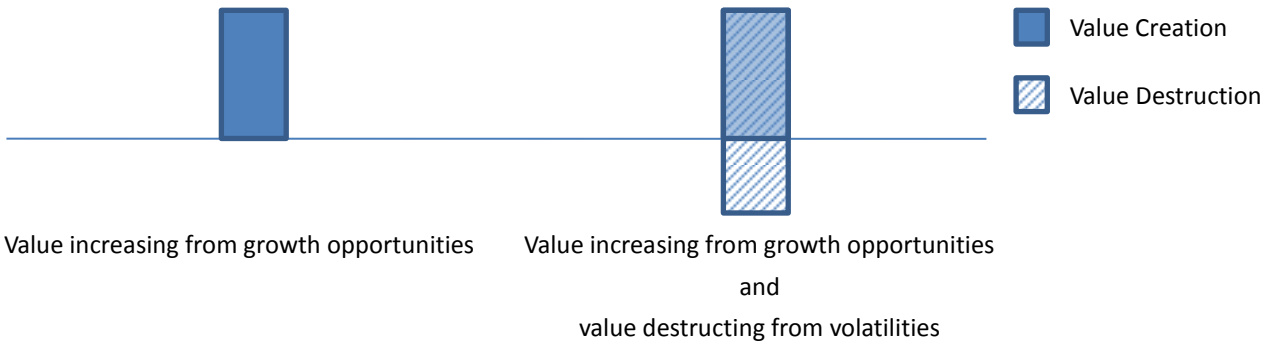

Figure 2 – Explanation to the negative correlations between volatility and EV

Part III. Methodology

3.1. Industry selection

We select our samples from U.S. listed firms, since the mature capital market and regulation could offer us more reliable resources, and the huge number of companies' base could provide broadly information. The accessibility of information from US listed companies is expected to be easier since the statistical data based on US market is vast. The other reason is that, since there are lots of related researches that have been done basing on U.S. firms, the results of our study will be much more comparable with former studies by reducing problems caused by using different accounting standards or some other country specific factors.

Our target is to compare the relationships of cash flow volatility and firm value between high growth firms and mature firms, including various controls required by Tobin's Q. We need to select two industries which have similar business model, target market, but with different growth rate. As a result, it is more convincible to illustrate and compare the effects of cash flow volatility on firms with different growth rates. Pharmaceutical and biotechnology industries fit exactly with our requirements since these industries are strongly related in business model, and the target markets are expected to be similar. Additionally, biotechnology industry is described as a high growth industry from many resources. For example, Biological technicians, a key biotechnology occupation, is expected to grow by 28.2 percent between 2004 and 2014, while the occupation of biological scientists is projected to grow by 17.0 percent (U.S. Bureau of Labor Statistics, National Employment Data). The pharmaceutical industry have a much lower P/E and much high market cap along with less number of companies(Yahoo finance industry center). It indicates that pharmaceutical industry is more mature than biotech companies. The growth of drug manufacture industry is also related to the R&D provided by the biotech industry

which suggests the growth of drug manufacture industry is a follower highly relies on biotechnology industry. The basic comparisons of the two industries are in Table 1:

Table 1

This table compares main differences of U.S. pharmaceutical and biotechnology companies. [5]

	Pharmaceutical	Biotechnology
Growth	Mature, low growth options	High growth
Cash position	Usually cash cow	Cash limited
R&D	Relying more on partnerships	Self R&D development
Risks	Lower volatility, higher flexibility	Higher volatility
Asset	Assets-intensive	Non-assets-intensive
Financing	Better access to capital market	Costly to get external financing

3.2. Sample Selection

There are total 286 listed firms in U.S. pharmaceutical industry and 316 listed firms in U.S. biotechnology industry. Our initial sample includes firms within these two industries with non-missing annual data for total assets and total revenues[6] for at least 8 out of 10 years from 2001-01-01 to 2010-12-31 which reduces the sample size of these two industries to 70 (pharmaceutical) and 96 (biotechnology) firms separately. All data are extracted from DataStream. There are three main distinctions in sample selections between BJG2008 and our study:

(1) BJG2008's research is based on all U.S. listed firms with quarterly data while our study is based on annual data. The reason is that we could not find enough quarterly data from the database to support us, especially when it

[5] The table is summarized by Fanding Li and Bo Cheng.

[6] The reasons to choose these two items are: (1) they are the basis to measure most of our regression variables and (2) other data are usually available if firms have these two data.

comes to cash flow from operations (CFO), only annual data could be found. There are at first two alternatives for us to choose, the first one is to random select 50 to 100 firms in each industry and hand collecting the data. However, we still do not think that the selected sample will have enough explanation power to convince us that the results represent the real situation of the whole industries. Thus we turned to the other alternative to base on an annual data. We think that this alternative is more reasonable due to: (i) firms tend to use more accruals at the end of the year to dress the annual reports, but not for every quarterly report, so this won't bring big differences to our study; (ii) the trend should be similar no matter basing on annual data or quarterly data; (iii) by using annual data, we could choose all firms meet with our criteria and reject problems linked with random selection; and (iv) the nature of our study imposes strong data requirements, the first alternative may not contain enough samples and observations after exclude data that do not meet with our requirements.

(2) BJG2008 has a much larger sample basis so it is able for them to collect data without any missing data of total sales and total assets. However, since we only focus on two industries which largely reduce the sample basis, we allow at most two missing annual data of total assets and total sales out of the ten years. Then we will hand collecting missing data from U.S. SEC's website[7]. The only exceptions are: (i) the IPO for the firm was in 2002 or 2003 and (ii) the firm filled bankruptcy or was privatized in 2009 or 2010. In these two circumstances, we keep the company in our sample with one or two years' missing data[8] and the data are noted as "None". We exclude all other data that do not meet with requirements mentioned in this paragraph.

[7] http://www.sec.gov/edgar/searchedgar/companysearch.html

[8] The final results showed that no more than 5 of these kinds of firms are included for each industry (or less than 0.5% of all observations). Thus the missing data won't affect our final regression results.

(3) BJG2008 focuses on a time period of 1987 to 2002 since they want to reduce possible outside factors like global financial factors which may affect the regression results. However, we choose to study companies from 2001 to 2010. We think that this time period better reflect the real risks in nowaday's business environment. Firms are not in theoretical contexts like perfect competition and stable outside environment. They could not choose to avoid risks like global financial crisis and they must to face the reality of a more volatile world. By choosing year from 2001 to 2010, we could have a better understand of the volatilities' impacts on companies and how earnings management can really create value.

There is still one thing to note: due to the methods we used to calculate sales growth, earnings volatility, cash flow volatility and accruals volatility, the observations that are finally used in our regression tests are from year 2002 and 2010. We also excluded extremely abnormal data, this leads to a final cross-sections of 70 and observations of no less than 555 in all regression tests of U.S. pharmaceutical industry and no less than 505 in all regression tests of U.S. biotechnology industry. The similar observations sizes for both industries ensure us to make the results comparable. The analysis of our samples' and results' reliability and robustness could be found in Part IV, namely "Analysis". Table 2 and Table 3 present the summary statistics of our samples and observations.

3.3. Cash flow volatility and firm value in specific industries

Most of the empirical studies have been done by multiple regressions to see the effect of earnings volatility / cash flow volatility on firm value, however, few focused on cash flow volatility in specific industries. We expected that there exist differences between different industries, and cash flow volatilities will have more influence on firms within non-assets-intensive industries like biotech. Since assets-intensive industries are usually quite mature, firms within those industries have more assets

Table 2

In this table we present summary statistics of our samples and observations for U.S. pharmaceutical industry.

U.S. Pharmaceutical Industry					
Variables	Mean	Std.	25%	Median	75%
Tobin's Q	2.122106	26.96658	0.225276	0.411045	0.648616
Ln(Tobin's Q)	-2.94946	2.423887	-5.31685	-2.23853	-1.13615
Earnings per share	-0.38474	3.059358	-0.7525	-0.11	0.48225
Earnings volatility	1.91629	12.67697	0.248975	0.514389	1.142857
Ln (Earnings volatility)	-0.59287	1.357417	-1.36342	-0.6213	0.15345
Cash flow per share	0.197813	2.226403	-0.46575	-0.029	0.99575
CF volatility	1.448976	4.704773	0.18301	0.454472	1.050716
Ln (CF volatility)	-0.83138	1.485709	-1.68201	-0.7864	0.051118
Systematic risk	0.686063	0.880327	0.120174	0.477857	0.921757
Ln (Sys. Risk)	-1.41237	2.066423	-2.11883	-0.73844	-0.08147
Idiosyncratic risk	0.005997	0.029684	0.000541	0.001602	0.003755
Ln (Idio. Risk)	-6.53107	1.560382	-7.52139	-6.4362	-5.5848
Total assets	5349109	20131146	15513	69707.5	489589.8
Ln (Total assets)	11.45199	2.9655	9.725258	11.16246	13.1058
Sales growth	21.29867	487.4779	-0.07502	0.115883	0.42247
Return on assets	-16.4094	50.89984	-19.91	-0.3219	0.2223
Capex-to-sales	0.866258	10.52867	0.010329	0.034969	0.07346
R&D-to-sales	15.14642	213.2562	0.085433	0.216863	1.180533
SG&A-to-sales	29.03671	353.6062	0.451075	0.781903	2.366054
Leverage: D/E	88.88512	1636.941	0.000	7.990983	36.98703
Interest Expenses	0.040521	0.728832	0.000	0.000	0.221898
Effective Tax Rate	1.722998	30.79698	0.000	0.010961	0.050585

Table 3

In this table we present summary statistics of our samples and observations for U.S. biotechnology industry.

U.S. Biotechnology Industry					
Variables	Mean	Std.	25%	Median	75%
Tobin's Q	1.097362	4.647385	0.165199	0.337549	0.674859
Ln(Tobin's Q)	-1.01816	1.21945	-1.77806	-1.07977	-0.3724
Earnings per share	-1.77383	9.317634	-1.5056	-0.5338	-0.09911
Earnings volatility	1.638308	12.5947	0.17797	0.37796	0.79229
Ln (Earnings volatility)	-1.01465	1.49747	-1.72613	-0.97296	-0.23283
Cash flow per share	-1.18756	7.672351	-0.99263	-0.30437	-0.00618
CF volatility	1.86044	23.9416	0.17019	0.38762	0.8399
Ln (CF volatility)	-0.9832	1.46898	-1.77081	-0.94774	-0.17447
Systematic risk	0.752158	0.764438	0.131467	0.540833	1.164978
Ln (Sys. Risk)	-1.21609	1.927644	-2.029	-0.61465	0.1527
Idiosyncratic risk	0.006401	0.08879	0.000826	0.001586	0.003332
Ln (Idio. Risk)	-6.36951	1.153085	-7.09473	-6.4461	-5.69849
Total assets	725445.8	3424630	22089	83722.5	293369.5
Ln (Total assets)	11.20231	2.190796	10.00278	11.33526	12.58918
Sales growth	1.837903	19.65758	-0.17845	0.107554	0.492375
Return on assets	-55.2634	118.4367	-63.8375	-29.645	-5.7225
Capex-to-sales	2.038895	23.80021	0.033183	0.090067	0.261357
R&D-to-sales	29.15617	284.8935	0.171414	0.781759	3.27721
SG&A-to-sales	47.9434	480.9395	0.631864	1.677121	6.036363
Leverage: D/E	67.44257	2399.596	0.000	0.805	26.0875
Interest Expenses	7120.079	35288.72	10.00	306.5	3245.5
Effective Tax Rate	0.069319	0.419892	0.000	0.000	0.005089

and higher cash position, and they usually get access to capital market much cheaper and easier. However, for industries like biotech, firms within those industries usually have high R&D expenditures and need more cash to catch potential opportunities, but they usually have less assets and more future uncertainty and financial distress, thus it is more difficult for those firms to get access to capital markets when compared with firms in mature industries. In this way, we expect that cash flow volatilities affect more in non-assets-intensive industries.

Followed Brian, James and George (2008), we believe that earnings volatility also has a significantly negative coefficient correlation with firm value and the influence matters to the extent of its effect on underlying cash flow volatility.[9] So in our research, we start from the effect of cash flow volatility and build up the regression model by using variables as follow:

$$\text{Tobin's Q} = \alpha + \beta_1 \cdot \ln(Cash\ flow\ volatility) + \beta_2 \cdot \ln(Systematic\ risk) + \beta_3 \cdot \ln(Idiosyncratic\ risk) + \beta_4 \cdot \ln(\text{Total assets}) + \beta_5 \cdot ROA + \beta_6 \cdot g_{sales} + \beta_7 \cdot \frac{CAPEX}{Sales} + \beta_8 \cdot \frac{R\&D}{Sales} + \beta_9 \cdot \frac{Advertising}{Sales} + \beta_{10} \cdot \text{Leverage} + \beta_{11} \cdot Year\ Indicator + \varepsilon$$

Model 1 – Multiple Regression Model without New Variables

The method of using firm's market-to-book ratio as a simple approximation of Tobin's

[9] Brian, James and George also checked the robustness of their results in the journal "Do investors value smooth performance". The result is robust "regardless of estimation technique or particular regression specification". For instance, they used both EPS including and excluding extraordinary items as measurement of earnings volatility and got similar result that earnings volatility negatively affects firm value to the extent of its influence on real cash flow volatility. Generally, we followed their result and, one step more, to check specific industries and try to explain how cash flow volatility affects enterprise value later.

Q to reflect firm value is widely used in former empirical studies:

$$\text{Tobin's Q} = \frac{Market\ Value\ of\ Equity + Book\ Value\ of\ Total\ Debt}{Book\ Value\ of\ Total\ Assets}$$

We also follow and adjust variables used in Lang and Stulz(1994) and Allayannis and Weston(2001) and Brian, James and George (2008) to support our research:

(1) Cash-flow volatility (σ_{CF}): we use the natural logarithm of net cash flow from operations (CFO) over the sum of common and prefer stocks outstanding (and adjustment of stock splits) to get comparable CF per share and using the formula $\sigma_{CF} = (CFPS_t - CFPS_{t-1})/CFPS_{t-1}$ to measure quarterly cash flow volatility. All data are from firms' quarterly cash flows statements, item "Cash Flow from Operations". By using CFO but not including cash flow from financial activities, we reduced the possibility of managers' control of cash flow by increasing or decreasing extra expenditures artificially and maybe unethically or illegally, which may affect our research results.

(2) Systematic risk and idiosyncratic risk: In theoretical valuation framework, the firm's value could be discomposed into two parts: the value of asset in place and the value of future growth opportunities. Generally speaking, the value of future growth opportunities is in line with expected risks for firm to bear. This is reflected by discounting future cash flow at weight average cost of capital. We followed Shin and Stulz (2000) and use the Market Model to estimate both systematic and unsystematic (or to say idiosyncratic) risks:

$$\begin{cases} R_{ij} = a_j + \beta_j R(m)_i + \varepsilon_{ij} \\ \text{Systematic Risk} = \ln\{\beta_j^2 + variance[R(m)_i]\} \\ \text{Idiosyncratic Risk} = \ln\{variance[\varepsilon_{ij}]\} \end{cases}$$

Where R_{ij} is the natural logarithm of return of firm *j* at day *i*, $R(m)_i$ is the market return, which the firm *j* is in, at day *i*. By using linear regression, we could

get β_j and ε_{ij}. Thus, for all firms in the same industry, they will have the same variance of market return. And for certain firm, its systematic risk is composed of the industry risk and correlations between return of the firm and return of the market, so we use the natural logarithm of the sum of β_j^2 and $\text{variance}[R(m)_i]$ to reflect firm's systematic risk. For ε_{ij} , it shows the deviation for firm *j* at day *i* from the model, thus we could treat it as the idiosyncratic risk and measure it by using the natural logarithm of the variance of ε_{ij}. We expected to get the similar results as former empirical studies, that is, positive correlations between systematic risk and firm value while negative correlations between idiosyncratic risk and firm value.

(3) Size: we use the natural logarithm of total assets to measure firm size. We expected that Tobin's Q is negatively correlated with firm size since smaller firms may have higher growth opportunities and more information transparencies which are preferred by investors, meanwhile, large companies may have conglomerate discounts.

(4) Profitability: we use the return on total assets (ROA) to measure firm's profitability. We expect that there exist positive correlations between Tobin's Q and firm's profitability since more profitable firms are less likely to meet with financial distresses, easier to finance for future growth opportunities, and more preferred by investors.

(5) Sales growth: We use $\text{Growth} = (Sales_t - Sales_{t-1})/Sales_{t-1}$ to measure firm's growth from sales perspective. We expect that there exist positive correlations between Tobin's Q and sales growth which is quite reasonable.

(6) Investment growth: We use following ratios to measure firm's growth from investment perspective: (a) capital expenditures (CAPEX)/sales; (b) R&D/sales; (c)

SG&A/sales. These ratios reflect firm's future growth and more investments means the firm is trying to catch larger opportunities, thus it is reasonable to expect positive correlations between Tobin's Q and these financial ratios.

(7) Leverage: Debt has significant influences on EV from many aspects. For example, higher leverage means that firm has higher possibility to meet with financial distresses, higher leverage firms are usually with lower credit rating, are much costly to get access to capital market, and are discounted at higher rates during valuation. Lower leverage will also decrease equity risk which will increase firm value. Thus it is reasonable to expect negative correlation between EV and leverage. Brian, James and George (2008) used the ratio of long-term debt over total assets to measure firm's leverage. However, we think that short-term debt will also have impacts on firm's performance and firm value. Thus we use the following formula which is adjusted for short-term debt to measure leverage:

$$\text{Leverage} = \frac{100\% \cdot \text{Short} - \text{term Debt} + 100\% \cdot \text{Long} - \text{term Debt}}{\text{Total Assets}}$$

(8) Followed Brian, James and George (2008), we also control for time-effects by using year indicators. Since the purpose of this paper is to study cash-flow volatilities and firm value in different industries, thus we do not have to control for industry effects by using Standard Industrial Classification (SIC) as Brian, James and George (2008) suggested.

3.4. Cash flow volatility matters or accruals matters

It is no doubt that earning management could reduce earnings volatility and create value for firm. This is usually achieved by accruals management and real cash flow management. As mentioned in the literature review, researchers think that earnings managements are mainly accruals managements and managers prefer to use accruals to reduce cash flow volatility to create value. In other words, cash flow after

accruals matters. However, this was challenged by Brian, James and George (2008). In their study, cash flow volatility has directly impact on firm value, but not through accruals, and they found that accruals do not create value, only real cash flow management matters. We examined the results and former theories carefully and found it was mentioned that whether accruals create value should be examined in specific industries but not basing on general level (or to say the whole market). However, Brian, James and George (2008)'s study was based on over 4,000 firms listed in U.S. from nearly every industry, thus we do think that it is necessary to check accruals' influence on firm value again in specific industries. Basing on the former regression model, we add another two variables to the model: the natural logarithm of accrual volatility and correlation between cash flow volatility and accrual volatility. The relations between earnings volatility, cash flow volatility and accrual volatility is defined as the following formulas:

$$\begin{cases} \text{Accrual}_t = \text{Earnings}_t - Cash\ flow_t \\ \sigma^2_{earnings} = \sigma^2_{cash\ flow} + \sigma^2_{accruals} + 2cov(cash\ flow, accruals) \end{cases}$$

And the new regression model is:

$$\begin{aligned} \text{Tobin's Q} = \alpha + \beta_1 \cdot \ln(Cash\ flow\ volatility) + \beta_2 \cdot \ln(Accruals\ volatility) + \beta_3 \\ \cdot cov(Cash\ flow, accruals) + \beta_4 \cdot \ln(Systematic\ risk) \quad + \beta_5 \\ \cdot \ln(Idiosyncratic\ risk) + \beta_6 \cdot \ln(\text{Total assets}) + \beta_7 \cdot ROA + \beta_8 \cdot g_{sales} \\ + \beta_9 \cdot \frac{CAPEX}{Sales} + \beta_{10} \cdot \frac{R\&D}{Sales} + \beta_{11} \cdot \frac{Advertising}{Sales} \quad + \beta_{12} \cdot \text{Leverage} + \beta_{13} \\ \cdot Year\ Indicator + \varepsilon \end{aligned}$$

Model 2 – Multiple Regression Model controlling for accruals

By checking (1) the adjusted R^2 of the model after introducing new variables and (2) the significance of those variables, we could judge if the new variables have explanation power on Tobin's Q and if they improve the accuracy of the model. If the answers are yes, then we could check whether the coefficient is positive (means value creation) or negative (means value destruction). If not, then we know that the new variables do not have significant impact on firm value, thus not value creation.

3.5. Volatility creates value or destructs value

We select samples that are only different in growth opportunities with other criteria similar. As mentioned in sample selection, we choose U.S. healthcare sector to achieve this goal. We believe that firms within biotech industry are with high growth opportunities while firms within pharmaceutical industry are with relatively lower growth opportunities. By checking whether cash flow volatility is positively or negatively related to Tobin's Q, we could know if volatility is value creating or value destroying, and thus we could see how the results will support current theories and former researches.

3.6. How cash-flow volatilities affect firm value

Although quite a lot of researches have been done on studying the correlations between earnings volatility, cash-flow volatility and firm value, only a few are done to explain how cash-flow volatilities affect firm value, like through tax, financial distresses, information asymmetries etc. In our study, we combined items in income statements and items above net cash flows from operations in cash-flows statements to see factors that may have influence on CFO which were not mentioned in former researches and studies (See table 4). From table 4, we will build a new multiple-regression model to examine following items' correlations with firm value: effect tax rate, interest expenses over sales.

$$\begin{aligned}\text{Tobin's Q} = \alpha + \beta_1 \cdot \ln(Cash\ flow\ volatility) + \beta_2 \cdot \ln(Systematic\ risk) \quad + \beta_3 \\ \cdot \ln(Idiosyncratic\ risk) + \beta_4 \cdot \ln(\text{Total assets}) + \beta_5 \cdot ROA + \beta_6 \cdot g_{sales} \\ + \beta_7 \cdot \frac{CAPEX}{Sales} + \beta_8 \cdot \frac{R\&D}{Sales} + \beta_9 \cdot \frac{Advertising}{Sales} \quad + \beta_{10} \cdot \text{Leverage} \\ + \beta_{11} \cdot Year\ Indicator + \beta_{12} \cdot \tau + \beta_{13} \cdot \frac{Interests}{Sales} + \varepsilon\end{aligned}$$

Model 3 – New Multiple Regression Model with New Variables

Table 4

In this table we will examine items that could have impacts on firm value.

Items	Note
Revenue (Sales)	Mentioned
-COGS & SGA	Mentioned
-R&D	Mentioned
-Sales and Marketing (Advertising)	Mentioned
=Operating Income	-
+other income / (-other expense)	Extraordinary item
=EBIT	-
-interest expenses	**Not used**
=Income before income taxes	-
-income tax	**Not mentioned**
=Net income	-
+Depr. / Amor.	Mentioned
+Stock-based compensation	Mentioned
+Loss from investments and derivatives / (-Gain)	Mentioned
-Excess tax benefits from stock-based compensation	Mentioned
-Deferred income tax	Not mentioned
+Net deferred revenue	Not directly used
+Changes in operating assets and liabilities	Mentioned
=Net cash flows from operations	**-**

(1) Tax rate (τ): We use yearly effect tax rate as measurement. We expected that tax rate is negatively related with firm value due to the reason that firms with smooth earnings and cash-flows will benefit more from the tax shield and pay less income tax. By introducing tax rate as a variable, deferred tax will also be measured which could have an influence on cash flow volatility.

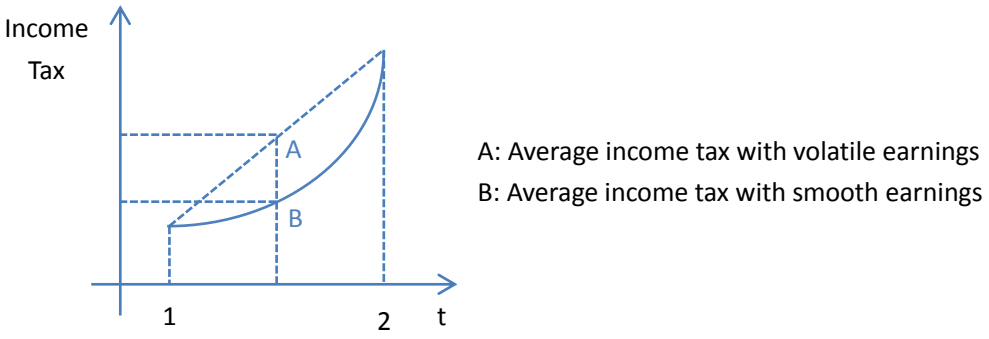

Figure 1 – Income Tax and Earnings Volatility

(2) Interest expenses: Firms with similar leverage might bear different cost of debt while firms with similar interest expenses per year might have different earnings. Thus, for a firm with debt, not only principal matters, but also the interests. We think that only using leverage as variable is not enough to describe firm's possibility to meet with financial distress. We add in the variable of interest expenses over sales to make the interest payments of different firms comparable and to describe firm's financial distress better. We expect a negative correlation between this ratio and firm value.

Besides the reasons mentioned above, we also seek for reasons lying in valuation process. Tax rate are important to calculate company's tax shield while interests payment reflects company's cost of debt. Thus we expected that the introducing of tax rate and interest expenses could improve our regression tests. Further details are discussed in section 4.2.3.

3.7. Robostness

We also designed robustness tests for our regression models to see if the results will be robust and reliable.

(1) By using different measurements of our variables. For example, using standard deviation to measure volatilities, using only long-term debt to measure leverage, using natural logarithm of Capex, R&D and SG&A expenditures to exclude the influence of total sales.

(2) We strictly followed Brian, James and George (2008)'s sample selection and all data are extracted form DataStream (Data type: World Scope, annually, samples with no more than 2 missing data). We also adjusted abnormal numbers by checking the firm's SEC filings. By using samples without any missing data for ten years, we will reduce our observations to 554. By exclude part of the data according to Brian, James and George (2008) and theoretical criteria (like lowest 5% total assets observations etc.), we will reduce our observations to 479.

(3) By using different variables and checking the changing in model's adjusted R^2 and changing in variables' T-value, we could find which variables have significant explanation power and how they changed in different regression model, and thus get to the conclusion whether the coefficients results are robustness.

(4) In order to make our regression tests reasonable, we avoid of using dummy variables in our original regression tests. However, in order to test the robustness of our results, we use dummy variables of time period to check if there is any change. We also use white (diagonal) method to eliminate heteroscedasticity problem.

The robustness test results will be showed in section 4.4.

Part IV. Analysis

4.1. Brief Introduction

In this part, we are going to examine the regression results and to discuss these in details to reach reasonable explanations and conclusions. We will firstly go through the two U.S. industries, pharmaceutical and biotechnology, to see their own specific characteristics. And then we will put the results of the two industries together and compare them to see similarities and differences of the two industries.

4.2. Pharmaceutical Industry

4.2.1. Pearson Correlation Examination

Followed Brian, James and George (2008), we firstly use Pearson correlation to examine whether there exist any multicollinearity problem of our variables used in the regression model. Based on the study from Kaplan (1994), the general method to detect multicollinearity is inspection of correlation matrix. We assume the correlation between each two variables in our correlation matrix should be less than 0.5.[10] We do think that it is even important for our study to do a more detailed Pearson correlation than Brian, James and George (2008). According to U.S. GAAP, firms that highly rely on R&D should capitalize their R&D expenditures which might cause multicollinearity problem between the two variable total assets (which is used to measure firm size) and R&D/Sales in our model. We are also interested in the correlations between leverage and annual interest expenses. Fortunately, no high multicollinearity is observed for former mentioned items. The correlation between total assets and R&D/Sales is -0.019, which could be explained by firm's accounting choices. If firm choose to capitalize R&D expenditures, then it will increase its total

[10] A roughly but relatively conservative estimation according to several studies, such as Jensen (2003)

assets but reduce the numbers reported in consolidated statements of income, *vice versa*. This fact also found in studies related to capitalized R&D, such as research from Paul, Stewart and Christopher (2002). This also explained why these two items are not highly correlated, since the R&D expenditures should not be double reported in both consolidated balance sheets and consolidated income statements. For leverage and interest expenses, the correlation is 0.049, which is very easy to understand. Low leverage means low debt and thus low interest payments. While leverage could to some extent explain interest payments, the latter is also determined by cost of debt, which could not be reflected in leverage, thus no large correlation should be observed between the two items, and the result is in line with our estimation. However, we found high correlations between Capex/Sales, R&D/Sales, SG&A/Sales and Interest expenses/Sales. The reason is that these four items are measured by the percentage of companies' revenues. After excluding the effect of sales, we no longer observe any high correlation in our model. We also observed a high correlation between EPS and CFPS which is quite easy to understand. Since we won't use both variables at the same time, there won't be any problem.The Pearson correlation table is in Appendix 1.1.

4.2.2. Regression Test without New Variable

Basing on former theories like Merton (1974) and empirical studies like Brian, James and George (2008), we do believe that cash flow volatility has influences on firm value, but not sure if the impact is positive or negative. In following part we present our regression test of following two hypotheses:

(1) Cash flow volatility is negative related to firm value, which is measured as Tobin's Q in our study. And if this is true, then our results will be in line with former empirical studies like Brian, James and George (2008), but still could not directly reject Merton Model. Or,

(2) Cash flow volatility is positive related to firm value. The values of firms in both industries highly rely on R&D successes, patents periods and the results are with high uncertainty, and thus higher volatility could lead to a higher Tobin's Q. If this is true, then our results will support Merton Model, and more important, to prove that (i) volatility could be both value creation (as in our study) and value destruction (as Brian, James and George, 2008, etc.) and (ii) whether volatility is value creating or value destroying should be checked on an industry level.

Table 4 shows that our believing in that cash flow volatility has an impact on firm value is correct. The logic behind it is that larger adjusted R^2 reflect more accuracy of the model. In regression 1.1 we do not include systematic risks, idiosyncratic risks and volatilities, which are measurements of corporate uncertainty and growth opportunities, see Brian, James and George (2008), Shin and Stulz (2000). In this regression we could see a rather low accuracy with most items' P-value larger than 10%. In regression 1.2 we add in systematic and idiosyncratic risks as variables but not cash flow volatility, and in regression 1.3 we add in cash flow volatility. We could see great improvement after introducing cash flow volatility as variable since the adjusted R^2 increased 0.079 from 0.023357 to 0.102659. Meanwhile, we could see that now most variables have better explanation powers with P-values under 0.1. This illustrates that cash-flow volatility do impact firm value.

Similar to former studies and arguments, we found negative coefficients between cash flow volatility and Tobin's Q. The result demonstrates that, for U.S. Pharmaceutical firms, volatile cash flows will destroy value, or at least destroy more than it could create. This is in line with Brian, James and George (2008) and supports our hypothesis (1). It also meets with our estimation that cash flow volatility will generally destruct value for mature industry with lower growth opportunities.

Table 4

In this table we will present results from panel regressions of our 569 observations. P-values are reported beneath the coefficients results in parentheses.

Dependent Variable: Ln(Tobin's Q)			
	Regression 1.1	Regression 1.2	Regression 1.3
Ln (Cash flow volatility)			-0.08879
			(0.0049)
Ln (Systematic risk)		-0.045638	0.003733
		(0.399)	(0.8813)
Ln (Idiosyncratic risk)		0.39138	0.286527
		(0.0015)	(0.0000)
Ln (Total assets)	0.066918	0.251304	0.066137
	(0.0601)	(0.0003)	(0.0380)
Sales growth	-9.24E-05	-6.49E-05	0.000102
	(0.6458)	(0.7468)	(0.2643)
Return on assets	-0.003826	-0.003601	-0.002822
	(0.1143)	(0.1397)	(0.013)
Capex/Sales	-0.034184	-0.053698-	-0.058835
	(0.5414)	(0.3462)	(0.0237)
R&D/Sales	-0.001466	0.003331	-0.004224
	(0.7736)	(0.5204)	(0.0737)
SG&A/Sales	0.001996	0.003657	0.003983
	(0.6433)	(0.4051)	(0.0467)
Leverage	9.52E-05	8.94E-05	3.44E-05
	(0.101)	(0.123)	(0.1919)
Constant	-3.780265	-3.398679	0.131773
	(0.000)	(0.000)	(0.5842)
Adj. R^2	0.009697	0.023357	0.102659

Table 5

In this table, we check variables with significant coefficients with Tobin's Q in regression 1.3.

Dependent Variable: Ln(Tobin's Q)			
Variables	Coefficients	Significant Level	P-Value
Ln (Cash flow volatility)	-0.08879	***	(0.0049)
Ln (Idiosyncratic risk)	0.286527	***	(0.0000)
Ln (Total assets)	0.066137	**	(0.0380)
Return on assets	-0.002822	**	(0.013)
Capex/Sales	-0.058835	**	(0.0237)
R&D/Sales	-0.004224	*	(0.0737)
SG&A/Sales	0.003983	**	(0.0467)

However, for other variables except SG&A costs, the results are opposite to Brian, James and George (2008). The reason could be that our work focus on specific industries but not all listed U.S. firms, thus our results stand for specific industry characteristics of U.S. pharmaceutical firms. Meanwhile, Brian, James and George (2008) and our study use different time periods (and the reasons are explained in Methodology part). Thus the different results could also possibly reflect recent changes. Possible explanations are:

(1) Systematic and Idiosyncratic risks: Brian, James and George (2008) used Shin and Stulz (2000)'s method to measure these two kinds of risks and found that systematic risk is positive related to Tobin's Q while idiosyncratic risk is negative related to Tobin's Q. However, in Shin and Stulz(2000), the authors mentioned that this method and following results only fit for large companies in specific circumstances. For our sample of pharmaceutical companies in 2010, we have an average total asset of $8.15 billion. However, only 7 firms' total assets is above average, while the median of total asset is only $0.12 billion, this is not difficult to understand since U.S. pharmaceutical market are mainly dominated by several global giants as Pfizer and Johnson & Johnson, while other companies are all small and medium size and focusing on either a few specific patent medicines or some other Nicky markets. The other reason is time period. Both Brian, James and George (2008) and Shin and Stulz (2000) focus on time periods of late 20th century while our study choose a time period from year 2001 to 2010, which could mean that the industry environment might have already changed. From this point of view, we think that Shin and Stulz(2000)'s results do not meet with our samples. Rogers, Maranas and Ding (2005) argued that pharmaceutical companies usually enter into partnerships with biotechnology firms in order to get licensed developed medicines and thus two companies will share their risks or more exactly, risk shifting from biotechnology firms to pharmaceutical companies. These kinds of risks are generally like marketing and manufacturing, but not

the possibility of failure to develop the medicine or failure to pass the FDA's regulation since the medicine is already developed and licensed. Thus a pharmaceutical company with a higher idiosyncratic risk signals that the firm is currently involving into more corporate joint ventures or strategic alliances, which enable the firm to access to more licensed patents and larger revenues. From this point of view, idiosyncratic risk could be positive related to Tobin's Q within pharmaceutical industry.

(2) Total assets: It is observed in Brian, James and George (2008) that the firm size is negative correlated with firm value, but no explanation is given. Till now, however, few empirical studies are specifically designed to find the reasons behind this phenomenon and no theory could perfectly explain it. Our study finds that Tobin's Q is positive related to total asset, which is a proxy of firm size. The possible explanation is that larger firms could bear more risks, which is appreciated by investors and thus lead to a higher market-to-book value. From corporate governance and valuation theory points of view, larger firm may have more interest conflicts and information asymmetries, and its structure is more difficult for outsider to understand, which means lower transparency to outside. And low transparency firms are usually related to high market-to-book value which shows that the market is difficult to correctly value the firm and thus deviate more from its book value.

(3) Capital expenditures: Theoretically, all firms within mature industry will tend to generate similar return on invested capital (ROIC) which would not deviate far from industry weight average cost of capital (WACC), and new investments usually won't create a large value for the firm[11]. And firms within mature industry tend to seek for potential cost reduction rather than highly relying on new investments (Schon, 2008). For pharmaceutical industry, which is highly

[11] See Palepv et al, 2007, "Business Anaylsis and Valuation Tools", Chapter 6

mature, higher capital expenditures could means that the firm could not effectively reduce its cost, mainly manufacturing cost. Thus higher Capex will be related with lower Tobin's Q.

(4) R&D expenditures: Following Rogers, Maranas and Ding (2005) and our argue of idiosyncratic risk, it is reasonable to believe that high R&D expenditures for pharmaceutical companies is a bad signaling to market that the firm is lacking of licensed patents resources or most of the firm's on-going patents will be out of date soon or, even worse, that the company is facing with both problems at the same time. Due to the long period of developing new medicines (generally 10 to 20 years, from launching the research plan to finishing human testing, not including waiting for the FDA's approve), the possibility of failure of medicine test and unexpected termination, and the failure to get FDA's approve, increasing in R&D expenditure largely increases the firm's risk and reduces its flexibility. Thus R&D expenditures will be negatively related with Tobin's Q.

(5) SG&A expenditures: We also observe a positive coefficients between SG&A and Tobin's Q. This is similar to Brian, James and George (2008) that selling and marketing are positive related with firm value. However, in Brian, James and George (2008)'s study, they did not include general and administration expenditures, thus it is necessary for us to explain these two kinds of fees' relation with firm value. The general and administration expenditures could be another proxy of firm size and larger firms tend to have higher general and administration expenses under the condition that the firms' corporate governance systems are effective and efficient. Following our argue of firm size's relation with Tobin's Q, it is reasonable to believe that firms with higher general and administration fees will tend to have a higher Tobin's Q.

Both Brian, James and George (2008) and our study find that leverage does not

significant related to Tobin's Q. In our study, systematic risk and sales are also not significant. Pharmaceutical industry itself is a quite mature industry. U.S. FDA is famous for its strict regulation and cautious attitude towards new products, without frequent changes of regulation policies. These factors largely reduced the systematic volatility, and thus could be used to explain why systematic risk is not significant for pharmaceutical companies. From theoretical point of view, firms within mature industries are usually hard to achieve large sales growth without specific tactics like mergers and acquisitions. Thus sales growth won't have a significant impact on Tobin's Q.

Interestingly, we also observe a negative coefficient between Tobin's Q and return on assets (ROA). This is mainly due to that most of the pharmaceutical firms reported net losses in recent years. In our sample of pharmaceutical industry, over 50% observations have a positive Ln (Tobin's Q) while a negative ROA. Thus now it is clear why our regression results showed a negative coefficient between these two items. This doesn't mean that firm with lower ROA will have higher market value, it just reflects the phenomenon that lots of firms with Tobin's Q above 1 reported net losses.

4.2.3. Regression Test with Interest Expenses and Tax Rate as Variables

In this part, we introduce another two variables to try to improve the model one step more and try to use these variables to check whether cash flow, without relying on other factors, has direct impact on firm value. The choosing of variables is based on the items below Total Sales or Revenue and above Cash Flows from Operating as Table 1 in Methodology part. Although seeing from the regression results that these two variables are not significant, it is still important for us to argue the meaning to do this test.

One may argue that, Free cash flow (FCF) =Cash flow from operations (CFO) +

Depreciation – Reinvestments in depreciation – New investments in working capital – New investments, and once CFO is decided, FCF is decided (since depreciation, reinvestments and new investments are controlled by the variable Capex/Sales), and for a discount-cash-flow valuation (DCF Valuation), the firm value is decided by the FCF and given discounting rate. And thus it is meaningless to add other variables like

Table 6

In this table, we added another two variables, namely annual interest expenses and tax rate, to see if there is any improvement of the regression model.

Dependent Variable: Ln(Tobin's Q)			
Variables	**Regression 1.3**	**Regression 1.4**	**Regression 1.5**
Effective Tax Rate			0.003272
			(0.9632)
Interest Expenses/Sales		-0.00112	
		(0.7771)	
Ln (Cash flow volatility)	-0.08879	-0.088411	-0.088682
	(0.0049)	(0.0052)	(0.0051)
Ln (Systematic risk)	0.003733	0.003251	0.003754
	(0.8813)	(0.8969)	(0.8808)
Ln (Idiosyncratic risk)	0.286527	0.28831	0.286575
	(0.0000)	(0.0000)	(0.0000)
Ln (Total assets)	0.066137	0.067182	0.06611
	(0.0380)	(0.0365)	(0.0383)
Sales growth	0.000102	0.000102	0.000102
	(0.2643)	(0.2653)	(0.2647)
Return on assets	-0.002822	-0.002769	-0.002822
	(0.013)	(0.0162)	(0.0131)
Capex/Sales	-0.058835	-0.066212	-0.058825
	(0.0237)	(0.0723)	(0.0238)
R&D/Sales	-0.004224	-0.004822	-0.004223
	(0.0737)	(0.1284)	(0.0741)
SG&A/Sales	0.003983	0.004598	0.003983
	(0.0467)	(0.1199)	(0.047)
Leverage	3.44E-05	3.47E-05	3.44E-05
	(0.1919)	(0.189)	(0.1922)
Constant	0.131773	0.131436	0.132302
	(0.5842)	(0.5854)	(0.5834)
Adj. R^2	0.102659	0.101178	0.101052

tax rate or interest payments since they are all items above net income in income statements and net income is above CFO in cash-flow statements. However, we have our reasons to prove that it is necessary to do such tests, although the results show that it indeed is not significant.

We could look at the formula to calculate discounting rate, or WACC. If we do not take inflation rate into account, WACC = R_d * (1 – tax rate) * D/ (D+E) +R_e * E/ (D+E).[12] For Brian, James and George (2008), they take leverage into consideration. And since the purpose for Brian, James and George (2008) is to see if investors value the smooth performance, it is the equity investors themselves bearing the cost of equity. So we do not take cost of equity into consideration. We take the other two factors into consideration. For cost of debt, we use annual interest payments as a proxy since no weight cost of debt could be found for our samples in the database and it is too complicated and difficult for us to hand collect company's all debt contracts and calculate weight cost of debt and its duration as mentioned in Koller et al (2010).

However, the results are not satisfied. We could see that the P-values for both variables are quite high and the adjusted R^2 generally decreases after using either of the new variables. So in our study it is hard to say whether cash flow volatility has a direct impact on firm value or through the effect of tax and potential financial distress. But this could not reject our assumption that tax rate and cost of debt matter since our samples are not perfect. From the data we collected, a lot of pharmaceutical firms bear net losses in recent years, which means that the effective tax rate could not be observed. And most of the pharmaceutical companies are quite

[12] See Koller et al, "Valuation", Fifth edition, P261-265. If take inflation rate into consideration, see Arzac, "Valueation for Mergers, Buyouts, and Restructuring", Second edition. But inflation won't affect our introduction of tax rate and interest payments as variables. By taking inflation into consideration, one just need to add inflation into the WACC calculation, but would not remove tax rate or cost of debt. Higher inflation will reduce the true value of firm due to increasing in WACC. For the purpose to make it easy to describe, calculate and understand what affects Tobin's Q, we won't take inflation into consideration here.

cash rich with low leverage, it is not so easy to capture the effect of financial distress caused by cost of debt. Thus we suggest a further more study on industries like oil and gas or automobiles to see if tax rate and interests payments really matter.

4.2.4. The Effect of Accruals

There is a potential logic problem lying behind how people consider cash flow volatility. Traditionally, the theoretical framework considers that earnings management are mainly accruals management, and it treats cash flow volatility in a "vertical" way since cash flow itself is a product of total revenue minus accruals, and the logic of cash flow volatility in this framework is that cash flow volatility is created by earnings volatility after the elimination of accruals, it is totally new and could not exists alone without both earnings volatility and accruals. Thus accruals management creates value. However, this is challenged by Brian, James and George (2008), in their study they found that accruals volatility seldom affect Tobin's Q. Thereby, they refused the conclusion that accrual matters. However, if "accruals are value creation" is not true, why they are still widely used by today's corporations? If cash flow volatility is not a product of earnings and accruals, then what it should be?

The traditional theoretical framework is limited by how cash flow is calculated in accounting theory. From our point of view, cash flow volatility should already be contained in earnings volatility. The logic should be that earnings volatility is a product of both cash flow volatility and accruals volatility. And earnings management should not be treated as mainly accrual managements. Corporate behaviours like hedging and using financial derivatives should be redefined as real cash flow management. Thus, the cash flow volatility does not only exist in item Cash Flow from Operation, it already exists in Total Sales or Revenues. Accruals management might be used to dressing financial statements or taking big baths due to managers' self-interests, it could also be for tax considerations. However, delaying current year's tax liability by accruals could not really create value since the company has to pay

more tax in later years. However, following agency theory, the increasing of net income (by reducing current year's tax payments) could increase the reputation of the manager who is in charge at present and they do not need to consider what will happen in later years when they will not work for the firm. And this could also increase manager's bonus if it is linked with firm's performance.

However, there are still other arguements like that the effect of accruals should be examined on an industry level since accruals' influence on firm value differs from industry to industry. To make sure whether Brian, James and George (2008)'s results are correct, we design the following regression tests to check it (see Table 5).

Focusing on the changing of adjusted R^2, we could see that by using of accruals and cash flow volatilities instead of using earning volatility slightly improve the accuracy of the model. Meanwhile, since in our model earnings volatility consists and only consists of accruals volatility and cash flow volatility, it is easy to understand why the improvement is not so large, since they measured the same thing. We could see that accruals volatility has very little influence on Tobin's Q since the P-value is over 85%, which reflects a large scale of "random walk". Meanwhile, cash flow volatility is negatively related with Tobin's Q. These results reflects that investors (1) prefer lower cash flow volatility; (2) do not treat accruals volatility as value creation; (3) Even if the accruals volatility's P-value is under 10%, it still means that investors prefer lower accrual volatility which means that less earning smooth by accruals will lead to higher value. The results remain unchanged even if we take the correlation of cash flow volatility and accrual volatility into consideration to reduce multicollinearity problem in our robustness test.

We also observe a relatively large improvement by only using cash flow volatility as variables (from 0.090 to 0.102), when compared with the improvement by using both accruals and cash flow volatilities (from 0.090 to 0.093), which indicates that cash flow volatility is the primitive and primary volatility factor that determine firm's

Tobin's Q, and this result is also consist with Brian, James and George (2008).

Table 7

In this table, we show three regressions with different volatility variables, for regression 2.1, we use earnings volatility as variables. For regression 2.2, instead of using earnings volatility, we use the method mentioned in methodology part to decouple earnings volatility into cash flow volatility and accruals volatility and use these two factors as variables. For regression 2.3, we remove the accruals volatility and only keep cash flow volatility as variable. Thus, through compare this three regression tests, we could get access to the answer to whether accruals create value in U.S. pharmaceutical industry.

Dependent Variable: Ln(Tobin's Q)			
	Regression 2.1	Regression 2.2	Regression 2.3
Ln (Earnings volatility)	-0.073804		
	(0.0321)		
Ln (Accruals volatility)		-0.007566	
		(0.8459)	
Ln (Cash flow volatility)		-0.08556	-0.08879
		(0.041)	(0.0049)
Ln (Systematic risk)	0.003778	0.000519	0.003733
	(0.8848)	(0.9837)	(0.8813)
Ln (Idiosyncratic risk)	0.280771	0.260639	0.286527
	(0.0000)	(0.0000)	(0.0000)
Ln (Total assets)	0.075557	0.064182	0.066137
	(0.0218)	(0.0474)	(0.0380)
Sales growth	0.000101	0.000104	0.000102
	(0.2766)	(0.2513)	(0.2643)
Return on assets	-0.002741	-0.00303	-0.002822
	(0.0211)	(0.0081)	(0.013)
Capex/Sales	-0.05611	-0.059398	-0.058835
	(0.0339)	(0.0215)	(0.0237)
R&D/Sales	-0.003997	-0.004275	-0.004224
	(0.0964)	(0.0685)	(0.0737)
SG&A/Sales	0.003808	0.004018	0.003983
	(0.0619)	(0.0435)	(0.0467)
Leverage	3.99E-05	3.58E-05	3.44E-05
	(0.1364)	(0.1723)	(0.1919)
Constant	-0.002228	-0.034213	0.131773
	(0.9929)	(0.8898)	(0.5842)
Adj. R^2	0.089757	0.092889	0.102659

When taking all results above into consideration, even they do not necessarily mean that accruals management will destruct value, we are able to say that the results indicate that, for U.S. pharmaceutical industry, earning management could only create value through real cash flow management while accruals management seldom add value. Our results are in line with Brian, James and George (2008).

4.3. Biotechnology Industry

4.3.1. Pearson Correlation Examination and Regression Tests Results

Generally, we do same Pearson correlation test and regression tests for U.S. biotechnology industry as we did for U.S. pharmaceutical industry. No correlation is observed higher than 0.5, which indicates that there doesn't exist any serious multicollinearity problem. The Pearson correlation test could be found in Appendix 1.2.

Table 8

In this table we present results from panel regressions of 505 observations in biotechnology industry. P-values are reported in parentheses.

Dependent Variable: Ln(Tobin's Q)			
Variables	Coefficient	Significance level	P-value
Ln (Cash flow volatility)	0.009694	(*)	(0.1072)
Ln (Systematic risk)	-0.025262		(0.2881)
Ln (Idiosyncratic risk)	0.059405		(0.2496)
Ln (Total assets)	-0.417163	***	(0.0000)
Sales growth	8.77E-05		(0.8914)
Return on assets	-0.243377	***	(0.0038)
Capex/Sales	0.001196	**	(0.0265)
R&D/Sales	0.001468	***	(0.0000)
SG&A/Sales	-0.001256	***	(0.0000)
Leverage	4.76E-06		(0.2408)
Constant	4.334323	***	(0.0000)
Adj. R^2	0.685135		

Similar as pharmaceutical industry, we observed an increase in adjusted R^2 after introducing systematic risk and idiosyncratic risk as variables. We also observed a great increase in adjusted R^2 after introducing cash flow volatility, which means that cash flow volatility is one important determinant of Tobin's Q. Tax rate and annual interest payments are still not statistically significant.

The panel regression results above show the significance of the controls we tested. According to our result, the firm size, which is measured by Ln (total assets), is the most significant one (T-value is -5.378) with a strong negatively coefficient relation with Tobin's q. It shows that in biotechnology industry, the firms with lower total assets have higher Tobin's Q, which is measured by market-to-book values. This could be explained that generally there are more growth opportunities for small firms when compared with large companies, and investors will value this. The R&D/Sales and SG&A/Sales also have strong statistical significance. The result indicates the R&D/Sales have slightly positively coefficients with Tobin's Q and the SG&A/Sales have a slightly negatively coefficient. It could explain by that the firms with higher R&D expenses tend to have higher market value since these means that companies are trying to catch with potential growth opportunities, and these are essential for the value creation in biotech industry. The empirical evidence from Brian, James and George (2008) also support the positively coefficient of capital expenditure and R&D expenses. Our results also shows the firms with less SG&A expense have higher market value since less SG&A expense could provide firms with more flexibility to catch growth opportunity by offering more general resources from inside (Tong and Reuer, 2006). The return on assets also have a significant negatively coefficient as for pharmaceutical industry. This raised a question: Should not a higher ROA represent a higher firm value? We check our data and found that in our samples of biotechnology industry, most of the firms reported losses in recent 10 years, which caused a negatively return on assets. Although we use natural logarithm to control Tobin's Q, there are still over 70% of the samples have opposite sign between ROA and Tobin's q, or to say, positive Tobin's Q with negative ROA. This will of course

generate a negative coefficient between Tobin's Q and ROA. Thus, we do think that this phenomenon indicates that many firms with market-to-book ratio higher than 1[13] reported loss rather than firms with lower ROAs are more appreciated by investors.

The Capex/Sales is significant at 5% level with a positively coefficient. A possible explanation is that more capital expenditure could be a positive sign to investors that the firm is currently investing more which indicates the existence of growth options. Although the cash flow volatility isn't so statistically significant, it is still close to the 10% level and relatively more "significant" than other controls. If we consider this result is a statistically meaningful result, the positively coefficient conflicts with the result from Rountree, Weston and Allayannis (2008). The conflicts could cause either by insignificant result or the view of real option, which demonstrates that the firms with higher cash flow volatility has more valuable growth opportunity if the growth opportunities are real option on cash flow from assets in place (Dixit and Pindyck, 1993). And this will support our hypothesis (2) mentioned in analysis of pharmaceutical industry that volatility could be value creation and thus support for Merton(1974).

4.3.2. The effect of accruals

We also make a similar comparison as we do for pharmaceutical industry by setting up three different regression models with different controls. In overall, the significant level for the intercommunity controls change little, as well as the coefficient. However, the increasing adjusted R-square from regression 5.1, 5.2 and regression 5.3 indicate the cash flow volatility add some explanatory power of regression model. The adjusted R-square increased by 0.0007 from regression 5.1 to 5.2, and 0.0006 from regression 5.2 to 5.3. Although the change is minor, there is clearly an

[13] Since we use Ln(M/B) as an approximation of Ln(Tobin's Q), a M/B above 1 will lead to a positive Ln(Tobin's Q)

increasing trend when we emphasize the cash flow volatility.

Table 9

In this table, we show three regressions with different volatility variables, for regression 5.1, we use earnings volatility as variables. For regression 5.2, instead of using earnings volatility, we use the method mentioned in methodology part to decouple earnings volatility into cash flow volatility and accruals volatility and use these two factors as variables. For regression 5.3, we remove the accruals volatility and only keep cash flow volatility as variable. Thus, through compare this three regression tests, we could get access to the answer to whether accruals create value in U.S. biotechnology industry.

Dependent Variable: Ln(Tobin's Q)			
	Regression 5.1	Regression 5.2	Regression 5.3
Ln (Earnings volatility)	-0.002281		
	(0.6597)		
Ln (Accruals volatility)		0.009267	
		(0.6383)	
Ln (Cash flow volatility)		0.009713	0.009694
		(0.1046)	(0.1072)
Ln (Systematic risk)	-0.029071	-0.026399	-0.025262
	(0.2267)	(0.2677)	(0.2881)
Ln (Idiosyncratic risk)	0.059681	0.057652	0.059405
	(0.2520)	(0.2606)	(0.2496)
Ln (Total assets)	-0.413726	-0.41894	-0.417163
	(0.0000)	(0.0000)	(0.0000)
Sales growth	0.00015	0.000194	8.77E-05
	(0.8182)	(0.7786)	(0.8914)
Return on assets	-0.246344	-0.239656	-0.243377
	(0.0034)	(0.0048)	(0.0038)
Capex/Sales	0.001191	0.001147	0.001196
	(0.0272)	(0.0403)	(0.0265)
R&D/Sales	0.001447	0.001432	0.001468
	(0.0000)	(0.0000)	(0.0000)
SG&A/Sales	-0.001247	-0.001226	-0.001256
	(0.0000)	(0.0000)	(0.0000)
Leverage	4.76E-06	4.83E-06	4.76E-06
	(0.2430)	(0.2369)	(0.2408)
Constant	4.286168	4.344267	4.334323
	(0.0000)	(0.0000)	(0.0000)
Adj. R^2	0.683816	0.684516	0.685135

One reason is the statistic significant of cash flow volatility is close to 10% level, contrast to the insignificant of earning volatility and accruals. Another possible reason is our result is consistent with the conclusion of Brian, James and George (2008), which indicate the earning smooth via accruals doesn't add value beyond the cash-flow component of earnings. The comparison between regression 3 and regression 2 reveals slightly changes when add accruals. It could not clearly explain since the accruals do not have statistical significance. As a result, the conclusion from Brian, James and George (2008) could not be supported by our result, but only provide a possible explanation.

4.4. Robustness

We use the method described in methodology part to test the robustness of our regression results. The results are satisfied and show that our regression tests are reliable:

(1) By using different measurements of our variables: The results keep unchanged with our former regression tests, which indicate that our measurements of variables are reliable.

(2) By adjusting/excluding abnormal data: The results remain unchanged. These indicate that our selected samples and observations are reliable.

(3) By using different variables and checking the changing in model's adjusted R^2 and changing in variables' T-value, we found that idiosyncratic risk has the most powerful determination on Tobin's Q, the T-value never falls below 3. Cash flow volatility, Total assets remain T-values above 2. Other significant variables have T-values around 2 with slightly deviation. This indicates that the significances of our variables are reliable.

(4) In order to test the robustness of our results, we use dummy variables of time period to check if there is any change. We also use white (diagonal) method to eliminate heteroscedasticity problem. The results are consisting with our original regression tests. This indicates that the results of our variables are reliable.

4.5. Comparisons Between U.S. Pharmaceutical and Biotechnology Industries

In this part, we will compare our regression results for both industries and try to give out reasonable explanations to our four questions raised at the very beginning.

We do observe different coefficients between cash flow volatility and firm value in these two different industries. However, it is hard to say whether cash flow volatility impacts more on non-asset-intensive industry as we estimated. There are two alternative explanations:

(1) If we accept that the cash flow volatility has a significant impact on Tobin's Q: Although the absolute value shows that there is a higher coefficient in biotechnology industry which stands for high growth industry, the cash flow volatilities' influences are totally different for two industries. In our study, we see value destruction from cash flow volatility in pharmaceutical industry, which consists with the result of Brian, James and George (2008), while on the contrary value creation from cash flow volatility in biotechnology industry. Thus these two kinds of influence could not be compared directly and a quantitatively comparison will be meaningless. What we could say is that cash flow volatility does have different impacts on firms in different industries. We prefer to believe that the differences are caused by growth option since the results could be perfectly support by current existing academic theories and empirical studies on both sides. However, this also need further research to examine cash flow volatilities' influences on all industries. Or

Table 10

In this table, we will compare main variables and their coefficients and significant level. P-values are reported beneath the coefficients results in parentheses.

Dependent Variable: Ln(Tobin's Q)		
Panel A	**Pharmaceutical**	**Biotechnology**
Ln (Cash flow volatility)	-0.08879	0.009694
	(0.0049)***	(0.1072)(*)
Ln (Systematic risk)	0.003733	-0.025262
	(0.8813)	(0.2881)
Ln (Idiosyncratic risk)	0.286527	0.059405
	(0.0000)***	(0.2496)
Ln (Total assets)	0.066137	-0.417163
	(0.0380)**	(0.0000)***
Sales growth	0.000102	8.77E-05
	(0.2643)	(0.8914)
Return on assets	-0.002822	-0.243377
	(0.013)**	(0.0038)***
Capex/Sales	-0.058835	0.001196
	(0.0237)**	(0.0265)**
R&D/Sales	-0.004224	0.001468
	(0.0737)*	(0.0000)***
SG&A/Sales	0.003983	-0.001256
	(0.0467)**	(0.0000)***
Leverage	3.44E-05	4.76E-06
	(0.1919)	(0.2408)
Constant	0.131773	4.334323
	(0.5842)	(0.0000)***

Panel B	**Pharmaceutical**	**Biotechnology**
Ln (Accruals volatility)	Not significant	Not significant
Interest Expenses/Sales	Not significant	Not significant
Effective Tax Rate	Not significant	Not significant

(2) If we reject that the cash flow volatility has a significant impact on Tobin's Q: Thus cash flow volatility will have a significant impact on mature industry while won't have a significant impact on industries with high growth option. Possible explanation is that investors who involved into a high growth industry are not risk-averse and have already accepted the potential risks due to the growth option or otherwise they will just invest in low risk industries that generate stable but generally low returns. Thus investors of high growth industries no longer take

cash flow volatility into consideration. In this way, cash flow volatility does have different impacts on industries with different level of potential growth, but the impact could also not be compared directly and quantitatively. However, there exist potential challenges from both behavior finance theory and corporate finance theory. From behavioral theory point of view, people are generally risk-averse, and thus should prefer a stable cash flow (Hersh Shefrin, "Behavioral corporate finance", P11-12). While from corporate finance point of view, investors could do diversifications by themselves by making up their own portfolios to diversify risk. Thus no matter which industry the investor is involved in, he/she should always not be risk-averse as long as owning a diversified investment portfolio (Gaughan, "Mergers, Acquisitions and Corporate Restructuring", p136-145). Then it is hard to say why investors do value smooth cash flow in a mature industry, as in our study, pharmaceutical industry.

In both situations we do observe different impacts of cash flow volatility on firm value and the results could give us reasonable explanations to our Question 1. Although it is hard to compare the influences directly and quantitatively, we believe that the different is caused by growth options, and what's more, volatility could be both value creating and value destroying. This will lead to the discussion of our Question 3.

The results of our study, basing on an industry level, support former studies from both sides. The result of value destruction in pharmaceutical industry is in line with Trueman and Titman (1988), Badrinath, Gay, and Kale (1989), J.Peter Ferderer (1993), Froot, Scharfstein and Stein (1993), John and Clifford (1999) and Brian, James and George (2008), while the result of value creation consists with Merton (1974) and Pastor and Veronesi (2003). This exactly meets with our assumption that cash flow volatility could be both value creations (as it represents future potential growth opportunities) and value destructions (as it will cause problems related to financing, cost of capital, tax and financial distress) at the same time, and the net effect should be examined on an industry basis. The conflicts could shows that in certain

circumstances one theory will have more explanation power than others. What's more, it also reflects that sometimes different theories are not the two polar of one line, and it will give us a totally new view if we use an eclectic point of view but not the conflict one.

When it comes to Question 2, results from both industries show that accruals managements seldom add value to firm and are not valued by investors. The results are in line with Brian, James and George (2008). This indicates that (1) earning management could create value, but only to the extent how much cash flow volatility is reduced; (2) management should focus on real cash flow management but not accruals management to create value; (3) traditional theoretical framework has its logic problem as discussed in section 2.4.

The results of introducing tax rate and annual interest payments are not satisfied since both variables are not significant in both industries' regression tests. We didn't see any improvement in model's adjusted R^2. However, this could also indicate that cash flow volatility has a direct impact on firm value but not through other factors since we have already take all factors that are used in a DCF valuation into consideration and it is common accepted that a DCF valuation should be the most accurate valuation method. However, we still suggest a further research focusing on industries with more positive ROA to check whether cash flow has direct impacts on firm value is true.

Till now, our regression test results have already answered all four questions. However, there are still some interesting phenomenons that worth further study. For example, we could see that (1) firm size is positively related to Tobin's Q while most of former empirical studies come to the conclusion of negative coefficients and (2) capital expenditures and R&D expenses are negatively related to Tobin's Q which is also not in line with most of former studies. We followed former studies' methodology to select samples and to set variables, and we have also done a series

of robustness test to prove that our results are reliable, but we still get some results that go against with existing researches, like Brian, James and George (2008), the one we strictly followed. This indicates that some of the results are on a general basis while the real situation may deviate from those results, just like in our study, the cash flow volatility's impacts on firm value.

Part V. Conclusion

5.1. Conclusion

This paper, basing on U.S. pharmaceutical and biotechnology industries which represent mature industry and high growth option industry separately, tests four hypotheses related to cash flow volatility's impacts on firm values:

(1) Cash flow volatilities' impacts on firms differ from pharmaceutical industry to biotechnology industry although the two industries are highly related and to some extent similar to each other.
(2) Cash flow volatilities will be net value creating for biotechnology firms while net value destroying for pharmaceutical firms. This will demonstrates that cash flow volatility could be both value creating and value destroying.
(3) The result from Brian, James and George (2008) that accruals generally do not add value is also true when be examined on an industry basis but not on a national basis.
(4) Effective tax rate and annual interest payments will not affect cash flow volatilities' influence on firm values in our study.

While former studies like Brian, James and George (2008) has done similar works on a national basis contain samples from all industries, still little work is done on an industry level to see if there is any difference between industry specification and general situation.

Our study finds that cash flow volatilities' impacts differ from one industry to the other. For pharmaceutical industry, cash flow volatilities are generally value destroying, which is in line with former studies and indicates that although the results could not specifically deny the positive effects of cash flow volatility, the value destruction from a volatile cash flow outweigh potential gains from it. However, for

biotechnology industry, we do observe positive coefficients between cash flow volatilities and firms' Tobin's Qs. The comparisons of two industries indicate that the hypothesis that cash flow volatility could be both value creation and value destruction is right. Our results support theories and researches for sides like Merton (1974) and Brian, James and George (2008). Moreover, our results support an eclectic approach to different theories and show that different results are sometimes not the two opposite polar of one line, but one outweigh the others in certain circumstances. Other signals like the effects of firm size, capital expenditures and R&D expenditures on firm values also differ from the general situation in pharmaceutical industry. Through digging deeply into the reasons behind these phenomenons, we found that they could all be explained by different growth opportunities for different industries. Although our results are robust within U.S. healthcare sector and we expect that similar situations could be observed for other industries that differ in growth options, we still suggest more researches to be done on an industries basis in order to identify different industry specifications, which could make the theoretical results more applicable for real business running.

Being consistent with Brian, James and George (2008) and going against prior academic theories, our results show that for both industries accruals management seldom add value. Earnings management does create value for mature industries like pharmaceutical industry, but only to the extent the real cash flow volatility it reduces. We also detected one potential logic problem which could be used to explain the distinctions between traditional theoretical framework and our study.

Our results also show that the introducing of new variables like tax rate and interest expenses do not improve the regression model and the new variables are not significant. However, this could not directly deny the effects of tax rate and interest payments due to the characteristics of our samples. For recent ten years, lots of pharmaceutical and biotechnology firms reported net losses, which would lead to zero tax liability. This makes us hard to detect tax rate's real impact on firm value. For

interest payments, since most of pharmaceutical companies are generally cash rich, interest payments hardly create financial distress and thus this variable won't have significant influence on firm value and won't be valued by investors. While for biotechnology companies, it is generally hard for firms to finance for its growth options from internal resources and they will usually turn to borrow money to finance its research and developments and thus investors also do not take this into consideration during valuation. This could also be used to explain why the variable leverage is also not significant for both industries. Although these two new variables are insignificant in our study, whether this is generally right for all other industries need further researches.

Our work suggests that, generally, accruals management do not create value while cash flow volatility is not always value destruction. As a result, the study also contributes to risk management literatures and suggests that the real impact of cash flow volatility should be checked on an industry basis, and it could be more important for managers of companies within mature industries to focus more on real cash flow managements. We also identified some knowledge gaps lying in this field which suggest further researches on this topic, especially studies basing on other industries in order to achieve an integrated view of cash flow volatilities' influences on firms with different growth options.

Reference

Ahmed, Anwer S., Khalid Nainar, and Jian Zhou. (2005). Do analysts' forecasts fully reflect the information in accruals? Canadian Journal of Administrative Sciences. 22 (4), p329–342.

Barth, Mary E., William H. Beaver, John R.M. Hand, and Wayne R. Landsman. (1999). Accruals, cash flows, and equity values. Review of Accounting Studies. 4 (3-4). p205–229.

Beneish, Messod Daniel and Nichols, D. Craig, Earnings Quality and Future Returns: The Relation between Accruals and the Probability of Earnings Manipulation(May 17, 2005).Available at SSRN: http://ssrn.com/abstract=725162

Brett Trueman and Sheridan Titman. (1988). An Explanation for Accounting Income Smoothing. Journal of Accounting Research. 26, p127-139.

Charles E. Wasley & Joanna Shuang Wu, (2006). Why Do Managers Voluntarily Issue Cash Flow Forecasts?. Journal of Accounting Research. 44 (2), p389-429.

Christie, A. A. (1982). The stochastic behavior of common stock variances: Value, leverage, and interest rate effects. Journal of Financial Economics. 10. p407-432.

Core, John E., Wayne R. Guay, Scott A. Richardson, and Rodrogi S. Verdi. (2006). Stock market anomalies: What can we learn from repurchases and insider trading? Review of Accounting Studies. 11(1), p49–70.

Dechow, Patricia, Richard Sloan, and Amy P. Sweeney. (1995). Detecting earnings management. The Accounting Review. 70 (2), p193–225.

Duffee, G. R. (1995). Stock returns and volatility: A firm-level analysis. Journal of Financial Economics 37. p399-420.

Elgers, Pieter T., Ray J. Pfeiffer Jr., and Susan L. Porter. (2003). Anticipatory income smoothing: A re-examination. Journal of Accounting and Economics. 35 (3), p405–422.

Enrique Arzac (2004). Valuation for Mergers , Buyouts and Restructuring. 2nd ed. New York: John Wiley & Sons.

Fairfield, Patricia, Scott Whisenant, and Teri Lombardi Yohn. (2002). The differential persistence of accruals and cash flows for future operating income versus future profitability. Review of Accounting Studies. 8 (2-3), p221–243.

Finger, Catherine A. (1994). The ability of earnings to predict future earnings and cash flows. Journal of Accounting Research. 32 (2). p210–223

George Day and Liam Fahey. (1988). Valuing Market Strategies. The Journal of Marketing. 52 (3), p45-57.

Gul, Ferdinand A., S. Leung, and Bin Srinidhi, (2000). Efficient management of earnings to signal growth opportunities–an empirical investigation. Working Paper, City University of Hong Kong.

Hersh Shefrin (2007). Behavioral Corporate Finance. New York: McGraw-Hill/Irwin. p11-12.

J. Peter Ferderer. (1993). The Impact of Uncertainty on Aggregate Investment spending: An Empirical Analysis. Journal of Money, Credit and Banking. 25 (1), p30-48.

Keith W. Chauvin and Mark Hirschey. (1993). Advertising, R&D Expenditures and the Market Value of the Firm. Financial Management. 22 (4), p128-140

Kenneth A. Froot, David S. Scharfstein and Jeremy C. Stein. (1993). Risk Management: Coordinating Corporate Investment and Financing Policies. The

Journal of Finance. 48 (5), p1629-1658.

Leuz, Christian, Nanda, Dhananjay and Wysocki, Peter D. (2003). Earnings Management and Investor Protection: An International Comparison. Journal of Financial Economics. 69, p505-527.

Merton, R., (1974). The pricing of corporate debt: a note. Journal of Finance. 36, p1187–1189.

Michael J. Rogers, Costas D. Maranas and Min Ding. (2005). Valuation and design of pharmaceutical R&D licensing deals. AIChE Journal. 51 (1), p198-209.

Pastor, Lubos and Veronesi, Pietro, Stock Prices and IPO Waves (July 4, 2003). CRSP Working Paper No. 548.

Patrick A. Gaughan (2007). Mergers, Acquisitions, and Corporate Restructurings. 4th ed. New Jersey: John Wiley & Sons, Inc. p136-145

Paul M. Healy, James Michael Wahlen. (1999). A review of the earnings management literature and its implications for standard setting.Accounting Horizons. 13 (4), p365-383.

Piotroski, Joseph D. and Darren T. Roulstone. (2005). Do insider trades reflect both contrarian beliefs and superior knowledge about future cash flow realizations? Journal of Accounting and Economics. 39 (1). p55–81

Rajdeep Grewal, Joseph A. Cote and Hans Baumgartner. (2004). Multicollinearity and Measurement Error in Structural Equation Models: Implications for Theory Testing. Marketing Science. 23 (4). p519-529.

Randolph B. Cohen, Paul A. Gompers, and Tuomo Vuolteenaho. (2002). Who underreacts to cash-flow news? evidence from trading between individuals and institutions. Journal of Financial Economics. 66 (2-3), p409-462.

S. G. Badrinath, Gerald D. Gay and Jayant R. Kale. (1989). Patterns of Institutional Investment, Prudence, and the Managerial "Safety-Net" Hypothesis. The Journal of Risk and Insurance. 56 (4), p605-629.

Shin,Hyun-Han and Stulz, Rene. , Firm Value, Risk, and Growth Opportunities (July 2000). NBER Working Paper Series, Vol. w7808, pp. -, 2000. Available at SSRN: http://ssrn.com/abstract=236869

Tim Koller, Marc Goedhart, David Wessels (2010). Valuation: Measuring and Managing the Value of Companies. 5th ed. New Jersey: John Wiley & Sons. p261-265.

Tong, Tony W. and Reuer, Jeffrey J. (2006). Firm and Industry Influences on the Value of Growth Options. Strategic Organization, 4 (1)

Appendix 1.1 – Pearson Correlation Examination: Pharmaceutical

	Q	TOTAL_ASSETS	EPS	CFPS	SYS_RISK	IDIO_RISK	ABS_E_V	ABS_CF_V	G_SALES_	ROA	CAPEX_SALES	R_D_SALES	SGA_SALES	LEVERAGE	INTERESTS	TAX_RATE
Q	1															
TOTAL_ASSETS	-0.047261	1														
EPS	-0.064754	0.217758	1													
CFPS	-0.070324	0.367649	0.735231	1												
SYS_RISK	-0.067316	0.157952	0.061335	0.086395	1											
IDIO_RISK	0.274914	-0.050033	-0.027167	-0.062749	-0.02077	1										
ABS_E_V	-0.019735	-0.028816	0.046528	-0.00304	0.024874	-0.014213	1									
ABS_CF_V	-0.036495	-0.056053	0.020435	0.026426	0.051857	-0.008905	0.061281	1								
G_SALES_	0.000204	-0.012303	0.003471	-0.007351	-0.004521	-0.005513	-0.002435	-0.000253	1							
ROA	-0.235677	0.128101	0.12717	0.221303	0.118586	-0.060547	0.01842	0.042069	0.065779	1						
CAPEX_SALES	0.018497	-0.021658	-0.024827	-0.053653	-0.030592	-0.00766	-0.010001	-0.020013	-0.003481	-0.341607	1					
R_D_SALES	0.050183	-0.01942	-0.009539	-0.031199	-0.012775	-0.00369	-0.008115	-0.017518	-0.003062	-0.412507	0.642974	1				
SGA_SALES	0.061919	-0.022152	-0.008307	-0.031795	-0.019336	-0.002486	-0.009618	-0.02002	-0.003528	-0.432137	0.836374	0.954802	1			
LEVERAGE	0.032222	-0.011148	-0.068949	-0.039955	-0.012959	-0.004394	-0.003862	-0.013096	-0.002399	-0.065482	0.027884	0.041138	0.040543	1		
INTERESTS	0.090152	-0.014837	-0.010697	-0.020729	0.00243	0.000936	-0.007012	-0.012384	-0.002422	-0.354379	0.615097	0.84082	0.855289	0.04903	1	
TAX_RATE	-0.015697	0.063657	0.035043	0.080534	0.004417	-0.018711	-0.027158	-0.037808	-0.003886	0.000557	-0.006205	-0.006195	-0.006799	-0.003804	-0.004684	1

Appendix 1.2 – Pearson Correlation Examination: Biotechnology

	Q	TOTAL_ASSETS	EPS	CFPS	SYS_RISK	IDIO_RISK	ABS_E_V	ABS_CF_V	G_SALES_	ROA	CAPEX_SALES	R_D_SALES	SGA_SALES	LEVERAGE	INTERESTS	TAX_RATE
Q	1															
TOTAL_ASSETS	-0.05174	1														
EPS	-0.031954	0.075815	1													
CFPS	-0.035302	0.112384	0.93461	1												
SYS_RISK	0.014672	0.064121	-0.03357	-0.021453	1											
IDIO_RISK	0.439506	-0.117569	0.018671	0.005253	-0.00843	1										
ABS_E_V	-0.00066	-0.010062	0.000515	-4.85E-05	0.079055	-0.022883	1									
ABS_CF_V	-0.020139	0.054383	0.025695	0.029145	-0.051191	-0.03994	-0.009019	1								
G_SALES_	-0.012617	-0.01662	-0.002609	-0.000418	0.060187	-0.007721	-0.002658	-0.009658	1							
ROA	-0.645521	0.159714	0.101586	0.088019	0.093979	-0.44665	-0.012057	0.04094	-0.027345	1						
CAPEX_SALES	-0.011969	-0.015216	-0.000123	0.001005	0.004607	0.088842	-0.007031	-0.009486	-0.006067	-0.019861	1					
R_D_SALES	0.005395	-0.030521	-0.038442	-0.041388	-0.019175	0.024043	-0.010047	-0.014391	-0.014932	-0.056504	0.316086	1				
SGA_SALES	0.021539	-0.036717	-0.047766	-0.051068	-0.030099	0.062305	-0.012102	-0.017065	-0.016597	-0.086286	0.38934	0.972148	1			
LEVERAGE	-0.006098	-0.012096	0.008585	0.007143	-0.008925	-0.030713	-0.006967	-0.006127	-0.005172	-0.004331	3.60E-05	0.006381	0.006126	1		
INTERESTS	0.063623	-0.023747	-0.175481	-0.18042	-0.010911	0.085907	-0.007869	-0.01086	-0.010175	-0.088689	0.105848	0.263665	0.380673	-0.003939	1	
TAX_RATE	-0.037706	0.062463	0.038384	0.037128	-0.005625	-0.064415	-0.012979	-0.004067	-0.01323	0.11058	-0.013874	-0.021207	-0.025104	-0.0092	-0.015577	1

Appendix 2.1 – Regression 1.1 (Pharmaceutical)

Sample: 2002 2010
Periods included: 9
Cross-sections included: 70
Total panel (unbalanced) observations: 590

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_ASSETS_	0.066918	0.035526	1.88361	0.0601
G_SALES_	-9.24E-05	0.000201	-0.459864	0.6458
ROA	-0.003826	0.002419	-1.581502	0.1143
CAPEX_SALES	-0.034184	0.055942	-0.611054	0.5414
R_D_SALES	-0.001466	0.005093	-0.287796	0.7736
SGA_SALES	0.001996	0.004309	0.463285	0.6433
LEVERAGE	9.52E-05	5.79E-05	1.642844	0.101
C	-3.780265	0.435624	-8.677813	0

R-squared	0.021466	Mean dependent var	-2.937322
Adjusted R-squared	0.009697	S.D. dependent var	2.385415
S.E. of regression	2.373822	Akaike info criterion	4.580346
Sum squared resid	3279.587	Schwarz criterion	4.639738
Log likelihood	-1343.202	Hannan-Quinn criter.	4.603483
F-statistic	1.823894	Durbin-Watson stat	0.392956
Prob(F-statistic)	0.080211		

Note: Only variables stand for firms' characteristics are used.

Appendix 2.2 – Regression 1.2 (Pharmaceutical)

Dependent Variable: LN_Q_
Method: Panel Least Squares
Date: 05/21/11 Time:
19:43
Sample: 2002 2010
Periods included: 9
Cross-sections included: 70
Total panel (unbalanced) observations: 582

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_SYS_RISK_	-0.045638	0.054066	-0.844113	0.399
LN_IDIO_RISK_	0.39138	0.122855	3.185715	0.0015
LN_ASSETS_	0.251304	0.068561	3.665414	0.0003
G_SALES_	-6.49E-05	0.000201	-0.323074	0.7468
ROA	-0.003601	0.002435	-1.478781	0.1397
CAPEX_SALES	-0.053698	0.056956	-0.942796	0.3462
R_D_SALES	-0.003331	0.00518	-0.643155	0.5204
SGA_SALES	0.003657	0.00439	0.833138	0.4051
LEVERAGE	8.94E-05	5.79E-05	1.544558	0.123
C	-3.398679	0.519203	-6.545949	0

R-squared	0.038486	Mean dependent var	-2.941614
Adjusted R-squared	0.023357	S.D. dependent var	2.398923
S.E. of regression	2.370742	Akaike info criterion	4.581316
Sum squared resid	3214.879	Schwarz criterion	4.656341
Log likelihood	-1323.163	Hannan-Quinn criter.	4.610561
F-statistic	2.543882	Durbin-Watson stat	0.411062
Prob(F-statistic)	0.007198		

Note: Variables stand for firms' characteristics and variables stand for systematic and idiosyncratic risks are used.

Appendix 2.3 – Regression 1.3 (Pharmaceutical)

Dependent Variable: LN_QL_
Method: Panel Least Squares
Date: 05/21/11 Time: 17:38
Sample: 2002 2010
Periods included: 9
Cross-sections included: 70
Total panel (unbalanced) observations: 569

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_CF_VOL_	-0.08879	0.03146	-2.822269	0.0049
LN_SYS_RISK_	0.003733	0.024994	0.149352	0.8813
LN_IDIO_RISK_	0.286527	0.056658	5.057149	0
LN_ASSETS_	0.066137	0.031803	2.079614	0.038
G_SALES_	0.000102	9.13E-05	1.117484	0.2643
ROA	-0.002822	0.001132	-2.492531	0.013
CAPEX_SALES	-0.058835	0.025935	-2.268539	0.0237
R_D_SALES	-0.004224	0.002358	-1.791541	0.0737
SGA_SALES	0.003983	0.001999	1.993143	0.0467
LEVERAGE	3.44E-05	2.63E-05	1.306689	0.1919
C	0.131773	0.24062	0.547641	0.5842

R-squared	0.118457	Mean dependent var	-0.881125
Adjusted R-squared	0.102659	S.D. dependent var	1.137605
S.E. of regression	1.077632	Akaike info criterion	3.006551
Sum squared resid	647.9997	Schwarz criterion	3.090528
Log likelihood	-844.3638	Hannan-Quinn criter.	3.039319
F-statistic	7.498136	Durbin-Watson stat	0.33987
Prob(F-statistic)	0		

Note: Both variables stand for firms' characteristics and firms' risks are used. Cash flow volatility included.

Appendix 2.4 – Regression 1.4 (Pharmaceutical)

Dependent Variable: LN_QL_
Method: Panel Least Squares
Date: 05/21/11 Time: 17:39
Sample: 2002 2010
Periods included: 9
Cross-sections included: 70
Total panel (unbalanced) observations: 569

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_CF_VOL_	-0.088411	0.031515	-2.805381	0.0052
LN_SYS_RISK_	0.003251	0.025072	0.129659	0.8969
LN_IDIO_RISK_	0.28831	0.057053	5.053381	0
LN_ASSETS_	0.067182	0.032042	2.096694	0.0365
G_SALES_	0.000102	9.14E-05	1.114988	0.2653
ROA	-0.002769	0.001148	-2.411412	0.0162
CAPEX_SALES	-0.066212	0.03677	-1.800713	0.0723
R_D_SALES	-0.004822	0.003166	-1.522871	0.1284
SGA_SALES	0.004598	0.002952	1.557701	0.1199
LEVERAGE	3.47E-05	2.64E-05	1.31504	0.189
INTERESTS	-0.00112	0.003953	-0.283266	0.7771
C	0.131436	0.240821	0.545783	0.5854

R-squared	0.118584	Mean dependent var	-0.881125
Adjusted R-squared	0.101178	S.D. dependent var	1.137605
S.E. of regression	1.078521	Akaike info criterion	3.009922
Sum squared resid	647.9064	Schwarz criterion	3.101533
Log likelihood	-844.3228	Hannan-Quinn criter.	3.045669
F-statistic	6.812546	Durbin-Watson stat	0.339132
Prob(F-statistic)	0		

Note: New variable “annual interest payments” is added.

Appendix 2.5 – Regression 1.5 (Pharmaceutical)

Dependent Variable: LN_QL_
Method: Panel Least Squares
Date: 05/22/11 Time: 01:35
Sample: 2002 2010
Periods included: 9
Cross-sections included: 70
Total panel (unbalanced) observations: 569

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TAX_RATE	0.003272	0.070877	0.046169	0.9632
LN_CF_VOL_	-0.088682	0.031575	-2.808654	0.0051
LN_SYS_RISK_	0.003754	0.02502	0.15002	0.8808
LN_IDIO_RISK_	0.286575	0.056718	5.052624	0
LN_ASSETS_	0.06611	3.18E-02	2.07653	0.0383
G_SALES_	0.000102	9.14E-05	1.116487	0.2647
ROA	-0.002822	0.001133	-2.490106	0.0131
CAPEX_SALES	-0.058825	0.025959	-2.266087	0.0238
R_D_SALES	-0.004223	0.00236	-1.789575	0.0741
SGA_SALES	3.98E-03	2.00E-03	1.991013	0.047
LEVERAGE	3.44E-05	2.64E-05	1.305761	0.1922
C	0.132302	0.241108	0.548727	0.5834

R-squared	0.118461	Mean dependent var	-0.881125
Adjusted R-squared	0.101052	S.D. dependent var	1.137605
S.E. of regression	1.078596	Akaike info criterion	3.010062
Sum squared resid	647.9972	Schwarz criterion	3.101673
Log likelihood	-844.3627	Hannan-Quinn criter.	3.045809
F-statistic	6.804491	Durbin-Watson stat	0.339603
Prob(F-statistic)	0		

Note: New variable “effective tax rate” is added.

Appendix 3.1 – Regression 2.1 (Pharmaceutical)

Dependent Variable: LN_QL_
Method: Panel Least Squares
Date: 05/21/11 Time: 17:51
Sample: 2002 2010
Periods included: 9
Cross-sections included: 70
Total panel (unbalanced) observations: 555

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_E_VOL_	-0.073804	0.034353	-2.148412	0.0321
LN_SYS_RISK_	0.003778	0.02606	0.144989	0.8848
LN_IDIO_RISK_	0.280771	0.058188	4.825276	0
LN_ASSETS_	0.075557	0.032851	2.299992	0.0218
G_SALES_	0.000101	9.29E-05	1.089138	0.2766
ROA	-0.002741	0.001185	-2.313381	0.0211
CAPEX_SALES	-0.05611	0.026391	-2.12612	0.0339
R_D_SALES	-0.003997	0.0024	-1.665589	0.0964
SGA_SALES	0.003808	0.002035	1.870586	0.0619
LEVERAGE	3.99E-05	2.68E-05	1.491415	0.1364
C	-0.002228	0.250004	-0.00891	0.9929

R-squared	0.106187	Mean dependent var	-0.900778
Adjusted R-squared	0.089757	S.D. dependent var	1.148811
S.E. of regression	1.096043	Akaike info criterion	3.04091
Sum squared resid	653.5123	Schwarz criterion	3.126511
Log likelihood	-832.8525	Hannan-Quinn criter.	3.074348
F-statistic	6.462864	Durbin-Watson stat	0.325818
Prob(F-statistic)	0		

Note: Earnings volatility is included.

Appendix 3.2 – Regression 2.2 (Pharmaceutical)

Dependent Variable: LN_QL_
Method: Panel Least Squares
Date: 05/22/11 Time: 15:26
Sample: 2002 2010
Periods included: 9
Cross-sections included: 70
Total panel (unbalanced) observations: 556

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_CF_VOL_	-0.08556	0.04176	-2.048863	0.041
LN_ACC_VOL_	-0.007566	0.038904	-0.194483	0.8459
LN_SYS_RISK_	0.000519	0.025339	0.020463	0.9837
LN_IDIO_RISK_	0.260639	0.057322	4.546911	0
LN_ASSETS_	0.064182	0.032301	1.987	0.0474
G_SALES_	0.000104	9.07E-05	1.148525	0.2513
ROA	-0.00303	0.00114	-2.657855	0.0081
CAPEX_SALES	-0.059398	0.025763	-2.305553	0.0215
R_D_SALES	-0.004275	0.002342	-1.825159	0.0685
SGA_SALES	0.004018	0.001985	2.023836	0.0435
LEVERAGE	3.58E-05	2.62E-05	1.366713	0.1723
C	-0.034213	0.246859	-0.138595	0.8898

R-squared	0.110868	Mean dependent var	-0.886548
Adjusted R-squared	0.092889	S.D. dependent var	1.122779
S.E. of regression	1.069361	Akaike info criterion	2.993346
Sum squared resid	622.0816	Schwarz criterion	3.0866
Log likelihood	-8.20E+02	Hannan-Quinn criter.	3.02977
F-statistic	6.166614	Durbin-Watson stat	0.341946
Prob(F-statistic)	0		

Note: Earnings volatility is removed, cash flow volatility and accruals volatility are added.

Appendix 3.3 – Regression 2.3 (Pharmaceutical)

Dependent Variable: LN_QL_
Method: Panel Least Squares
Date: 05/21/11 Time: 17:53
Sample: 2002 2010
Periods included: 9
Cross-sections included: 70
Total panel (unbalanced) observations: 569

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_CF_VOL_	-0.08879	0.03146	-2.822269	0.0049
LN_SYS_RISK_	0.003733	0.024994	0.149352	0.8813
LN_IDIO_RISK_	0.286527	0.056658	5.057149	0
LN_ASSETS_	0.066137	0.031803	2.079614	0.038
G_SALES_	0.000102	9.13E-05	1.117484	0.2643
ROA	-0.002822	0.001132	-2.492531	0.013
CAPEX_SALES	-0.058835	0.025935	-2.268539	0.0237
R_D_SALES	-0.004224	0.002358	-1.791541	0.0737
SGA_SALES	0.003983	0.001999	1.993143	0.0467
LEVERAGE	3.44E-05	2.63E-05	1.306689	0.1919
C	0.131773	0.24062	0.547641	0.5842

R-squared	0.118457	Mean dependent var	-0.881125
Adjusted R-squared	0.102659	S.D. dependent var	1.137605
S.E. of regression	1.077632	Akaike info criterion	3.006551
Sum squared resid	647.9997	Schwarz criterion	3.090528
Log likelihood	-844.3638	Hannan-Quinn criter.	3.039319
F-statistic	7.498136	Durbin-Watson stat	0.33987
Prob(F-statistic)	0		

Note: Accruals volatility is removed.

Appendix 4.1 – Regression 3.3 (Pharmaceutical, Robustness Test)

Dependent Variable: LN_QL_
Method: Panel Least Squares
Date: 05/21/11 Time: 17:58
Sample: 2002 2010
Periods included: 9
Cross-sections included: 70
Total panel (unbalanced) observations: 577

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_CF_VOL_	-0.0984	0.031376	-3.136153	0.0018
LN_IDIO_RISK_	0.300069	0.055105	5.445393	0
LN_ASSETS_	0.066558	0.029526	2.254215	0.0246
ROA	-0.002777	0.001086	-2.556703	0.0108
CAPEX_SALES	-0.069411	0.024426	-2.841733	0.0046
R_D_SALES	-0.005182	0.002217	-2.337952	0.0197
SGA_SALES	0.004805	0.001883	2.552302	0.011
C	0.211694	0.21768	0.972501	0.3312

R-squared	0.135023	Mean dependent var	-0.869672
Adjusted R-squared	0.124382	S.D. dependent var	1.155833
S.E. of regression	1.081565	Akaike info criterion	3.008462
Sum squared resid	665.6059	Schwarz criterion	3.068883
Log likelihood	-859.9413	Hannan-Quinn criter.	3.032024
F-statistic	12.68871	Durbin-Watson stat	0.350267
Prob(F-statistic)	0		

Note: Cash flow volatility is included. Insignificant variables are removed.

Appendix 4.2 – Regression 4.2 (Pharmaceutical, Robustness Test)

Dependent Variable: LN_QL_
Method: Panel Least Squares
Date: 05/22/11 Time: 15:27
Sample: 2002 2010
Periods included: 9
Cross-sections included: 70
Total panel (unbalanced) observations: 569
White diagonal standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_CF_VOL_	-0.098187	0.032758	-2.997345	0.0028
LN_SYS_RISK_	-0.007256	0.028816	-0.251791	0.8013
LN_IDIO_RISK_	0.284648	0.110593	2.573842	0.0103
LN_ASSETS_	0.063401	0.057753	1.097798	0.2728
G_SALES_	9.92E-05	1.79E-05	5.530587	0
ROA	-0.002798	0.001402	-1.995593	0.0465
CAPEX_SALES	-0.05444	0.034024	-1.600064	0.1102
R_D_SALES	-0.003839	0.003083	-1.245143	0.2136
SGA_SALES	0.003663	0.002618	1.399202	0.1623
LEVERAGE	2.96E-05	1.46E-05	2.024559	0.0434
C	0.129006	0.311686	0.413897	0.6791

Effects Specification
Period fixed (dummy variables)

R-squared	0.127309	Mean dependent var	-0.881125
Adjusted R-squared	0.098748	S.D. dependent var	1.137605
S.E. of regression	1.079977	Akaike info criterion	3.024579
Sum squared resid	641.4931	Schwarz criterion	3.169629
Log likelihood	-841.4927	Hannan-Quinn criter.	3.081178
F-statistic	4.457476	Durbin-Watson stat	0.336845
Prob(F-statistic)	0		

Note: Cash flow volatility is included. White (diagonal) method is used. Time Period is fixed.

Appendix 5.1 – Regression 5.1 (Biotechnology, Robustness Test)

Dependent Variable: COR_M_B
Method: Panel Least Squares
Date: 05/22/11 Time: 23:11
Sample: 2002 2010
Periods included: 9
Cross-sections included: 83
Total panel (unbalanced) observations: 502
White diagonal standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
COR_SYS_RISK	-0.029071	0.024011	-1.210741	0.2267
COR_IDO_RISK	0.059681	0.052023	1.14721	0.252
COR_LN_ASSETS_	-0.413726	0.077576	-5.333165	0
COR_G_SALES	0.00015	0.000652	0.230039	0.8182
COR_ROA_2	-0.246344	0.083536	-2.948972	0.0034
COR_CAPEX_SALES	0.001191	0.000538	2.216071	0.0272
COR_R_D_SALES	0.001447	0.000302	4.796695	0
COR_SGA_SALES	-0.001247	0.000259	-4.814972	0
COR_D_E	4.76E-06	4.07E-06	1.169279	0.243
COR_VOL_E	-0.002281	0.005176	-0.440642	0.6597
C	4.286168	0.906299	4.729309	0

Effects Specification
Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.746927	Mean dependent var	-0.879522
Adjusted R-squared	0.683816	S.D. dependent var	1.028909
S.E. of regression	0.578557	Akaike info criterion	1.921194
Sum squared resid	134.2262	Schwarz criterion	2.769956
Log likelihood	-381.2197	Hannan-Quinn criter.	2.25419
F-statistic	11.83522	Durbin-Watson stat	1.069155
Prob(F-statistic)	0		

Note: Earnings volatility is included.

Appendix 5.2 – Regression 5.2 (Biotechnology, Robustness Test)

Dependent Variable: COR_M_B
Method: Panel Least Squares
Date: 05/22/11 Time: 23:13
Sample: 2002 2010
Periods included: 9
Cross-sections included: 83
Total panel (unbalanced) observations: 502
White diagonal standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
COR_SYS_RISK	-0.026399	0.023786	-1.10988	0.2677
COR_IDO_RISK	0.057652	0.051175	1.12656	0.2606
COR_LN_ASSETS_	-0.41894	0.077774	-5.386636	0
COR_G_SALES	0.000194	0.000689	0.281357	0.7786
COR_ROA_2	-0.239656	0.0845	-2.836157	0.0048
COR_CAPEX_SALES	0.001147	0.000557	2.057448	0.0403
COR_R_D_SALES	0.001432	0.000316	4.53265	0
COR_SGA_SALES	-0.001226	0.000268	-4.579957	0
COR_D_E	4.83E-06	4.08E-06	1.184635	0.2369
COR_VOL_CF	0.009713	0.005972	1.626477	0.1046
COR_ACC	0.009267	0.0197	0.470388	0.6383
C	4.344267	0.911	4.76868	0

Effects Specification
Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.748117	Mean dependent var	-0.879522
Adjusted R-squared	0.684516	S.D. dependent var	1.028909
S.E. of regression	0.577917	Akaike info criterion	1.920465
Sum squared resid	133.595	Schwarz criterion	2.77763
Log likelihood	-380.0366	Hannan-Quinn criter.	2.256758
F-statistic	11.76276	Durbin-Watson stat	1.086668
Prob(F-statistic)	0		

Note: Earnings volatility is removed. Cash flow volatility and accruals volatility are added.

Appendix 5.3 – Regression 5.3 (Biotechnology, Robustness Test)

Dependent Variable: COR_M_B
Method: Panel Least Squares
Date: 05/22/11 Time: 22:15
Sample: 2002 2010
Periods included: 9
Cross-sections included: 83
Total panel (unbalanced) observations: 502
White diagonal standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
COR_VOL_CF	0.009694	0.006005	1.614388	0.1072
COR_SYS_RISK	-0.025262	0.023749	-1.063689	0.2881
COR_IDO_RISK	0.059405	0.051523	1.152971	0.2496
COR_LN_ASSETS_	-0.417163	0.07757	-5.377884	0
COR_G_SALES	8.77E-05	0.000642	0.136626	0.8914
COR_ROA_2	-0.243377	0.083614	-2.910734	0.0038
COR_CAPEX_SALES	0.001196	0.000537	2.227758	0.0265
COR_R_D_SALES	0.001468	0.000301	4.879639	0
COR_SGA_SALES	-0.001256	0.000257	-4.883755	0
COR_D_E	4.76E-06	4.06E-06	1.17462	0.2408
C	4.334323	0.907381	4.776741	0

Effects Specification
Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.747982	Mean dependent var	-0.879522
Adjusted R-squared	0.685135	S.D. dependent var	1.028909
S.E. of regression	0.57735	Akaike info criterion	1.917016
Sum squared resid	133.6666	Schwarz criterion	2.765778
Log likelihood	-380.171	Hannan-Quinn criter.	2.250012
F-statistic	11.90156	Durbin-Watson stat	1.085111
Prob(F-statistic)	0		

Note: accruals volatility is removed.