DISSERTATION

THREE ESSAYS ON EMPIRICAL STUDIES OF THE SHORT-SALE BAN IN SHANGHAI AND HONG KONG STOCK MARKETS

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THREE ESSAYS ON EMPIRICAL STUDIES OF THE SHORT-SALE BAN IN SHANGHAI AND HONG KONG STOCK MARKETS

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Abstract

Short sale is a transaction of selling financial assets that an investor does not own currently by borrowing them with the intention that one can subsequently repurchase them at lower prices and therefore enjoy the capital gain, typically for a very short period of time. Given the prevalence of short-sale bans on financial markets around the world and the inconclusive results of their impacts both in theoretical and empirical literature as a background, this dissertation attempts to empirically examine the impact of short-selling in financial markets and to enhance the understanding on this subject among regulators, investors and academics. In this study, a negative relationship between the heterogeneity of investors' beliefs and future returns under short sale ban is confirmed in Shanghai Security Exchange, where short-sale ban is imposed for decades. This relationship is robust with controlling for several stock characteristics such as size, leverage, book-to-market ratio, momentum, and different quantiles of the distribution of returns. Although a similar negative relationship between the heterogeneous beliefs and future returns is found for the stocks under short-sale ban in Hong Kong Stock Exchange, this relationship disappears if short-sale ban is lifted. Moreover, such a varying impact of short-sale ban on future returns is stronger if good news of companies' earnings are announced, because the ban tends to eliminate potential short-sellers, who have relatively negative opinions on companies' earnings. Therefore, relatively optimistic investors remain in the market and their opinions are easily augmented by good earnings news, which makes them to purchase more aggressively, leading to greater overvaluation of stock prices. In addition to the impacts on future returns, this study establishes that the short-sale ban has a positive effect on liquidity during a non-crisis period, while such an effect disappears during the 2007-2009 financial crisis period. These findings suggest three important policy implications. First, the effect of short-sale ban on future returns is typically negative. Second, short-sale constraint of a Hong Kong-style may support liquidity of somewhat distressed stocks during a normal period, so that the effect of a short-sale ban on stocks may be subject to a trade-off between a negative impact on future returns and a positive impact on current liquidity. Third, the liquidity-supporting effect of a short-sale constraint may disappear in the face of a market-wide financial distress.

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Dedicated to

my wonderful mother.

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Chapter 1

Introduction

Short sale is a transaction of selling financial assets that an investor does not own currently by borrowing them with the intention that one can subsequently repurchase them at lower prices and therefore enjoy the capital gain, typically for a very short period of time. Although it is not a novel transaction method in financial markets,[1], the specific conducting procedures are not same in different countries. They are regulated by regulatory commissions of financial markets, such as U.S. Securities and Exchange Commission (SEC), European Securities and Markets Authority (ESMA), Financial Service Agency (FSA) in Japan and China Securities Regulatory Commission (CSRC) in China, based on the specific conditions in each financial markets. For example, there are no restrictions on the eligibility of investors to conduct short sale and only naked short sales are prohibited in the United States.[2] Federal Financial

[1]The history of short sale can be back to early 1600s, when several Dutch businessmen sold shares of the East India Company promised to buy later because of anticipating the incorporation of another company (Gelderblom and Jonker, 2004).

[2]`http://www.sec.gov/spotlight/keyregshoissues.htm`, retrieved as of August 25, 2014.

Supervisory Authority (BaFin) in Germany, forbidden short sale from September 19, 2008 to January 31, 2010, but the market makers and designated sponsors can still do short sale during this period. [3] In China, during 1998 to 2004 only the spot transactions of securities permitted, security companies shall not engage in capital/stock raising business. In 2005, whenever providing security financing service, companies shall meet the provisions of, and be subject to the approval of, the regulatory authority under the State Council.

Short-sale receives more attentions from regulators, general investors and academics over recent years during financial crisis. The regulators of the 30 major stock exchanges all imposed constraints on short sales as a reaction to the 2007-2009 crises. A representative view from regulators amid financial crisis on short selling can be found as follows: " At present, it appears that unbridled short selling is contributing to the recent, sudden price declines in the securities of financial institutions unrelated to true price valuation" (SEC News Release 2008-211 [4]). Another example is European market regulators' ban on the short sale of sovereign bonds and stocks in the summer of 2011 amid the European sovereign debt crisis. Although all of these regulations have targeted on short sale in financial markets, their implemented timing, tightness, types of short-selling (naked or not) and durations show great variations (Bris, Goetzmann and Zhu, 2007, Table 1; Beber and Pagano 2013, Figure 1).

Moreover, academic investigations on the effect of short-sale ban in financial markets have yet to reach any conclusion both in theoretical and empirical literature.

[3] `http://www.bafin.de/SharedDocs/Aufsichtsrecht/EN/Verfuegung/vf_080919_leerverk_en.html`, retrieved as of August 25, 2014.

[4] http://www.sec.gov/news/press/2008/2008-211.htm, retrieved as of June 24th, 2014.

The existing literature mainly focuses on two aspects of short-sale ban. In one strand, the main focus is on the impact of ban on the relationship between heterogeneity of investors' beliefs and future returns. Based on the assumption that investors process information in heterogeneous manners, more and more studies reckon the heterogeneity of investors' beliefs as an important factor in predicting future returns (Hong and Stein, 2007; Hirshleifer , 2001; Barberis and Thaler, 2003). However, this heterogeneity-return relationship may be influenced by short-sale ban because investors with negative opinions about future stock prices are excluded from short-selling to materialize their pessimism. In theory, Miller (1977), Harrsion and Kreps (1978) and Scheinkman and Xiong (2003) suggest the possibility of overvaluation of security prices as investors' beliefs become more dispersed given the short-sale ban. On the other hand, Varian (1985) suggests the possibility of undervaluation for greater divergence of investors' opinions without consideration of short sale ban. Because the price will be adjusted to a fundamental level as such a dispersion in investors' beliefs converge, we will observe negative future returns on Miller's side, and positive future returns on Varian's side. Empirical results on these theoretical predictions are also mixed. Diether, Malloy and Scherbina (2002) state the existence of a negative relationship between future returns and the dispersion of earnings forecasts by analysts. In contrast, Anderson, Ghysels and Juergens (2005) state the existence of a positive relationship between future stock returns and analysts' various forecasts. Garfinkel and Sokobin (2006) find a similar positive relationship between post-earnings announcement returns and the heterogeneity of investors' beliefs. In sum, the relationship between heterogeneous beliefs and future asset returns is unclear: it depends on the status of a short-sale regulation policy.

Another strand of the empirical literature examines the impact of short-sale ban on stock liquidity. Stock liquidity is the ease with which investors can change an asset from a security position to a cash position. The shortage of liquidity means that the investors cannot find a counterpart to trade their assets and increases the risk of a huge capital loss. However, the evidences of the impact of short-sale ban on stock liquidity are mixed. Beber and Pagano (2013) and Boehmer, Jones and Zhang (2013) find some evidences that short sale bans in many markets around the world may have adverse impacts on liquidity during the 2007-09 financial crisis. On the other hand, Jones' (2012) study on the Great Depression in the United States suggests that 1932 requirement on the necessity of a written authorization may reduce liquidity, while 1931 and 1938 requirements on impose upticks rules may increase liquidity. Moreover, the majority of studies in the current literature, focusing on a particular financial crisis period, has not examined whether and how the impact of short sale ban varies over time.

Given the prevalence of short-sale bans and the inconclusive results both in theoretical and empirical literature as a background, this dissertation attempts to empirically examine the impact of short-selling in financial markets and to enhance the understanding on this subject among regulators, investors and academics. This thesis consists of three empirical studies on the short sale ban in Shanghai Stock Market (SSE) and Hong Kong Exchange Market (HKEx). The contributions to the existing literature are three-fold.

First, I verify the theoretical conjecture on the relationship between the heterogeneity of beliefs and future returns under short sale ban, as suggested by Miller's (1977) static model, even in a dynamic environment. I find a negative cross-sectional relationship between these two factors in the Shanghai Security Exchange in which the short-selling had been banned in our sample from January 2001 to December 2009. This return-heterogeneity relationship remains true if I control several stock characteristics such as size, leverage, book-to-market ratio, momentum, illiquidity and idiosyncratic uncertainty, and if I focus on different return quantiles.

Second, I establish that a significantly negative return-heterogeneity relationship for the unshortable stocks turns to be insignificant once the short-sale ban is lifted. I achieve this result by examining the changing status of stocks regarding the short-sale restrictions in HKEx. To my best knowledge, this is the first study to discover the dynamic change of such a relationship according to the change in shortability of stocks.

Third, I find that short-sale ban has a positive effect on liquidity during non-crisis period, while such an effect disappears during financial crisis period. According to the regulations on short-sale ban in HKEx, liquidity is one of two main criteria for selecting stocks to be shortable. To avoid endogeneity problem due to such an interaction between liquidity and shortability of stocks as a policy outcome, I employ the propensity score matching with replacement to form pairs of stocks with similar characteristics but different status of shortabilty. I find a supportive effect of ban on liquidity in a regular time and a significant reverse during 2007-2009 financial crisis. The results remain true if I change the measure of liquidity and if I use the matching without replacement. My results complement the recent investigations on the urgent short-sale ban amid the financial crisis from 2007 to 2009, as investigated by, e.g., Beber and Pagano (2013) and Boehmer, Jones and Zhang (2013).

The rest of this thesis is organized as follows. Chapter 2 uses data from the SSE to examine the relationship between heterogeneity of investors' beliefs and future returns under the strict short-sale ban in the mainland Chinese market. Chapter 3 switches the focus to data from HKEx to investigate the change of shortablities of stocks and its impact on the above mentioned relationship. This chapter provide Chapter 4 also analyzes stocks with changing shortablities from HKEx, however, pays more attention on the impact of short-sale ban on stock liquidity. Chapter 5 wraps up the findings of the empirical analyses from Chapter 2 to 4 and discusses the policy implications and future studies.

Chapter 2

Heterogeneous Beliefs, Short-Sale Ban, and the Cross Section of Stock Returns: Evidence from Shanghai

2.1 Introduction

The class of factor-based models for the relationship between risk and return, such as the one-factor capital asset pricing model (CAPM) and its multi-factor modifications including Fama and French (1993), is often accompanied by the assumption that different investors form their beliefs about the distribution of future payoffs on an asset in a homogeneous fashion. This counterintuitive assumption implies that all investors reach an identical estimate of the expected return and therefore draw the same conclusion about the fundamental value of stocks using a discounted present value formula. Even if the flow of public information is equally available to all investors, they may estimate future profitability of a company in various ways on the basis of different rules of updating their beliefs, different accessibility to private information, and different behavioral characteristics uncovered recently, as summarized in Hong and Stein (2007). Fama and French (2007) analyze the impact of disagreement among investors on the discrepancy between the market portfolio and the tangency portfolio, which is null in the classical CAPM given a common agreement among investors. In sum, heterogeneous beliefs may have an important impact on models for the risk-return relationship. More interestingly, the direction and magnitude of such an impact can be different in the face of additional complications. Among them, we focus on a short-sale constraint.

The short-sale constraint is an important example of departure from the frictionless market. Several authors have investigated its influence on the relationship between heterogeneous beliefs and asset returns on the basis of security-market equilibrium models. In theory, Miller (1977), Harrsion and Kreps (1978) and Scheinkman and Xiong (2003) suggest the possibility of overvaluation of security prices as investors' beliefs become more dispersed. On the other hand, Varian (1985) treats the heterogeneity of beliefs as a source of risk and derives the possibility of undervaluation for greater divergence of investors' opinions. If prices are dynamically adjusted to their fundamental levels subsequently as the disagreement of investors' opinions converge, these two strands of literature imply the opposite relationship between the heterogeneity of investors' beliefs and future returns: negative on the Miller's side, and positive on the Varian's side. In sum, the theoretical impact of heterogeneous beliefs on asset returns is mixed: it depends on the tightness and coverage of a short-sale constraint. The theoretical inconclusiveness of the effect of a short-sale constraint poses a real danger in terms of regulatory objectives and should be complemented by robust empirical analyses, especially given the recent interest in banning the naked short-selling of credit default swaps in the European market.[1]

Unfortunately, the empirical results are also mixed. Relying on a theoretical argument by Miller (1977), Diether, Malloy and Scherbina (2002) state the existence of a negative relationship between future stock returns and the dispersion of earnings forecasts by analysts. In contrast, Anderson, Ghysels and Juergens (2005) state the existence of a positive relationship between future stock returns and analysts' various forecasts. Garfinkel and Sokobin (2006) also find a similar positive relationship between sixty-day drift of post-earnings announcement returns and the "unexplained volume" as a proxy for the heterogeneity of investors' beliefs. Buraschi, Trojani and Vedolin (2013) suggest a more complex interaction of the dispersion of analysts' forecasts, future returns and leverage ratios. In sum, the aforementioned empirical studies show mutually incompatible results in terms of the relationship between heterogeneous beliefs and stock returns. Moreover, they typically rely on data from markets in the United States without tight regulatory constraints on short-selling. Therefore, the empirical relationship between heterogeneous beliefs and stock returns under a short-sale ban has yet to reach any conclusion.

[1] `http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/ecofin/128081.pdf`, retrieved as of April 1, 2014.

We attempt to confirm any relationship in a clear fashion by combining two empirical strategies. First, we define a serially demeaned, market-adjusted transaction volume per share outstanding (turnover) as a proxy for the dispersion of opinions. This is what is referred to as "unexplained volume" by Garfinkel and Sokobin (2006). Such a demeaned volume-based measure has three advantages over the forecast-based measures: (i) it is informative about the fresh disagreements of investors' private opinions, (ii) it is available regardless of size or representativeness of stocks, and (iii) it is relatively free of analyst-related selection bias. Second, we focus on the Shanghai Stock Exchange (SSE). Data from the SSE provide us a rare opportunity to test the Miller effect because (i) the SSE regulation had prohibited short-selling in our sample period, (ii) a decade-long ban would induce general investors to take the impossibility of short-selling for granted, and (iii) the stringent short-selling ban allows us to use several liquidity-related variables as such, rather than as proxies for the short-sale constraint.

The contributions of this study are three-fold. First, we find a negative cross-sectional relationship between heterogeneous beliefs and future stock returns. The evidence is robust to controlling for several stock characteristics such as size, leverage, book-to-market ratio, momentum, and different quantiles of the distribution of returns. In particular, we verify the Miller's hypothesis on small shares in the SSE, which have been overlooked so far. Second, our finding is robust to the projection of unexplained volume on the measures of illiquidity and idiosyncratic uncertainty. Although the negative relationship between turnover and future returns is often attributed to these factors, the residual from this projection, treated as a new proxy, still produces a result that is similar to the original result. Third, we confirm that the Miller's overvaluation hypothesis holds even under a decade-long short-selling ban. It complements the recent investigations on the urgent short-sale ban amid the financial crisis from 2007 to 2009, as investigated by, e.g., Beber and Pagano (2013).

2.2 Literature Review

2.2.1 Negative Relationship between Dispersion and Returns

Miller's (1977) *overvaluation* hypothesis claims that a short sale constraint together with the investors' dispersed beliefs about the payoff distribution elevates a security's price relative to the price in a market without such characteristics because the institutional restriction on taking a short position may prevent informed pessimists from pulling the market price downward. However, the elevated price will eventually revert to a fundamental level associated with the present value formula as the investors' opinions converge. Therefore, we will observe a positive return initially and negative returns subsequently. Let us call this dynamic behavior of returns as the "Miller effect". Although Miller's model about overvaluation is static in nature, dynamic models such as Harrison and Kreps (1978), Scheinkman and Xiong (2003) and Hong, Scheinkman, and Xiong (2006) share similar results with Miller, thereby making the relationship between the heterogeneity of investor beliefs and future equity returns as negative. In addition to these partial equilibrium models, DeTemple and Murthy (1997) propose a general equilibrium model of a security market populated by investors with the logarithmic preference. Each investor maximizes her/his lifetime utility from a future consumption stream in the presence of a portfolio constraint including a short-sale constraint. In their model, the equilibrium stock price is at a premium with respect to the expected present value of a stream of future dividends. Because such a discounted present value prevails as an equilibrium stock price if investors have common beliefs, their result formally expresses the initial elevation of stock price induced by greater dispersion of investors' beliefs under a short-sale constraint. Nevertheless, their theoretical result is not satisfactory because of the restrictive logarithmic preference of investors.

Duffie, Gârleanu and Pedersen (2002) emphasize the necessity and difficulty of locating a lendable security which leads to the initial elevation and decline afterward of the price so that such a short-sale restriction induces a negative future return, especially after the initial public offering (IPO). Since it is impossible to take a short position before an IPO and cumbersome to do so immediately after its issue, IPO data provide a rare opportunity to test the relationship between the heterogeneity of beliefs and stock returns under a short-sale constraint. Using IPO data from the Securities Data Company Platinum New Issues database, Chemmanur and Krishnan (2012) find a result consistent with the Miller's overvaluation hypothesis.

Lee and Swaminathan (2000) discover that a lower return follows a higher turnover. When this discovery is combined with several types of the volume-generating mechanism as surveyed by Hong and Stein (2007), their result suggests a negative return-heterogeneity relationship. Based on a dataset in the United States from 1983 to 2000, Diether et al. (2002) find a negative relationship between future returns and the dispersion of analysts' forecasts as a proxy for the heterogeneity of investor beliefs. Moreover, they state that the negative relationship is more pronounced for firms with larger market capitalizations, higher book-to-market ratios, and lower momentum. Goetzmann and Massa (2005) find a negative relationship based on a measure of the belief dispersion constructed from panel data of investors' accounts in the United States.

2.2.2 Positive or Null Relationship between Dispersion and Returns

In contrast to Miller (1977), Varian (1985) predicts the *undervaluation* of a risky asset given greater disagreement of beliefs of sufficiently risk-averse investors, e.g., having the coefficient of relative risk aversion greater than one.[2] Then, the stock price will be gradually elevated and positive returns will be observed as the dispersion of beliefs will shrink subsequently. However, his model lacks a short-sale restriction. It is unclear if we can apply his prediction to the analysis of stock returns under a short-sale restriction for our sample period.

Doukas, Kim and Pantzalis (2006) argue that the forecast dispersion is positively related to stock returns if we control for the common uncertainty in the analysts' earnings forecasts. They attribute the negative dispersion-return relationship found

[2]Varian (1985, Fact 2, 3 and 4) imply that we may observe a negative or null response of the stock price if the coefficient of relative risk aversion, $\gamma > 0$, is less than or equal to one. However, Bliss and Panigirtzoglou (2004, Table III) find the option-based estimates of γ from 3 to 5 with the t-values greater than 1.645 for $H_0 : \gamma = 1$ against $H_1 : \gamma > 1$. Using international data including China from 1890 to 2008, Barro and Jin (2011, Figure 8) find the disaster-based estimates of γ around 3 with the left-end points of the 95% confidence intervals greater than 2.

in Diether et al. (2002) to the uncertainty effect, instead of opinion disagreement, and report that the returns associated with earnings announcement increase as ex-ante opinions among analysts become more dispersed. Anderson et al. (2005, (19) and Table 3) separate the dispersion of analysts' forecasts into the short-term and long-term components. They demonstrate that lagged values of both measures are positive risk factors of excess returns of the value-weighted portfolios of S&P 500 companies by using the Fama and French's (1993) time-series regression. Garfinkel and Sokobin (2006) establish a positive relationship between the unexplained volume and the sixty-day drift of post-earning-announcement returns. Note that all of these empirical studies in favor of the positive return-dispersion relationship are based on data in the United States without regulatory restrictions on short-selling during their sample periods. Buraschi, Trojani and Vedolin (2013) suggest that the disagreement among analysts may have a negative (positive) impact on the average stock returns of less (more) leveraged firms. Finally, Diamond and Verrecchia (1987) construct a rational expectation model of the competitive and risk-neutral market makers, informed traders and uninformed traders. The model predicts that the short-sale prohibition affects the speed of adjustment of security prices, especially to bad news, but not their equilibrium levels. However, the lack of established market makers for stock trading in the SSE may invalidate the direct application of their theoretical prediction to our environment.[3]

[3] The SSE has admitted market makers in block trading of bonds from 2006, but not in trading of stocks. For details of the former, visit `http://english.sse.com.cn/tradmembership/trading/rules/c/en_sserule20060515.pdf`, retrieved as of April 1, 2014.

In sum, a theoretical impact of the heterogeneity of beliefs on average returns given the short-sale restriction has not been determined in a convincing way. Not all theoretical models employ any short-sale restrictions. We need a care to interpret earlier empirical results because of the multiplicity of proxies for the heterogeneity of beliefs and potential slackness of the short sale restriction in the market.

2.2.3 Stock Price Premia in mainland China

Wang and Jiang (2004) study the price premia of stocks dually listed in A-shares that are traded exclusively in mainland China, relative to H-shares that are available to Hong Kong and institutional investors. They attribute the existence of price premia to the difference of volume per share outstanding, as a measure of liquidity, between mainland Chinese markets and the Hong Kong market. However, they do not consider the effect of short-sale restrictions in their sample. Fang and Jiang (2013) consider turnover as a measure of the investor disagreement as we do. They combine turnover with short-sale restrictions in mainland Chinese markets to verify the existence of the Miller effect. However, they do not control for the liquidity effect that may affect turnover. Moreover, both studies are based on 55 dually listed stocks. Their limited coverage of the whole universe of Chinese traded stocks and a potential problem of selection bias, to be discussed in Section 2.3.1, make it non-trivial to interpret their results in favor of the Miller effect.

2.3 Data and Methodology

2.3.1 Proxy for the heterogeneity of beliefs

There are two representative approaches to measure the heterogeneity of investor beliefs: the forecast-based approach and the volume-based approach. The former is based on some variants of the dispersion of reported earnings forecasts by analysts, whereas the latter is based on the trading volume of stocks. See Garfinkel (2009, Footnote 2) for the list of representative works in these two categories. We consider that the following three conditions are important for the dispersion of analysts' forecasts to be a valid proxy for investors' beliefs:

(a) Analysts express their unbiased opinions in their earnings forecasts.

(b) Investors' opinions follow analysts' opinions.

(c) Analysts cover a wide variety of stocks.

However, these conditions may not be valid in reality. Regarding (a), several studies concern the selection bias in analysts' reports. McNichols and O'Brein (1997) argue that analysts are reluctant to issue unfavorable investment information because they fear losing potential investment business, trading commissions, and their access to management as a source of information. Moreover, they suggest that a typical reaction to these disincentives for issuing unfavorable information is to select a few favorable stocks rather than to issue upwardly biased reports in general. Regarding (b), the dispersion of analysts' opinions may not represent that of investors whose opinions may be formed by specific private information or valuation methods, as is consistent with the state of "heterogeneous priors" in Hong and Stein (2007). Thus, any proxy for the heterogeneity of *investors*' beliefs based on the variation of *analysts*' earnings forecasts may be misleading. Regarding (c), Boehme, Danielsen and Sorescu (2006) emphasize that the forecast-based measure requires multiple analysts to pursue a particular company. Such a company is usually large and considered to be industry representative. In addition, if firm size is negatively correlated with heterogeneity of investors' beliefs, as we will see later in our sample, the analysts' earnings forecasts may suggest a downwadly biased effect of belief dispersion on stock returns across different size quantiles. Consequently, any reported effect of the dispersion of opinions may be an attenuated version of the true effect with a bias toward zero, especially for smaller companies.

These drawbacks of the forecast-based approach motivate us to use a volume-based approach. Following Garfinkel and Sokobin (2006) and Garfinkel (2009), we construct a measure of the heterogeneity of beliefs based on serially demeaned, market-adjusted volume per share outstanding. More concretely, let $V_{i,t}$ be the raw transaction volume and $S_{i,t}$ be the total share outstanding for the stock i on day t. $i = m$ represents any variables for the market portfolio. For instance, $V_{m,t}$ is the market volume defined by the weighted average of individual volume where each weight is given by the market capitalization for that stock divided by the total market capitalization on day t.[4] $t = T$ is assigned to any monthly variables in the month-T. The day-t unadjusted turnover for the stock-i and for the market m are given by $V_{i,t}/S_{i,t}$ and $V_{m,t}/S_{m,t}$, respectively. Their difference, i.e., the daily excess turnover,

[4]The series of market volume is also retrieved from the China Resset database. It is constructed based on all traded shares in mainland China.

is further adjusted by subtracting its average from 54 to 5 days ago in the rolling-window of 50-day size, resulting in the daily turnover for stock-i, $TO_{i,t}$. We refer to this procedure as "serial demeaning", and it accounts for the "unexplained volume" for $TO_{i,t}$ by Garfinkel and Sokobin (2006); namely, the variation unexplained by the time-series average of the daily market-adjusted volume per shares outstanding. Finally, the average of $TO_{i,t}$ at day $t = 1, \ldots, n_T$ within month-T defines our measure of the monthly turnover, $TURN_{i,T}$. They are summarized as follows:

$$TO_{i,t} := \left(\frac{V_{i,t}}{S_{i,t}} - \frac{V_{m,t}}{S_{m,t}} \right) - \frac{1}{50} \sum_{s=t-54}^{t-5} \left(\frac{V_{i,s}}{S_{i,s}} - \frac{V_{m,s}}{S_{m,s}} \right), \quad TURN_{i,T} := \frac{1}{n_T} \sum_{t=1}^{n_T} TO_{i,t}. \tag{2.1}$$

Let us make several remarks. First, the definition of $TO_{i,t}$ as the individual turnover in excess of the market counterpart allows us to control the economy-wide news effect. Second, the serial demeaning in our daily turnover reflects the current rather than persistent disagreements prior to each day. The distinction between persistent disagreements and fresh disagreements is important because Hong and Stein (2007) emphasize that trade occurs between any two investors whenever the more optimistic investor switches to being the more pessimistic investor of the two, hence generating a non-zero return. The serial demeaning allows us to control the asset-specific liquidity effect, too. Third, our daily measure is calculated for all days in our sample period rather than for special days, such as the days of earnings announcements as seen in Garfinkel and Sokobin (2006). The serial demeaning partially alleviates a possible time-varying momentum effect of the trading volume, too. Fourth, Garfinkel (2009) suggests that the unexplained volume in Garfinkel and

Sokobin (2006) is positively correlated with his new measure of the dispersion of investors' private opinions, which is based on proprietary data of limit and market orders. In contrast, the variability of analysts' forecasts does not correlate with his new measure if the companies are small or when earnings are announced. Fifth, D'Avolio (2002) and Ali and Trombley (2006) construct a proxy for the tightness of a short-sale constraint based on several variables, including turnover, from data in the United States. They treat turnover as a measure of the short-sale restriction and interpret the greater turnover as a tightening of such a constraint. However, our sample is under the strict short-sale ban, yet we still observe the variations of turnover and their varying impacts on portfolio returns. Therefore, turnover should reflect something different from an indirect effect of short-sale restriction. Sixth, in contrast to forecast-based proxies, our volume-based proxy can be constructed widely and relatively free of size or representativeness of companies in the sample, or of analysts-related selection bias. Finally, one should also notice that this volume-based proxy only provides a lower bound for the heterogeneity of investors' beliefs under short-sale ban. Short-sale ban constrains pessimistic investors to sell short, therefore those investors tend to sell their current holdings and leave the market. For pessimistic investors without any holdings in their hands, their opinions cannot be observed from the trading records.

2.3.2 Data Descriptions

Our daily data cover the period from January 1, 2001 to December 31, 2009, and include all A-share stocks on the SSE. A-shares are denominated in the Chinese

Yuan. After filtering unqualified stocks, the final sample comprises 743 stocks. The number of stocks in our sample differs from one day to another, owing to the lack of any daily trades. We match their daily and monthly transaction data with the corresponding accounting data from the audited financial reports. All Chinese data are collected using the China Resset database.[5]

The upper panel in Figure 2.1 depicts two histograms of the log-transformed market capitalizations of 698 total shares in our sample on December 31, 2009, and of 53 dually listed shares included in the sample of Wang and Jiang (2004) and Fang and Jiang (2013). The comparison of two histograms reveals that these earlier studies on China cover a small number of large companies. Moreover, the majority of ten largest shareholders of twenty largest companies in our sample are state-owned companies, as shown in Table 2.1. Note that many large Chinese companies are under the strong influence of the government through the ownership by state-owned companies (see, e.g., Chen et al. 2009). In contrast, our sample comprises more observations of smaller shares which may be less influenced by the government. In addition to a general contribution to the effect of heterogeneous beliefs on stock returns under the short-sale restriction, subsequent results will shed new light on the returns of smaller Chinese shares overlooked so far.

[5] Visit `http://www.resset.cn/en/`, retrieved as of April, 2014.

Table 2.1: 20 Largest Companies in Market Caps and Profiles of Shareholdings

Code	Industry	Business	Top 10	State
600000	Finance	banking	41.1	67.4
600005	Industry	black metal processing	69.0	93.8
600009	Public utilities	transportation	63.2	84.2
600015	Finance	banking	59.8	43.3
600018	Public utilities	transportation	90.5	48.9
600019	Industry	black metal processing	77.3	95.7
600031	Industry	transportation equip. manufact.	66.7	91.1
600048	Real estate	real estate	56.4	82.1
600089	Industry	machinary	34.6	0.0
600104	Industry	transportation equip. manufact.	87.7	90.0
600348	Industry	coal mining and Processing	65.9	88.6
600519	Industry	beverage manufacturing	70.5	92.2
600739	Commercial	commercial brokerage-agencies	29.4	43.2
600837	Finance	securities	43.9	72.9
600900	Industry	electric steam hot water prod.	74.8	90.9
601001	Public utilities	coal mining and processing	69.8	86.6
601006	Public utilities	railway transportation	78.4	90.1
601166	Finance	banking	49.7	41.9
601169	Finance	banking	45.0	36.4
601699	Public utilities	coal mining and processing	73.9	87.7

All data are as of December 31, 2009. “Industry” and “Business” columns identify the classifications of companies’ types. “Top 10” column displays the total percentages of shareholding by ten largest shareholders. “State” column shows the share percentages of state-owned companies among these top-10 shareholders.

In the bottom panel of Figure 2.1, the histogram of log-transformed market capitalizations of stocks in the New York Stock Exchange, Nasdaq and American Stock Exchange on December 31, 2000, is superimposed on our histogram.[6] We select these markets on this particular day because they are in the last month of data covered by Diether et al. (2002). Note that $(.01, .33, .66, .99)$ quantiles of our sample roughly correspond to $(.44, .62, .75, .97)$ quantiles of that sample in the United States. Note also that .33 and .66 quantiles will separate our small-, medium- and large-size portfolios. Therefore, subsequent results about the medium-to-large-size portfolios in our sample have some implications about the results on the large-size portfolios in Diether et al. (2002) using forecast-based proxy of the dispersion in the market without a tight short-sale constraint, unless any omitted variables may have serious impacts on returns.

2.3.3 Research Hypothesis

Note that a few representative studies in favor of a positive return-heterogeneity relationship, such as Doukas et al. (2005) and Garfinkel and Sokobin (2006), rely on data about the New York Stock Exchange and American Stock Exchange in the U.S. Center for Research in Security Prices (CRSP) datafiles. D'Avolio (2002) empirically documents that most stocks in the CRSP files can be sold short and that hard-to-borrow stocks are mostly illiquid and can account for only 16% of all stocks and .6% of the total market value. Therefore, it is not obvious if these results defy the negative

[6] We retrieve data from Thomson Datastream based on the company lists for these markets. The lists are available at `http://www.nasdaq.com/screening/company-list.aspx`. We eliminate one outlier with extremely small market capitalization.

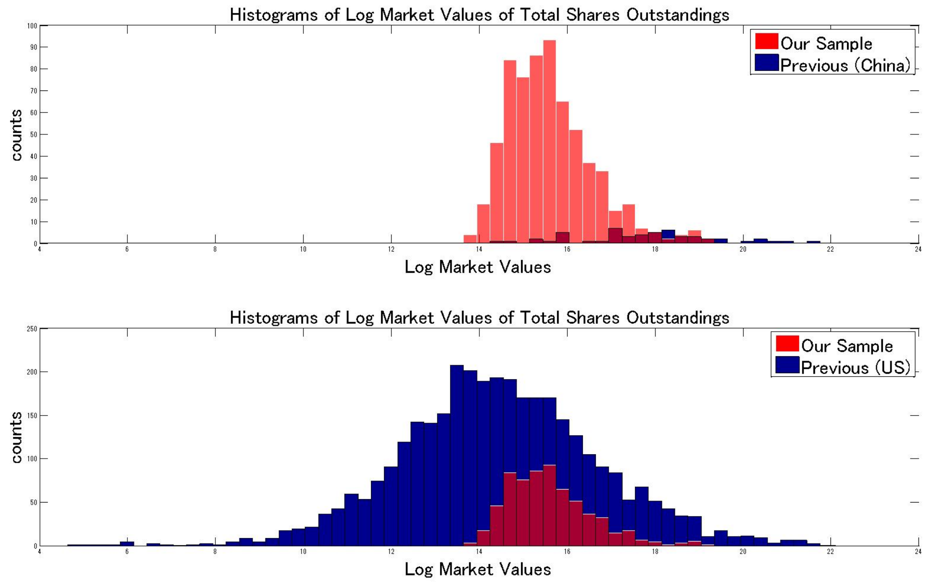

Figure 2.1: Histograms of the Log-transformed Market Capitalizations
our sample of 698 shares (red, in both panels) on December 31, 2009, the sample of Wang and Jiang (2004) and Fang and Jiang (2013) of 53 dually listed shares (blue, in the upper panel), and a sample of 3440 stocks from NYSE, NASDAQ and AMEX on December 31, 2000 (blue, in the bottom panel). The total shares comprise traded and non-traded shares, and are converted to and denominated in 1000 Chinese Yuan before the log transformation.

return-heterogeneity relationship because a strict short-sale constraint in conjunction with the heterogeneous beliefs may be necessary, as Boehme et al. (2006) emphasize. In contrast, the short selling was prohibited in the security markets across mainland China, including the SSE, from the early 1990s until March 2010. If Miller's (1977) prediction is correct, the stocks traded on the SSE may have been overpriced when investors disagreed with their fundamental values because pessimistic opinions might not have been incorporated in the price level, but might have been adjusted toward a fundamental value, generating a subsequent negative return. Let us pose the null and alternative hypotheses as follows:

H_0 : Greater belief dispersion has *no* effect on future stock returns in the SSE.

Therefore, if the null hypothesis, transformed into a statistically testable form, is rejected at an appropriate significance level, it supports Miller's conjecture.[7] We conduct a regression-based test and a portfolio-based test of the null hypothesis.

2.3.4 A Regression-based Test

The first approach relies on the time-series aggregation of cross-sectional regressions à la Fama and MacBeth (1973), as used by Moskowitz and Grinblatt (1999, Table VI) and Diether et al. (2002, Table VII and Table IX).[8] The first step amounts to running the cross-sectional regression of monthly returns on the lags of unexplained volume and several other covariates in each month T:

$$RET_{i,T} = \alpha_T + \beta_1 \cdot TURN_{i,T-1} + \beta_2 \cdot ILQ_{i,T-1} + \beta_3 \cdot IV_{i,T-1}$$
$$+\beta_4 \cdot UMD_{i,T-1} + \beta_5 \cdot ln(M_{i,T-1}) + \beta_6 \cdot ln((B/M)_{i,T-1}) + \beta_7 \cdot BETA_{i,T-1} + \epsilon_{i,T} \quad (2.2)$$

where the dependent variable $RET_{i,T}$ is the buy-and-hold return of stock i in month T (i.e., keeping the composition of stocks from the end of month $T-1$ to the end of month T), and the main dependent variable is the monthly unexplained volume, $TURN$, as defined in (2.1).

[7] All t-values under this simple null hypothesis will be consistent with Miller's conjecture. Alternatively, we can specify a composite null hypothesis such that greater dispersion of beliefs has a non-negative effect on stock returns in the SSE. The investigation of this case is left for a later research.

[8] We exploit the `xtfmb` command and its options in Stata. The Fama-Macbeth method is supposed to mitigate the measurement error problem in the generated regressors. In our context, it is particularly useful because the unexplained turnover is a proxy for the heterogeneity of beliefs.

The second step corresponds to assessing the time-series average of cross-sectional estimates in the first-step. If we abuse β's for the outcome of this aggregation in the second step, the previous null and alternative hypotheses are now reformulated as

$$H_0 : \beta_1 = 0, \quad H_1 : \beta_1 < 0. \tag{2.3}$$

We now consider the six additional covariates in the right-hand-side of (2.2).

$ILQ_{i,T-1}$

Amihud (2002, p.35) interprets turnover as a proxy for liquidity demand and suggests that illiquidity results in positive returns because the inability to trade sufficiently large amounts of stocks quickly should be considered as a risk factor, thereby owners are compensated. In that case, a negative relationship between turnover and future returns may be generated by higher liquidity demand and lead to a lower risk premium independent of heterogeneous beliefs and short-sale constraints. Although serial demeaning may partially account for the past momentum that may be driven by such liquidity trading (Garfinkel 2009, Section 3.1), we are now concerned with a contemporaneous liquidity effect. To control for this effect, we construct a measure of illiquidity à la Amihud (2002) as the scaled monthly average ratio of the daily absolute return to the trading colume on that day, given by

$$ILQ_{i,T} = \frac{1}{n_T} \sum_{t=1}^{n_T} \frac{|RET_{i,t}|}{V_{i,t}} \cdot 10^6.$$

Because the scale of $|RET_{i,t}|/V_{i,t}$ tends to be very small, we multiply it by 10^6 as Amihud (2002) does. It causes no changes in the subsequent statistical inference on slope coefficients based on t-values. The lagged value of ILQ is included in the right-hand side of (2.2) to control for the effect of illiquidity in $TURN_{i,T-1}$.

$IV_{i,T-1}$

Barinov (2013) suggests the view of turnover as a measure of firm-specific uncertainty rather than liquidity.[9] Therefore, we need to find a measure of the idiosyncratic volatility (IV) to isolate the dispersion of investors' opinions from turnover. Following Ang, Hodrick, Xing and Zhang (2006, Equation 8), we run an auxiliary regression and define IV as follows:

$$r_{i,t} = \hat{\gamma}_{i,0} + \hat{\gamma}_{i,1} MKT_t + \hat{\gamma}_{i,2} SMB_t + \hat{\gamma}_{i,3} HML_t + \hat{u}_{i,t}, \quad IV_{i,T} := \left(\frac{1}{n_T} \sum_{t=1}^{n_T} \hat{u}_{i,t}^2 \right)^{1/2} \tag{2.4}$$

where $r_{i,t} := RET_{i,t} - RET_{m,t}$ is the excess return of stock i on day t, which is regressed on the market (MKT) portfolio return factor, the small-market minus big-market (SML) capitalization factor, and the high minus low (HML) book-to-market factor, according to Fama and French (1993). $\hat{\gamma}_i$'s are the OLS estimates of regression coefficients and $\hat{u}_{i,t}$ is the OLS residual. The sample standard deviation of $\hat{u}_{i,t}$ defines $IV_{i,T}$ as the idiosyncratic volatility of the return of stock i in month T. Similar to ILQ, the lagged value of IV is included in the right-hand side of (2.2).

[9] Barinov (2013) and Buraschi et al. (2013) control the aggregate uncertainty by VIX. Unfortunately, the Chicago Board Options Exchange started assessing a similar index for China from March 16, 2011, which is beyond our sample.

CAPM-Fama-French-Carhart Factors

We also add several other covariates which have been effective in explaining the returns in previous empirical studies based on several multi-factor models. UMD_{T-1} is the momentum factor proposed by Jegadeesh and Titman (1993); that is, the average monthly return from months $T-12$ to $T-2$ to control for the past momentum of returns. Companies with large (small) momentum factors are frequently called "winners" (losers). M_{T-1} is the market capitalization in the previous month to control for the size effect. $(B/M)_{i,T-1}$ is the book-to-market ratio, which is defined as the book value of stockholder equity plus balance sheet deferred taxes divided by market capitalization at the end of the previous month. $BETA_{i,T-1}$ is the CAPM beta - the factor loading obtained by regressing individual returns on market returns for months $T-25$ to $T-2$.

2.3.5 A Portfolio-based Test

The second approach comprises four steps. (i) Sorting all stocks into several categories with respect to turnover as the proxy for the belief dispersion, size and other characteristics such as leverage, book-to-market ratio and momentum in the previous month. (ii) Constructing an equally weighted portfolio for each category and assessing its monthly buy-and-hold returns. (iii) Assessing the difference of the average returns of stock portfolios given a low and high level of belief dispersion (henceforth, "low-high return differentials" or just "return differentials") for each set of other sorting variables. (iv) Testing the null and alternative hypotheses for such portfolio, reformulated as

$$H_0 : \text{the return differential} = 0, \quad H_1 : \text{the return differential} > 0. \tag{2.5}$$

For this purpose, we will perform a t-test of whether the average returns of the low-dispersion and high-dispersion portfolios are generated from two Gaussian distributions with unknown and perhaps different variances with the same mean under the null hypothesis[10]. Sorting in (i) is implemented as follows: we calculate .33 and .66 empirical quantiles of market capitalizations of all stocks to define three sizes such as small, medium and large. For stocks in a particular size category, we further compute .33 and .66 empirical quantiles of turnover to define three levels of the dispersion of beliefs such as low, medium and high, thereby creating 9 categories. Each category comprises approximately equal number of stocks. If we have another sorting variable, we repeat this procedure for stocks in each of 9 categories, thereby creating 27 categories. For the portfolio analyses, we will use several covariates in the regression analysis as well as the leverage ratio. The leverage ratio is defined as the percentage ratio of the total debt to the total asset. We obtained our sample of liabilities and assets of firms from their accounting reports. Although these reports are not available every month, we will use the latest updates so that the information sets of all investors contain the leverage ratios.

[10]We rely on the `ttest2` with the option for the one-tailed test and unequal variances in the Matlab R-2012 Statistical Toolbox.

2.4 Results and Discussions

2.4.1 Results for the Regression-based Test

The second to fifth columns in Table 2.2 report a few summary statistics of variables in our regression analysis. The remaining columns summarize the time-series averages of the cross-sectional OLS estimates of the coefficients in (2.2). Model-IV contains the complete set of regressors, whereas Model-I, -II and -III omit the ILQ, IV and $BETA$, respectively, to see if uncontrolling for each of them may have any impact on the estimated coefficient of $TURN$. Numbers in parentheses are t-values based on heteroskedasticity and autocorrelation-consistent (HAC) standard errors à la Newey and West (1987) given the bandwidth of 10. $Adj.R^2$ is the coefficient of determination with the degree-of-freedom adjustment.

The estimated coefficients of ILQ are large and significantly positive, as is consistent with the illiquidity risk premia in stock returns as Amihud (2002) confirm. The coefficient of $BETA$ in Model-IV is marginally significant at the 10% level and therefore it has a weak but non-negligible explanatory power for returns. This may be in contrast to uniform insignificance of the market beta, reported by Fama and French (1992, Section II.B and IV.C). Unlike ILQ and IV, the inclusion of $BETA$ substantially improves the adjusted R^2 in Model-IV relative to Model-III. Moreover, the coefficient of $\ln(B/M)$ becomes smaller and less significant in Model IV than in Model III, perhaps because the CAPM beta captures some risk that are correlated with the other factors included in the regression.

Nevertheless, these covariates have no essential impacts on the coefficient of $TURN$, $\hat{\beta}_1$, which is significantly negative in all models. This is consistent with the Miller effect. The negativity of the estimated coefficients of IV suggest the importance of controling for IV in testing the Miller effect: otherwise, $TURN$ would be more responsible for the negative relationship with returns and over-estimate such an effect, as is suggested in the result from Model-II omitting IV. The significant negativity of the estimated coefficient of $TURN$ in Model-IV suggests that $TURN$ captures something different from the effect of idiosyncratic uncertainty. Therefore, this regression analysis suggests that the unexplained turnover can reveal a negative relationship between the heterogeneity of beliefs and returns on average. When compared with Wang and Lee (2004, Table 4) and Fang and Jiang (2013, Table IV), the estimated coefficients of our turnover variable are smaller by two digits. Such a discrepancy may be generated because (i) our sample covers more shares of smaller sizes, and (ii) our regression controls more confounding factors, especially the illiquidity and idiosyncratic volatility, than these earlier studies on China.

2.4.2 Portfolios Sorted by Size and Belief Dispersion

Let us discuss the outcomes of portfolio analyses. Although $TURN$ has a significantly negative but small impact on average returns in the regression analysis, it will turn out to be very informative in sorting portfolios.

The first case includes 9 portfolios of stocks sorted by size and unexplained turnover in the previous month. The average monthly returns of these portfolios are summarized in Table 2.3. It shows a negative relationship between turnover and

Table 2.2: Summary Statistics and Coefficient Estimates

Variables	Mean	Std	Min	Max	I	II	III	IV
RET	0.02	0.16	-0.76	1.89				
TURN	0.05	1.16	-8.80	17.68	-0.003^a	-0.005^a	-0.003^a	-0.003^a
					(-4.42)	(-7.22)	(-3.86)	(-4.01)
ILQ	0.00	0.04	0.00	6.13		1.080^a	1.131^a	1.017^a
						(3.62)	(3.13)	(3.41)
IV	0.19	0.02	0.00	3.25	-0.648^a		-0.538^a	-0.616^a
					(-6.56)		(-5.55)	(-6.24)
BETA	1.08	0.38	-2.16	10.77	0.020	0.019		0.020^c
					(1.65)	(1.60)		(1.66)
UMD	0.02	0.06	-0.16	0.97	0.037	0.025	0.071	0.041
					(0.58)	(0.36)	(1.40)	(0.64)
$ln(M)$	20.88	1.05	17.46	26.10	-0.001	0.001	-0.001	0.000
					(-0.64)	(0.30)	(-0.56)	(0.12)
$ln(B/M)$	-0.29	0.81	-9.04	2.92	0.003^b	0.005^a	0.005^a	0.003^b
					(2.00)	(4.07)	(3.98)	(2.61)
Const.					0.038	-0.011	0.050	0.005
					(0.81)	(-0.26)	(1.00)	(0.10)
$Adj.R^2$					15.13	15.10	9.64	15.95

Mean, Std, Min and Max columns display means, standard deviations, minimum and maximum over the whole sample of stocks and months. $Adj.R^2$ and the summary statistics of *RET* and *TURN* are in percentages. Numbers in parentheses are t-values based on HAC standard errors. ^{a}, ^{b}, ^{c} on estimates show statistical significance at 1%, 5% and 10% significance levels, respectively, according to two-tailed t-tests.

returns for each size category. The low-high return differentials are significantly positive for all portfolios sorted by size, even at the 1% significance level. This is in sharp contrast to Diether et al. (2002, Table II), who document significantly positive return differentials only for smaller-sized portfolios. Recall our discussion in Section 2.3.2 that Diether et al's large-size portfolios roughly correspond to our medium-to-large-size portfolios. Although many other factors remain to be uncontrolled, such a stark difference for these portfolios of similar sizes may be partly generated by different proxies for the belief dispersion and different tightness of the short-sale constraints in two samples.

Table 2.3: Mean Portfolio Returns by Size and Dispersion

	Size			
Dispersion	Small Cap	Mid Cap	Large Cap	All
Low	2.64	2.33	1.86	2.27
Medium	2.57	2.03	1.65	2.08
High	1.12	0.84	1.09	1.02
Low-High	1.52^a	1.49^a	0.77^a	1.25^a
	(5.49)	(5.63)	(2.98)	(8.16)

^{a} on estimates shows the statistical significance at 1% level. Numbers in parentheses are t-values for the low-high comparison under H_0 in (2.5).

The economic explanations of size effect in average stock returns remain controversial in the literature. However, Table 2.1 suggests that large-size portfolios in our sample may correspond to companies closely affiliated with the government. If the government implemented couter-cyclical stimulus policies by letting such companies invest more, their profitability would also be counter-cyclical. Because the consumption-CAPM suggests that such companies are good hedge for the aggregate consumption risk, their returns should be lower by the risk-return tradeoff. This is consistent with Chan, Chen and Hsieh (1985) and Chan and Chen (1991) using data in the United States, and with Xu, Wang and Xin (2013, Table 7) using data in China. If many Chinese investors knew such regularities, they should not form very dispersed opinions about large companies and therefore the low-high return differentials might not be large. The pattern of return differentials in Table 2.3 may be in line with this explanation.

2.4.3 Portfolios Sorted by Size, Leverage and Belief Dispersion

Panel A in Table 2.4 displays the average monthly returns of 27 portfolios triply sorted by size, leverage and belief dispersion. Each category admits three levels. Sorting stocks by leverage ratios is motivated by Buraschi et al. (2013, Section 4.3). We continue to sort stocks by size because the size and leverage ratio may be correlated, as documented by Rajan and Zingales (1995), whereas Buraschi et al. (2013) do not sort stocks by the size factor.

In sum, the leverage ratio does not disturb the negative relationship between the belief dispersion and future returns of small- and medium-sized stocks. Moreover, Panel B indicates the lack of a clear pattern between the average value of $TURN$ and the average return for each portfolio, and the relatively uniform return differentials over the spectrum of leverage ratios. They are consistent with Avramov et al. (2007)

who suggest that it is not the leverage but the credit rating that drives abnormal returns from momentum profits. We will sort the stocks by momentum in Section 2.4.5.

Table 2.4: Mean Portfolio Returns by Size, Leverage, and Dispersion

	Low Leverage			Medium Leverage			High Leverage		
Dispersion	Small Cap	Mid Cap	Large Cap	Small Cap	Mid Cap	Large Cap	Small Cap	Mid Cap	Large Cap
[Panel A]									
Low	2.65	2.63	1.86	3.10	2.21	1.92	2.88	2.66	2.01
Medium	2.49	2.32	1.65	2.62	1.80	1.88	2.73	1.97	1.87
High	1.21	1.16	1.06	1.26	0.80	1.43	1.17	1.05	1.12
Low-High	1.44^a	1.47^a	0.80^b	1.84^a	1.41^a	0.49	1.71^a	1.61^a	0.89^b
	(2.97)	(3.09)	(1.76)	(3.75)	(3.05)	(1.05)	(3.34)	(3.34)	(1.98)
[Panel B]									
Low	-0.89	-0.78	-0.65	-0.88	-0.79	-0.70	-0.91	-0.85	-0.69
Medium	-0.08	-0.04	-0.03	-0.05	-0.03	-0.03	-0.06	-0.04	-0.04
High	1.08	0.99	0.82	1.10	1.04	0.88	1.15	1.08	0.87

^{a} or ^{b} on estimates shows the statistical significance at 1% or 5% level. Numbers in parentheses are t-values for the low-high comparison under H_0 in (2.5). Panel B reports the average values of $TURN$ for each portfolio.

2.4.4 Portfolios Sorted by Size, BM Ratio and Belief Dispersion

Next, let us sort stocks by size, book-to-market (BM) ratio and belief dispersion with three levels in each dimension to obtain 27 portfolios. The average monthly returns of these portfolios are reported in Table 2.5. In this case, size-based sorting is motivated by the empirical regularity that firms with lower book-to-market ratios tend to have higher levels of market capitalization (Diether et al. 2002, Section II.A). Most of the pairings by size and book-to-market ratio suggest that returns and belief dispersion are inversely related. Interestingly, portfolios with *low* BM ratios exhibit larger return differentials than those with *high* BM ratios; that is, $(1.42, 1.65, 0.94) > (1.33, 1.46, 0.77)$. This pattern is opposite to what Diether et al. (2002, Table IV) find: the corresponding numbers are $(0.63, 0.14, 0.02) < (0.80, 0.48, 0.08)$. This discrepancy of patterns between ours and Diether et al.'s may be partly generated by different proxy variables of the heterogeneity of beliefs and/or different tightness of the short-sale constraint. Moreover, the average return of a portfolio for each pair of size and dispersion increases monotonically with the BM ratio, as is consistent with the well-documented value premia, whereas Diether et al. find no such pattern for the high dispersion portfolios. Panel B suggests that the different degrees of the heterogeneity of beliefs generates such a difference. In fact, the average differentials of turnovers for the low-BM portfolios are *greater* than those for the high-BM portfolios, as is opposite to what is found by Diether et al. (2002, "Mean Dispersion" panel in Table IV).

Recently, Gârleanu et al. (2013) propose an innovation-based explanation of the value premium. Innovation in product variety can be viewed as a risk factor, called the displacement risk, because it reduces the profits of existing firms and erodes the human capital of older workers by competition. However, returns of innovative firms may be negatively correlated with such a risk and therefore may be lower on average in equilibrium by the risk-return trade-off. Growth firms may correspond to such innovative firms because the market participants expect their greater profitability in the future based on their inventions of new products, thereby making their market values relatively higher than the book values and lowering the book-to-market ratios.[11] More interestingly, Panel B shows that dispersion in beliefs is greater for such innovative growth firms than for less-innovative value firms, and this effect is stronger for portfolios of smaller stocks. Because it is quite uncertain if innovation occurs or not, investors may form greater dispersion of beliefs about the innovation-oriented firms. The appetite for innovation may be stronger for smaller companies, which are often newcomers in the market. Combined with the short-sale restrictions, it exacerbates the negativity of future returns for the growth stocks relative to value stocks because the elevated prices of the former will lead to sharper declines afterward.

2.4.5 Portfolios Sorted by Size, Momentum and Belief Dispersion

Table 2.6 reports the average monthly returns of 27 portfolios of stocks triply sorted by size, momentum and belief dispersion. For portfolios of decent sizes, the negative relationship between returns and the dispersion of beliefs remains strong given each level of momentum. In particular, the large-momentum portfolios corresponding to past winners exhibit significantly positive return differentials for belief dispersion.

[11] Companies with lower BM ratios in our sample may not necessarily be privately owned. Chen et al. (2009, Table 3) suggest that the dominant state-ownership may have positive impact on the Tobin's Q ratios of Chinese companies. Because BM ratio and Q ratio are inversely related, these innovative firms may be generously supported by the government.

Table 2.5: Mean Portfolio Returns by Size, Book-to-Market and Dispersion

	Low BM (growth)			Medium BM			High BM (value)		
Dispersion	Small Cap	Mid Cap	Large Cap	Small Cap	Mid Cap	Large Cap	Small Cap	Mid Cap	Large Cap
[Panel A]									
Low	2.10	2.01	1.50	2.73	2.40	1.82	3.17	2.62	2.10
Medium	2.07	1.68	1.24	2.79	1.90	1.73	2.62	2.44	2.27
High	0.68	0.36	0.56	1.07	1.13	1.31	1.84	1.16	1.33
Low-High	1.42^a	1.65^a	0.94^b	1.66^a	1.27^a	0.51	1.33^a	1.46^a	0.77^b
	(2.78)	(3.43)	(2.05)	(3.46)	(2.74)	(1.11)	(2.84)	(3.26)	(1.82)
[Panel B]									
Low	-1.04	-0.94	-0.76	-0.88	-0.79	-0.67	-0.73	-0.67	-0.60
Medium	-0.11	-0.07	-0.09	-0.06	-0.03	-0.04	-0.05	-0.04	-0.01
High	1.14	1.06	0.77	1.01	0.96	0.81	0.84	0.78	0.71

^{a} or ^{b} on estimates shows the statistical significance at 1% or 5% level. Numbers in parentheses are t-values for the low-high comparison under H_0 in (2.5). Panel B reports the average values of $TURN$ for corresponding portfolios.

Avramov et al. (2007) document that the momentum profit is mainly driven by the profitability of low-grade firms. Specifically, the portfolio of extreme losers consists of stocks with the *lowest* credit rating, whereas the portfolio of extreme winners consists of stocks with *next to the lowest* credit rating. If this story is correct in our sample, the average returns of the loser- and winner-portfolios are respectively driven by the worst and next-to-worst stocks in terms of the credit risk. The discrepancy of return differentials between small- to large-momentum portfolios, i.e., $(1.45, 1.83, 0.53) > (1.19, 1.36, 0.52)$, may reflect greater uncertainty of the most credit-risky stocks and greater dispersion in beliefs for the loser-portfolios. On the other hand, portfolios of medium momentum may reflect a wide spectrum of the credit status after excluding these very risky stocks. A non-monotonic pattern of the average returns from small to medium to large values of the momentum factor may owe to such a mixed spectrum of credit risk behind the medium-momentum portfolios. In fact, the medium-momentum portfolios obey a monotonic decline of the return differentials as the size becomes larger, whereas the return differentials for loser- and winner-portfolios are quite parallel: the greatest for mid-cap stocks, milder for small-cap stocks, and insignificant for large-cap stocks. For these credit-risky stocks in loser- and winner-portfolios, the size factor may reflect a trade-off between the appetite of firms for innovation, which is good for future profitability as explained in Section 2.4.4, and vulnerability of firms to default-related events. The market participants may view the mid-cap stocks as the most-mixed ones in terms of such a trade-off and may form highly dispersed opinions about their future profitability.

Table 2.6: Mean Portfolio Returns by Size, Momentum, and Dispersion

	Small UMD (loser)			Medium UMD			Large UMD (winner)		
Dispersion	Small Cap	Mid Cap	Large Cap	Small Cap	Mid Cap	Large Cap	Small Cap	Mid Cap	Large Cap
Low	2.84	2.72	1.95	3.23	2.41	1.89	2.63	2.45	1.85
Medium	2.77	2.06	2.04	2.86	2.43	1.93	2.37	2.30	1.70
High	1.39	0.89	1.42	1.41	1.05	0.85	1.44	1.09	1.33
Low-High	1.45^a	1.83^a	0.53	1.82^a	1.36^a	1.04^a	1.19^a	1.36^a	0.52
	(2.88)	(3.89)	(1.15)	(3.75)	(2.87)	(2.34)	(2.30)	(2.80)	(1.08)

^{a} or ^{b} on estimates shows the statistical significance at 1% or 5% level. Numbers in parentheses are t-values for the low-high comparison under H_0 in (2.5).

2.5 Robustness Check

2.5.1 Negative Return-Dispersion Relationship in Quantile Regressions

The regression analaysis in Section 2.4.1 suggests a negative link between the heterogeneity of beliefs and future returns. However, a standard regression framework, including the Fama-Macbeth method, focuses on the conditional mean of the explained variable as a function of covariates. In order to obtain a more comprehensive picture of the relationship between the return distribution and covariates in an outlier-robust fashion, we run quantile regressions at .10, .25, .50 (median), .75 and .90 empirical quantiles of the return distribution in the pooled sample.[12] Given $\theta \in [0,1]$, the estimates of coefficients in the θ-quantile regression are obtained by minimizing the following criterion with respect to $\beta := [\beta_0, \beta_1, \ldots, \beta_7]'$:

$$\sum_{i,T} \left\{ \theta 1_{\{RET_{i,T} > x'_{i,T-1}\beta\}} + (1-\theta) 1_{\{RET_{i,T} < x'_{i,T-1}\beta\}} \right\} |RET_{i,T} - x'_{i,T-1}\beta|,$$

where $x'_{i,T-1} = [1, TURN_{i,T-1}, \ldots, BETA_{i,T-1}]$, which is the same set of regressors as in (2.2), and $1_{\{A\}} = 1$ or 0 if the condition A is correct or not.

Table 2.7 reveals that the unexplained turnover and returns are significantly, negatively and uniformly linked over a wide range of quantiles. The estimate is not significant for the 0.10 quantile corresponding to large negative returns, but its sign

[12] An alternative approach is to combine the cross-sectional quantile regressions with the Fama-MacBeth aggregation of the estimated coefficients in the time domain, but the lack of an appropriate formula for the asymptotic standard errors hinders this approach. We leave it for a future study.

is at least consistent with the Miller effect. On the other hand, the effects of ILQ and IV on returns are very different across five quantiles. The former has more negative effect in lower quantiles corresponding to greater negative returns, whereas the latter has the opposite effect in upper quantiles corresponding to greater positive returns. Signs of their coefficients at .50 quantile corresponding to the median regression are different from the previous estimates in Section 2.4.1. Such discrepancies suggest that the reported effects of ILQ and IV in the previous section may be influenced by few outliers. The uniformly negative relationship between turnover and return quantiles suggests why the heterogeneity of beliefs may be a good sorting variable for the portfolio analysis in Section 2.3.5.

2.5.2 Miller, Varian or Diamond-Verrecchia

Regression results in Table 2.2 suggest that the dispersion and one-month future returns are negatively correlated. However, both Miller's and Varian's conjectures suggest the existence of a period of price elevation: it occurs during the initial moment associated with the increase of dispersion in Miller's conjecture, whereas it occurs during the subsequent adjustment of initial undervaluation in Varian's conjecture given suficiently risk-averse investors. Moreover, no biased prices emerge from the model by Diamond and Verrecchia. Althuogh the last model with makert makers may not be directly applicable to the SSE as suggested in Section 2.2.2, it may be approximately true if the market makers are re-interpreted as agents who accommodate order imbalances and manage the positions of customers (see, e.g., Hasbrouck 2007, Section 11.5). To dynamically distinguish these competing stories,

Table 2.7: Quantile Regressions

	Q(.10)	Q(.25)	Q(.50)	Q(.75)	Q(.90)
$TURN$	-0.000	-0.009^a	-0.011^a	-0.009^a	-0.009^a
	(-0.55)	(-15.41)	(-18.91)	(-11.87)	(-7.22)
ILQ	-0.149^a	-0.138^a	-0.039^a	0.002	0.200^a
	(-15.98)	(-13.73)	(-2.63)	(0.09)	(7.09)
IV	-2.169^a	0.177^a	1.882^a	3.771^a	5.672^a
	(-74.52)	(3.63)	(54.09)	(121.10)	(160.50)
UMD	0.082^a	-0.015	0.036^a	0.161^a	0.312^a
	(4.14)	(-1.24)	(2.93)	(9.41)	(11.66)
$\ln(M)$	-0.014^a	-0.002^a	0.004^a	0.007^a	0.008^a
	(-12.46)	(-3.11)	(5.83)	(7.19)	(5.82)
$\ln(B/M)$	0.027^a	0.018^a	0.013^a	0.012^a	0.011^a
	(19.06)	(19.41)	(13.76)	(9.05)	(5.61)
$BETA$	-0.044^a	-0.028^a	-0.003^c	0.038^a	0.096^a
	(-17.58)	(-16.00)	(-1.69)	(17.05)	(27.60)
$Const.$	0.227^a	0.007	-0.103^a	-0.150^a	-0.184^a
	(9.63)	(0.47)	(-6.91)	(-7.40)	(-5.99)

For $\theta = .10$, .25, .50, .75 and .90, $Q(\theta)$ column display the coefficient estimates of the θ-quantile regression. Numbers in parentheses are t-values for two-tailed tests based on bootstrapped standard errors of 20 replications. ^{a} or ^{c} on estimates shows statistical significance at 1% or 10% level.

we run the Fama-MacBeth regressions of Model-IV in Table 2.2 using the regressors in month T, $T-1$, $T-2$,$T-3$, $T-4$ or $T-5$:

$$RET_{i,T} = \alpha_{T-j} + \beta_1 \cdot TURN_{i,T-j} + \cdots + \beta_7 \cdot BETA_{i,T-j} + \epsilon_{i,T}, \quad j = 0,1,2,3,4,5 \tag{2.6}$$

Table 2.8 collects the estimation results. The results for j=1 are identical to those for model IV in Table 2.2. The pattern of $\hat{\beta}_1$ over j is consistent with the Miller effect, namely, the initial overvaluation or the positive return for higher dispersion, followed by negative and decaying estimates as j becomes larger, and reaching insignificance at $j = 5$. This pattern defies conjectures by Varian and Diamond-Verrecchia in the SSE during our sample period: otherwise, we should have observed $\hat{\beta}_1 \leq 0$ for $j = 0$ and $\hat{\beta}_1 \geq 0$ for $j \geq 1$. None of them are true in Table 2.8.

2.5.3 Portfolio Analyses with Illiquidity and Idiosyncratic Volatility

The regression analyses in Section 2.3.4 suggest that illiquidity and idiosyncratic uncertainty may affect the generation of returns. Then, the negative relationship between the dispersion of beliefs and future returns may be suprious due to the correlation between turnover and these risk factors. To isolate the effect of belief dispersion, we regress the unexplained volume on the previous measures of illiquidity and idiosyncratic volatility to obtain the OLS residuals $\hat{\epsilon}_{i,T} = TURN_{i,T} - (\hat{\alpha}_{i,T} + \hat{\beta}_{i,ILQ} ILQ_{i,T} + \hat{\beta}_{i,IV} IV_{i,T})$ and replace $TURN_{i,T}$ by $\hat{\epsilon}_{i,T}$ in all

Table 2.8: Fama-MacBeth Estimates with Lag-0, ..., Lag-5 Regressors

	Lag 0	Lag 1	Lag 2	Lag 3	Lag 4	Lag 5
TURN	0.030^a	-0.003^a	-0.002^a	-0.002^a	-0.001^b	-0.001
	(19.65)	(-4.01)	(-3.39)	(-2.86)	(-2.21)	(-0.74)
ILQ	-0.411	1.017^a	0.974^a	1.006^a	1.040^a	1.028^a
	(-1.19)	(3.41)	(3.38)	(3.43)	(3.43)	(3.33)
IV	-0.441^a	-0.616^a	-0.721^a	-0.747^a	-0.751^a	-0.748^a
	(-5.43)	(-6.24)	(-6.14)	(-6.62)	(-6.61)	(-6.63)
UMD	0.090^c	0.041	0.046	0.054	0.058	0.057
	(1.67)	(0.64)	(0.74)	(0.86)	(0.89)	(0.89)
$\ln(M)$	-0.001	0.000	0.000	-0.000	0.000	-0.000
	(-0.50)	(0.12)	(0.09)	(-0.05)	(0.10)	(-0.04)
$\ln(B/M)$	0.002	0.003^b	0.003^b	0.003^a	0.003^a	0.003^b
	(1.10)	(2.61)	(2.44)	(2.78)	(2.72)	(2.58)
BETA	0.018	0.020^c	0.020	0.022^c	0.022^c	0.022^c
	(1.62)	(1.66)	(1.65)	(1.72)	(1.72)	(1.72)
Const.	0.027	0.005	0.008	0.015	0.009	0.016
	(0.67)	(0.10)	(0.17)	(0.31)	(0.18)	(0.32)
$Adj.R^2$	26.4	16.0	15.9	16.0	15.9	16.0

For $j = 0, \ldots, 5$, "Lag j" column displays the Fama-MacBeth estimates of the coefficients in (2.6) with j-th lagged values of regressors. Numbers in parentheses are t-values for the two-tailed significance test based on bootstrapped standard errors of 20 replications. ^{a}, ^{b}, or ^{c} on estimates shows the statistical significance at 1%, 5% or 10% level, respectively.

previous portfolio analyses. However, Table 2.9 shows a similar pattern compared with the original results in Section 2.4.

2.6 Conclusions

The relationship between the heterogeneity of beliefs and future returns is theoretically ambiguous. It is further blurred by the presence and different tightness of short-sale restrictions in different samples. Yet another type of complication emerges from the multiplicity of proxies to represent the dispersion of investors' opinions. We avoid these confounding effects in currently available approaches as much as possible by combining two empirical strategies. First, we define a measure of the dispersion of investor opinions by the market-adjusted turnover per shares outstanding demeaned over a rolling window in the time domain. Second, we use the Shanghai Stock Exchange data in which short sales had been prohibited in our sample period from January 1, 2001, to December 31, 2009. On the basis of regression and portfolio analyses, we confirm the negative relationship between dispersion of beliefs and future returns in a dynamic environment, as conjectured by Miller's (1977) static model.

The Shanghai Stock Exchange is a representative securities market in mainland China. The analyses of the effect of limiting short-selling in this study will be useful for infering the effect of a similar regulation in other local markets as well. Moreover, the China Securities Regulatory Commission has gradually promoted marginal trading and securities lending since March 2010. Therefore, our study will serve as

Table 2.9: Mean Portfolio Returns After Controlling Illiquidity and Idiosyncratic Volatility

	Size				Leverage								
					Low			Medium			High		
Dispersion	Small	Medium	Large	All	Small Cap	Mid Cap	Large Cap	Small Cap	Mid Cap	Large Cap	Small Cap	Mid Cap	Large Cap
Low	2.66	2.24	1.77	2.22	2.58	2.69	1.67	3.14	2.07	1.93	2.66	2.48	2.00
Medium	2.52	2.04	1.71	2.09	2.46	2.38	1.67	2.34	1.81	1.85	2.73	2.10	1.75
High	1.19	0.92	1.11	1.08	1.23	1.05	1.16	1.50	0.92	1.47	1.36	1.10	1.26
Low-High	1.47^a	1.32^a	0.66^a	1.14^a	1.35^a	1.64^a	0.51	1.64^a	1.15^a	0.46	1.30^a	1.38^a	0.74^c
(t-value)	(5.26)	(4.98)	(2.59)	(7.43)	(2.80)	(3.40)	(1.13)	(3.31)	(2.47)	(0.99)	(2.53)	(2.85)	(1.61)

	Book-to-Market									Mean Returns								
	Low			Medium			High			Losers			Mediums			Winners		
Dispersion	Small Cap	Mid Cap	Large Cap	Small Cap	Mid Cap	Large Cap	Small Cap	Mid Cap	Large Cap	Small Cap	Mid Cap	Large Cap	Small Cap	Mid Cap	Large Cap	Small Cap	Mid Cap	Large Cap
Low	2.06	1.98	1.45	2.71	2.43	1.82	3.22	2.67	2.09	2.84	2.68	1.95	3.29	2.39	1.86	2.53	2.46	1.79
Medium	2.13	1.73	1.21	2.76	1.83	1.75	2.63	2.37	2.13	2.81	2.05	1.91	2.69	2.36	1.91	2.38	2.14	1.73
High	0.74	0.33	0.64	1.12	1.20	1.28	1.80	1.22	1.49	1.36	0.99	1.53	1.59	1.16	0.91	1.55	1.24	1.38
Low-High	1.32^a	1.65^a	0.81^b	1.59^a	1.23^a	0.54	1.42^a	1.45^a	0.60^c	1.48^a	1.69^a	0.42	1.70^a	1.23^a	0.95^b	0.98^b	1.22^a	0.41
(t-value)	(2.59)	(3.41)	(1.76)	(3.31)	(2.67)	(1.18)	(3.02)	(3.20)	(1.42)	(2.93)	(3.56)	(0.91)	(3.46)	(2.59)	(2.16)	(1.91)	(2.49)	(0.86)

^{a}, ^{b} or ^{c} on estimates show the statistical significance at 1%, 5% or 10% level. Numbers in parentheses are t-values for the low-high comparison under H_0 in (2.5).

a basis for evaluating government policies regarding the short-sale restriction when a sufficiently large amount of post-ban data will be available in the future.

Chapter 3

Lift of Short Sale Ban and the Post-Earnings Announcement Return in the Hong Kong Stock Exchange

3.1 Introduction

Short sale is a transaction of selling financial assets that an investor does not own currently but has instead borrowed with the intention of subsequently repurchasing them at a lower price. Short sellers tend to make profits in a trend of price declining, because the cost of repurchase will be less than the gain from the initial sale. Short sale ban on financial assets vary greatly around the world, in terms of implemented timing, tightness and duration. Reaction to the 2007-2009 financial crisis, most of the major stock exchange regulators imposed constraints on short sales. The United States Security Exchange Commission (SEC) News Release 2008-211 announced the initiation of short sale ban in the U.S. financial market and stated the reason:" *At present (crisis period, authors' comment), it appears that unbridled short selling is contributing to the recent, sudden price declines in the securities of financial institutions unrelated to true price valuation.*"[1] Similarly, European market regulators banned short sale of sovereign bonds and stocks in the summer of 2011 amid the European sovereign debt crisis. On the contrary, since March 2010, exchange markets in mainland China has gradually relaxed short sale ban, which China had imposed since the beginning of Chinese financial market in 1990s.

Given various practices of short sale ban in the real world, it is natural to ask what is the effect of ban as a policy tool. Unfortunately, this effect is unclear from theoretical works. Miller (1977) casts doubt on the benefits of short selling bans. He conjectures that under short sale ban heterogeneous belief of investors are negatively related with future returns. This idea implies that under short sale constraints, the heterogeneity of beliefs can lead to lower expected returns (higher prices). On the contrary, Varian (1985, 1989) and David (2008) suggest that heterogeneity of beliefs leads to a positive risk premium in a market without short sale constraint. Does the existence of short sale ban explain why Varian and Miller drew different conclusions regarding the relationship between heterogeneity of investors' beliefs and future return? If it does, implementing short sale ban may lead to a systematic

[1]http://www.sec.gov/news/press/2008/2008-211.htm, retrieved as of June 24th, 2014.

decline of future return as Miller suggested. Therefore, it is worthwhile studying the effect of short sale on the change of relationship between heterogeneity and future return.

In order to isolate the effect of short sale ban on this relationship, I focus on an event of earnings announcement. The purpose to study this event lies on three folds. First, earnings announcements release information on profitability of firms. After the announcement of a company, investors may update their opinions based on newly released information and the stock price of that company will be adjusted. As the difference of prices, future returns will also be adjusted. Miller (1977) implies that the initially elevated price will revert to a new equilibrium level associated with the stock's fundamental valuation. Therefore, focusing on earnings announcements events helps us to identify the event-triggered heterogeneity and its relationship with subsequent returns. Second, Garfinkel and Sokobin (2006) and Anderson, Harris and So (2007) find the positive relationship between the heterogeneity of investors' opinions and post earnings announcement returns using data in the U.S. without a tight short-sale constraint. If we can establish a negative relationship in such events under short sale ban, it is likely that this sign alternation may due to the short sale ban. Third, the behavioral theory of investors' under-reaction to public information, proposed by Daniel (1998), suggests that investors put more weight on their own private information while treat public information, such as earnings announcements, as a confirmation of private information. If short sale ban expel pessimistic investors from markets, investors staying in markets are more easily to be confirmed by good earning news. To investigate this hypothesis, we classify all earnings announcement events into good and bad ones to see if the effect of short sale ban varies for different announcement types.

Our sample consists of stocks in the list of "designated securities" in Hong Kong Stock Exchange (HKEx). Although the majority of stocks traded in HKEx cannot be sold short, the securities in this list are exempt from such a ban. This data set provides several unique advantages in analyzing the effect of ban. First, these securities are under strict short sale ban before they are assigned to the shortable list. Therefore, we can compare the relationship between the heterogeneity of beliefs and future returns, before and after the lift of a ban on these securities. Second, these securities assigned to the list meet some criteria based on liquidity and market capitalization, so that those in the shortable list have relatively higher liquidity than other securities in the market. According to Carlin, Longstaff and Matoba (2012), it is easier to investigate the relationship between heterogeneity and future returns of liquid securities, because high liquidity makes it easier for investors to trade with each other, based on their own opinions.

We can summarize our findings as follows. We find a negative relationship between the heterogeneity of ivestors' beliefs and future returns when securities are subjected to the short-sale ban, but such an evidence disappears after the lift of a ban. When comparing the different types of public news, we find that good news leads to a stronger effect of this policy relaxation.

3.2 Literature Review

3.2.1 Heterogeneous Beliefs and Cross-section Returns

Previous studies find mixed results regarding the relationship between heterogeneity of beliefs and stock returns.

Miller's (1977) *overvaluation* hypothesis claims that a short sale constraint together with the investors' dispersed beliefs about the payoff distribution elevates a security's price relative to the price in a market without such characteristics because the institutional restriction on taking a short position may prevent informed pessimists from pulling the market price downward. However, the elevated price will eventually revert to a fundamental level associated with the present value formula as the investors' opinions converge. Therefore, we will observe a positive return initially and negative returns subsequently.

Duffie, Gârleanu and Pedersen (2002) emphasize the necessity and difficulty of locating a lendable security which leads to the initial elevation and decline afterward of the price so that such a short-sale restriction induces a negative future return, especially after the initial public offering (IPO). Since it is impossible to take a short position before an IPO and cumbersome to do so immediately after its issue, IPO data provide a rare opportunity to test the relationship between the heterogeneity of beliefs and stock returns under a short-sale constraint. Using IPO data from the Securities Data Company Platinum New Issues database, Chemmanur and Krishnan (2012) find a result consistent with the Miller's overvaluation hypothesis.

In contrast to Miller (1977), Varian (1985) predicts the *undervaluation* of a risky asset given greater disagreement of beliefs of sufficiently risk-averse investors. Doukas, Kim and Pantzalis (2006) argue that the forecast dispersion is positively related to stock returns if we control for the common uncertainty in the analysts' earnings forecasts. They attribute the negative dispersion-return relationship found in Diether et al. (2002) to the uncertainty effect, instead of opinion disagreement, and report that the returns associated with earnings announcement increase as ex-ante opinions among analysts become more dispersed. Garfinkel and Sokobin (2006) establish a positive relationship between the unexplained volume and the sixty-day drift of post-earning-announcement returns. However, all of these empirical studies in favor of the positive return-dispersion relationship are based on data in the United States without regulatory restrictions on short-selling during their sample periods.

In sum, the results about relationship of heterogeneity of beliefs and future return are not compatible with each other. To verify any relationship between them, we need to pay a careful attention to the actual degrees and tightness of short-sale bans.

3.2.2 Short Sale Ban in HKEx

Liu and Seasholes (2011) study the companies with dual-listed shares in mainland Chinese markets and HKEx. When the regulator in mainland China imposes a short sale ban on domestic stock markets, Chinese stock prices are on average 1.8 times as high as the Hong Kong counterparts. These results suggests that investors in Chinese domestic markets pay an additional cost to buy the stock of the same company listed in mainland China due to short sale ban. In addition, short sale ban may lead to higher price volatility, which is another cost for investors to hold an asset.

Chang, Cheng and Yu (2007) use the changes of designated security list in Hong Kong to study the effect of short-sale bans on the process of price discovery. They analyze the price effects following the event that a stock is newly added to the eligible list for short sale and find that short sale constraints tend to cause an overvaluation of the securities, hence supports Miller's overvaluation hypothesis.

Our paper is different from Liu and Seasholes (2011) because we investigate time series data for each designated security in Hong Kong market instead of two securities issued in two markets as Liu and Seasholes do. Concentrating on one market allows us to get rid of differences among several markets, such as market liquidity and information disclosure requirements, which may also affect future returns. Although we use a similar sample of designated securities in Hong Kong stock exchange as Chang et al. (2007) do, we investigate how short sale ban changes the relation between heterogeneous beliefs and future returns.

3.2.3 Investor psychology and security market under- and overreactions

To explain the post earnings announcement return, previous researchers study on investors' under- and overreaction to public and private information. Daniel et al. (1998) suggest that investors over-confidently trade based on a private signal, while a public signal just plays a role of confirmation to private signal. Investors' confidence rises if investors receive public information, which is consistent with their private information, their confidence rises but dis-confirming information causes confidence only fall modestly.

Liang (2003) tests the investors' reaction to public and private information and its impact on the post-earnings announcement return. Her empirical results reveal that investors' overconfidence about their private information and the reliability of the earnings information are two important factors to explain post earnings announcement return.

Different from previous studies, we test the effect of short sale ban. Considering the confirming effects of public news to private news, we test the return after good and bad news with or without short sale ban.

3.3 Background and Hypotheses

3.3.1 Background

In January 1994, in line with the reform of the securities borrowing and lending regime, the HKEx introduced a pilot scheme for regulated short selling. From then on, some designated securities in the market can be sold short. The profile of shortable securities is revised on a quarterly basis, depending on criteria regarding liquidity and market capitalization. According to the latest version of requirements, market capitalization of shortable stocks must be no less than HK$3 billion, and their ratio of aggregate turnover during the preceding 12 months to market capitalization must be no less than 50%.[2] By the end of 2012, the number of shortable securities is 646. From Jan. 2001 to Dec. 2012, there are 1285 security-times addition events.

Table 3.1 shows the information on the 1285 security-times addition events in our sample. *Effect Date* is the date on which the list change goes into effect. *Addition* is the number of stocks added to the list. *On List* is the number of stocks on the list after each revision.

3.3.2 Hypotheses

Note that a few representative studies in favor of a positive return-heterogeneity relationship, such as Doukas et al. (2005) and Garfinkel and Sokobin (2006), rely on data about the New York Stock Exchange, which is a market without short sale ban. Therefore, it is not obvious if these results defy the negative return-heterogeneity relationship because of the lack of a strict short sale ban. HKEx implemented a quarterly revised short sale ban, which provides us suitable data to investigate if the lift of short sale ban changes the relationship between heterogeneity and future returns. If both Miller's (1977) and Varian (1985)'s predictions are correct, the stocks traded on the HKEx might be overpriced under short sale ban when investors disagreed with their fundamental values, as predicted by Miller(1977), but this overprice might not exist when short sale ban is lifted, as predicted by Varian (1985).

Let us put the first hypothesis:

[2] `https://www.hkex.com.hk/eng/market/sec_tradinfo/regshortsell.htm`, retrieved June 2014

Table 3.1: List of Hong Kong Stock Exchange Experienced Short Sales Ban Changes.

Effective Date	Addition	On list	Effective Date	Addition	On List
2/12/2001	15	221	5/29/2006	23	284
5/14/2001	6	227	8/25/2006	38	314
8/21/2001	9	225	12/1/2006	55	363
12/3/2001	17	157	3/5/2007	30	369
2/25/2002	7	150	5/21/2007	29	394
5/21/2002	11	155	8/13/2007	134	527
7/29/2002	24	174	11/26/2007	64	567
11/29/2002	6	165	2/18/2008	33	560
1/27/2003	5	163	5/13/2008	22	536
5/19/2003	18	174	8/7/2008	10	501
7/21/2003	1	159	11/14/2008	6	363
11/3/2003	36	189	2/12/2009	25	361
2/10/2004	29	217	5/14/2009	13	352
4/27/2004	26	240	8/5/2009	49	386
8/2/2004	8	229	11/5/2009	58	433
11/8/2004	9	228	2/1/2010	65	503
2/7/2005	15	236	5/10/2010	59	553
3/1/2005	2	238	8/4/2010	40	575
5/17/2005	37	266	10/29/2010	47	605
7/8/2005	1	267	2/25/2011	70	698
8/15/2005	14	272	5/24/2011	65	749
2/20/2006	10	276	8/12/2011	24	724
3/1/2006	2	281	11/3/2011	18	646
Cumulative:				1285	

Hypothesis 1: Post earnings announcement returns is more negatively associated with the degree of heterogeneous beliefs among investors when short sales are banned than that when short sales are allowed.

Theoretical studies (e.g. Daniel et al. (1998)) find that market participants tend to under-react to public information and have overconfidence about private information, although private information is not necessarily better. Public information plays a role of confirmation to private information. When receiving confirming public information, investors get more confidence about their opinions and decide to further buy or sell stocks. When receiving disconfirming public information, confidence of investors will not be encouraged too much. Thus, public information can trigger further reaction if it confirms private information.

In the context of Miller (1977), under short sale restriction, more optimistic investors stay in the market. Optimists' opinions are more easily confirmed by good news. When good news hit the market, investors tend to be more confident and buy even more. This pushes price to be much higher and the post earnings announcement returns should be lower. On the contrary, when bad news comes, optimistic investors' confidence falls. The price will not be pushed too high like in the case of good news. Therefore, opinion dispersion and ex post returns are more negatively related under short sale ban when favorable news comes. Without short sale ban, all investors holding optimistic and pessimistic opinions on the securities stay in the market. Then, the good news and bad news confirm different kinds of investors' opinions. Therefore, the price should not be changed too much. Based on these analyses, we have the following hypothesis:

Hypothesis 2: The effect of lifting a short sale ban is stronger when good news comes than bad news.

3.4 Research Design

3.4.1 Data

Our data cover the period from January, 2001 to December, 2012, including all newly-added designated securities which have become eligible for short selling in the Hong Kong Stock Exchange. We obtain these historical addition events from the web site of the Hong Kong Stock Exchange.[3] We manually search each security's annual earnings announcement events before and after the dates of change in the status of shortablility it becomes designated securities. Then, we collect their daily trading data around every earnings announcement. All data come from China Genius database. [4]

3.4.2 Measures of Variables

3.4.3 Measuring Post Earnings Announcement Returns

Event studies in finance often use abnormal returns triggered by a specific event to assess its impact on the value of a firm (MacKinlay, 1997). Abnormal returns are the differentials between actual returns and expected returns. The occurrence of an event may contain information about the value of a firm that have not been priced by the

[3]http://www.hkex.com.hk/eng/newsconsul/hkexnews, retrieved as March, 2013.
[4]http://www.chinaef.com, retrieved as March, 2013.

market, thereby changing the current and subsequent returns. Therefore, it may be possible to elicit such unexpected information from post-events returns. Cumulative abnormal return (CAR) is the sum of abnormal returns during the post event period. We investigate the abnormal return associated with earnings announcement event and calculate CAR, by the sum of daily difference between returns of a stock and the returns of the market. Specifically, in each earnings announcement event, I calculate the market-adjusted returns of each stock over the windows of 30-, 60- and 90 trading days subsequent to the event:

$$CARN_{i,t} = \sum_{j=2}^{N+1}(R_{i,j,t} - R_{m,j,t}), N = 30, 60, 90.$$

$R_{m,j,t}$ is the return on day j in year t on the benchmark value-weighted market portfolio which the stock i belongs to. $R_{i,j,t}$ is the return on stock i at day j in year t. The announcement day is defined as j=0.

3.4.4 Turnover as a Proxy for Heterogeneous Beliefs

We use a variant of turnover as the proxy for heterogeneity of investors' beliefs. Hong and Stein (2007) suggest that trading volume in any given interval comes from the changes of disagreement. Scheinkman and Xiong (2003, 2006) document that: *i*) investors continually update their valuations based on their personal interpretations of news, and *ii*) a trade occurs whenever relatively optimistic ones become pessimists and vise versa. Therefore, we use turnover as proxy for heterogeneous beliefs as follow.

For the stock i at day j in year t, let $V_{i,j,t}$ be the raw transaction volume and $S_{i,j,t}$ be the total share outstanding. Variables with $i = m$ stand for those of the market. Following Mackinley, $j = -1, 0, +1$ define the event period, i.e. the announcement day, one day before and one day after. We choose such a three-day event window because some news may be known to investors one day before the official announcement. Our measure of the turnover for individual stock i during each earnings announcement is defined by

$$TO_{i,t} = \frac{1}{3} \sum_{j=-1}^{1} \left(\frac{V_{i,j,t}}{S_{i,j,t}} - \frac{V_{m,j,t}}{S_{m,j,t}} \right).$$

Let us put three remarks. First, we use the volume per share outstanding as a daily unadjusted turnover *in percentage*. Second, the market turnover is calculated from value-weighted average of all stocks in the market and is subtracted from individual turnovers to control the market-wide effects, such as recession. Third, researches often criticize the effectiveness of turnover as a proxy for heterogeneity because it is also used as a liquidity proxy. Stocks with higher turnover before the earnings announcement may be subject to higher liquidity, instead of greater heterogeneity of investors' beliefs. In order to control the liquidity effect, we use previous year's overall turnover for individual stock. In robustness check, we also use Amihud's (2002) liquidity measure to control liquidity.

Although we focus on the heterogeneity of beliefs caused by newly added information, it may be correlated with pre-event heterogeneity. We control such heterogeneity (PTO) before earnings-announcement by the average of turnovers in 60 days to 2 days before the announcement date.

3.4.5 Proxy for Policy of Short Sale Ban

To investigate the effect of short sale ban, we use the dummy variable SS, which is one when the short sale is allowed and zero otherwise. As explained in section 3.2.2 the list of designated securities is revised on a quarterly basis. For example, suppose a stock is designated to be eligible for short sale on February 12th, 2001. We search for its earnings announcement events before ($SS = 0$) and after ($SS = 1$) February, 2001. SS_{Effect} is an interaction term of beliefs heterogeneity (TO) and policy dummy SS. We focus on the coefficient of SS_{Effect} to study the change of the relationship between heterogeneity of investors' beliefs and future returns as the short sale ban is lifted.

3.4.6 Proxies for Earning Surprises

We measure unexpected earnings as follow:

$$UE_{i,t} = \sum_{j=0}^{1} (R_{i,j,t} - R_{m,j,t}),$$

where $R_{m,j,t}$ is the return on day j in year t on the benchmark market which stock i belongs to, and $R_{i,j,t}$ is the return on stock i at day j in year t. If unexpected earnings are positive (negative), we treat them as good (bad) news.

3.4.7 Control Variables

Previous studies on post earnings announcement and drift reveal that liquidity, size, return volatility and price momentum are good control variables. When testing the effect of short-sale ban lift, including these variables into regression helps us to control the effect of fundamental changes. Even if lift of short-sale ban indicates changes in some fundamental factors, we can still safely estimate the relationship between heterogeneous beliefs and future returns.

We use prior fiscal year's turnover as proxy for liquidity. According to Garfikel and Sokobin (2006), this variable is calculated by the total trading volume divided by shares outstanding at the end of the prior year of each announcement. We also control for firm size, following Foster et al. (1984) and Bernard and Thomas (1989, 1990). In their results, return is negatively related with firm size. We use logarithm of market value at earnings announcement day as the proxy for size. Zhang (2006) provides evidence that greater information uncertainty produces relatively higher expected returns following good news and relatively lower expected returns following bad news. As the proxy for information uncertainty we use return volatility, i.e. the standard deviation of abnormal returns over the period of 120 days before every earnings announcement. We also control the momentum effect of returns by using cumulative abnormal returns over the period of 120 days before earnings announcement. The definitions of variables used in our regressions are shown in Table 3.2.

Table 3.2: The List of Variables

Pre-announcement period	
PTO	Heterogeneous beliefs before earnings announcements. The average daily turnover (turnover is trading volume scaled by outstanding shares) over trading days [-61, -2], where day 0 is the earnings announcement day.
ILQ	Illiquidity proxy. Prior fiscal year turnover, the volume over the entire prior fiscal year divided by shares outstanding at the end of that year.
MOM	Price momentum, the 120 days cumulative abnormal returns over the period of [-125,-5].
VOL	Volatility. The 120 days standard deviation of abnormal returns over the period of [-125,-5].
Announcement period	
TO	Heterogeneous beliefs proxy. The average daily turnover (turnover is trading volume scaled by outstanding shares) over trading days [-1, 1], where day 0 is the earnings announcement day.
UE	Unexpected earnings. 2 days average abnormal returns over trading days [0,+1]. UE>0, good earnings news.
SS	Equals to 0 when short sale is prohibited, equals to 1 when short sale is allowed.
SS_{Effect}	TO$*SS$.
SIZE	The logarithm of market value of a stock at day 0.
Post-announcement period	
CAR30(60,90)	The 30-(60-,90-)days cumulative abnormal returns after the earnings announcement, over trading days [+2,+31], [+2,+61], [+2,+91].

3.4.8 Regression Model

To test Hypothesis-1 and Hypothesis-2 we estimate the following model:

$$\begin{aligned} CARN_{i,t} =& \alpha + \beta_1 \times UE_{i,t} + \beta_2 \times TO_{i,t} + \beta_3 \times SIZE_{i,t} \\ & + \beta_4 \times ILQ_{i,t-1} + \beta_5 \times MOM_{i,t} + \beta_6 \times VOL_{i,t} \\ & + \beta_7 \times SS + \beta_8 \times SS_{Effect} + \epsilon_{i,t}, N = 30, 60, 90. \end{aligned}$$

The subscript i stands for each stock and t for year, when an earnings report is announced for stock i. The coefficient of TO shows the relationship between heterogeneous beliefs and future returns. The coefficient of interaction term SS_{Effect} shows the changes of this relation before and after the lift of short sale ban. We consider this coefficient as the effect of short sale ban.

For Hypothesis-1, we estimate this model using data in three different samples before: before the lift (SS_{Before}), after the lift (SS_{After}) and over the whole period (All). For Hypothesis-2, we further divide samples into two sets. If unexpected earnings of designated securities are positive (negative), we define them as good (bad) earnings news. Based on good or bad news, we test different impacts of short sale bans lift.

3.5 Results

3.5.1 Regression Results

Table 3.3 presents empirical results regarding Hypothesis-1. In the first column of each CAR group, we report estimation results when the designated securities are not shortable. TO as the proxy of heterogeneous beliefs is negatively related with 30-days, 60-days and 90-days cumulative abnormal returns under short sale ban, as are displayed in SS_{Before} groups. The coefficients with 30-days and 60-days returns are significantly negative; 90-days returns are marginally insignificant but the sign is negative. The magnitude of coefficients in the short sale banned group (-0.069, -0.068, -0.046) are greater than those in the short sale eligible group SS_{After} and in the pooled samples group All, which are shown in second and third columns with each CAR. These results are consistent with Miller's (1977) idea that the dispersion of opinions leads to lower future returns.

In the second column of each CAR group, when the ban is relaxed (shown in SS_{After} group), the coefficients of TO turns to be statistically indistinguishable from zero. The significant negative relationship between heterogeneous beliefs and future returns in the SS_{Before} columns disappears in the SS_{After} columns. For the 60-days returns, TO's insignificant coefficient shows a wrong sign. Garfinkel et al. (2006) find positive relationship between heterogeneity of investors' beliefs and the post-earnings announcement returns, using data in the United States, in which no short-sale ban has been imposed. Their results support Varian (1985) regarding heterogeneity as a type of risk and thus investors requires higher returns to compensate extra risk taking cost. Our results do not directly support the positive relation when there is no short sale ban in the market. However, these results show that the relaxation of ban changes the relationship between heterogeneity and returns.

In the third column of each CAR group, we add a policy dummy variable SS. The coefficients of SS_{Effect} for CAR30 and CAR60 groups are significantly positive. These results imply that due to relaxation of short sale ban, the relationship between heterogeneity of investors' beliefs and future returns changes toward a positive direction. Short sale ban, as a departure from frictionless market, has a distortionary effect on this relationship. These results support our Hypothesis-1.

Results for testing Hypothesis-2 are shown in Table 3.4 and Table 3.5. Table 3.4 reports results when good news on earnings are announced. The coefficient of TO in the first column of each CAR group indicates a negative relationship between heterogeneous beliefs and future returns. The magnitudes of coefficients in SS_{Before} group are greater than those in Table 3.3: (-0.144, -0.192, -0.111) $<$ (-0.0069, -0.068, -0.046). According to Daniel et al. (1998), if public information confirms investors' private opinions, it will increase investors' confidence and will encourage them to buy or sell futher. Because of the short sale ban, investors who stay in the market are relatively optimistic. Then, good news confirm these optimists' opinions and induce them to buy. As a result, the price will be higher the immediate return will be more positive, whereas subsequently the price will decline and returns will be more negative.

The second column shows that the effect of heterogeneity turns to be positive, although it is still insignificant. In this case, without short sale ban, pessimists and

Table 3.3: Post-Earnings Announcement Return and Belief Dispersion

	CAR30			CAR60			CAR90		
	SS_{Before}	SS_{After}	*All*	SS_{Before}	SS_{After}	*All*	SS_{Before}	SS_{After}	*All*
UE	0.052	0.322^b	0.181	0.628	0.621^a	0.604^b	0.676	0.857^a	0.739^b
	(0.14)	(1.97)	(0.98)	(1.26)	(3.04)	(2.41)	(1.01)	(3.21)	(2.16)
TO	-0.069^b	-0.001	-0.068^a	-0.068	0.032	-0.054^c	-0.046	0.041	-0.024
	(-2.37)	(-0.04)	(-3.41)	(-1.64)	(1.39)	(-1.93)	(-0.77)	(1.57)	(-0.67)
PTO	-0.008	-0.009	-0.007	-0.025	-0.023	-0.023	-0.084	-0.103^a	-0.089^a
	(-0.25)	(-0.53)	(-0.42)	(-0.54)	(-1.09)	(-0.98)	(-1.46)	(-3.97)	(-2.86)
$SIZE$	-0.063^a	0.005	-0.019^a	-0.124^a	0.005	-0.040^a	-0.210^a	-0.006	-0.078^a
	(-3.89)	(0.93)	(-2.77)	(-5.52)	(0.76)	(-4.22)	(-7.08)	(-0.64)	(-6.11)
LIQ	-0.019^b	-0.006	-0.015^b	-0.031^b	-0.034^a	-0.029^a	-0.043^b	-0.006	-0.031^a
	(-2.04)	(-0.74)	(-2.45)	(-2.22)	(-3.48)	(-3.45)	(-2.43)	(-0.52)	(-2.84)
MOM	-0.005	0.004	0.004	0.011	0.005	0.009	0.016	0.037	0.015
	(-0.43)	(0.28)	(0.51)	(0.61)	(0.27)	(0.94)	(0.71)	(1.55)	(1.18)
VOL	-0.000	0.161	0.000	0.001	0.057	0.001	0.001	-0.220	0.001
	(-0.43)	(1.09)	(0.51)	(0.60)	(0.30)	(0.92)	(0.69)	(-0.92)	(1.13)
SS			-0.058^a			-0.094^a			-0.128^a
			(-3.62)			(-4.28)			(-4.32)
SS_{Effect}			0.072^b			0.074^c			0.078
			(2.52)			(1.85)			(1.48)
$Const.$	1.404^a	-0.109	0.489^a	2.733^a	-0.115	0.965^a	4.614^a	0.119	1.842^a
	(4.15)	(-0.90)	(3.32)	(5.75)	(-0.75)	(4.79)	(7.39)	(0.60)	(6.81)
N	655	975	1630	720	1091	1811	655	946	1601
$Adj.R^2$	0.045	0.016	0.035	0.056	0.031	0.046	0.091	0.036	0.069

^{a} ^{b} ^{c} statistically significant at 1% level, 5% level, 10% level respectively.

optimists stay in the market so that the price is not overly elevated. Our results weakly support Varian (1985) on the positive relationship between heterogeneous beliefs and future returns. Third column shows the effect of short sale ban relaxation. The coefficients of SS_{Effect} are significantly positive and the magnitude is much larger than those in Table 3.3: (0.139, 0.131, 0.113) > (0.072, 0.074, 0.078).

Table 3.4: Post-Earnings Announcement Return and Belief Dispersion when Good News Comes

	CAR30			CAR60			CAR90		
	SS_{Before}	SS_{After}	All	SS_{Before}	SS_{After}	All	SS_{Before}	SS_{After}	All
UE	-0.560	0.213	-0.061	1.392	0.677^c	1.186^b	1.149	0.456	1.009
	(-0.63)	(0.82)	(-0.15)	(1.27)	(1.85)	(2.28)	(0.86)	(0.92)	(1.54)
TO	-0.144^c	0.042^c	-0.110^b	-0.192^c	0.072^b	-0.116^c	-0.111	0.102^b	-0.041
	(-1.76)	(1.96)	(-2.29)	(-1.93)	(2.36)	(-1.93)	(-0.90)	(2.55)	(-0.54)
PTO	0.062	-0.032^c	-0.013	0.160	-0.036	0.002	0.062	-0.139^a	-0.098^c
	(0.58)	(-1.70)	(-0.36)	(1.18)	(-1.30)	(0.05)	(0.38)	(-3.93)	(-1.74)
$SIZE$	-0.071^c	0.010	-0.010	-0.112^b	0.006	-0.024	-0.174^a	-0.010	-0.054^b
	(-1.91)	(1.39)	(-0.76)	(-2.38)	(0.58)	(-1.43)	(-3.12)	(-0.74)	(-2.55)
LIQ	-0.023	0.002	-0.006	-0.056^c	-0.060^a	-0.030^c	-0.052	-0.006	-0.016
	(-0.92)	(0.19)	(-0.47)	(-1.70)	(-3.51)	(-1.89)	(-1.36)	(-0.25)	(-0.84)
MOM	0.000	0.016	-0.007	0.009	0.005	-0.003	0.011	0.032	0.001
	(0.00)	(0.80)	(-0.46)	(0.23)	(0.20)	(-0.15)	(0.23)	(0.86)	(0.05)
VOL	0.000	-0.326	-0.001	0.001	-0.179	-0.000	0.001	-0.443	0.000
	(0.00)	(-1.59)	(-0.46)	(0.23)	(-0.63)	(-0.16)	(0.22)	(-1.15)	(0.03)
SS			-0.055^c			-0.075^c			-0.106^b
			(-1.78)			(-1.95)			(-2.18)
SS_{Effect}			0.139^b			0.131^c			0.113
			(2.39)			(1.78)			(1.24)
$Const.$	1.576^b	-0.207	0.295	2.381^b	-0.104	0.572	3.787^a	0.246	1.283^a
	(2.00)	(-1.30)	(1.05)	(2.39)	(-0.46)	(1.60)	(3.20)	(0.81)	(2.87)
N	283	424	707	309	481	790	283	413	696
$Adj.R^2$	0.030	0.027	0.024	0.047	0.055	0.039	0.054	0.052	0.049

$^{a\ b\ c}$ statistically significant at 1% level, 5% level, 10% level respectively.

Table 3.5: Post-Earnings Announcement Return and Belief Dispersion when Bad News Comes

	CAR30			CAR60			CAR90		
	SS_{Before}	SS_{After}	All	SS_{Before}	SS_{After}	All	SS_{Before}	SS_{After}	All
UE	0.544	0.398	0.374	0.715	0.486	0.300	1.093	0.904	0.589
	(0.92)	(1.07)	(1.13)	(0.71)	(1.09)	(0.60)	(0.71)	(1.61)	(0.79)
TO	-0.045[b]	-0.050[c]	-0.052[a]	-0.044	-0.020	-0.039	-0.037	-0.024	-0.031
	(-1.98)	(-1.68)	(-2.84)	(-1.07)	(-0.55)	(-1.31)	(-0.62)	(-0.54)	(-0.75)
PTO	-0.025	0.010	-0.012	-0.072[c]	0.004	-0.045[c]	-0.130[b]	-0.066	-0.099[a]
	(-1.08)	(0.37)	(-0.73)	(-1.71)	(0.11)	(-1.68)	(-2.16)	(-1.62)	(-2.64)
$SIZE$	-0.064[a]	-0.000	-0.027[a]	-0.136[a]	0.005	-0.052[a]	-0.238[a]	-0.004	-0.099[a]
	(-4.60)	(-0.02)	(-3.62)	(-5.62)	(0.47)	(-4.58)	(-6.60)	(-0.37)	(-5.99)
LIQ	-0.025[a]	-0.005	-0.018[a]	-0.028[c]	-0.021	-0.025[b]	-0.053[b]	-0.002	-0.038[a]
	(-2.95)	(-0.49)	(-2.85)	(-1.82)	(-1.62)	(-2.52)	(-2.36)	(-0.12)	(-2.71)
MOM	-0.007	0.004	0.005	0.065[c]	0.014	0.047[b]	0.074	0.048	0.056[c]
	(-0.33)	(0.17)	(0.38)	(1.79)	(0.54)	(2.13)	(1.39)	(1.56)	(1.82)
VOL	0.013	0.434[b]	0.047	-0.459	0.155	-0.286	-0.473	-0.136	-0.321
	(0.08)	(2.09)	(0.41)	(-1.61)	(0.60)	(-1.56)	(-1.15)	(-0.44)	(-1.25)
SS			-0.059[a]			-0.100[a]			-0.140[a]
			(-3.50)			(-3.90)			(-3.71)
SS_{Effect}			0.034			0.048			0.073
			(1.06)			(0.96)			(1.02)
$Const.$	1.448[a]	0.001	0.657[a]	3.006[a]	-0.122	1.223[a]	5.240[a]	0.072	2.302[a]
	(4.91)	(0.01)	(4.16)	(5.80)	(-0.57)	(5.03)	(6.82)	(0.27)	(6.52)
N	372	551	923	411	610	1021	372	533	905
$Adj.R^2$	0.106	0.052	0.067	0.095	0.022	0.065	0.136	0.029	0.094

[a] [b] [c] statistically significant at 1% level, 5% level, 10% level respectively.

Table 3.5 reports the results when bad news are announced. If more optimistic investors stay in the market under the short-sale ban, according to Daniel et al (1998), bad news has only a moderate effect on the confidence of investor's private information. It is confirmed by our results that the coefficients of TO under the short-sale ban are smaller than those in Table 3.4: (-0.045, -0.044, -0.037) > (-0.144, -0.192, -0.111). Compared with first columns in Table 3.4, we can see that bad news do not increase further overconfidence and thus do not escalate the price relative to the case of good news. The third column shows policy relaxation effect. Unlike results in Table 3.4, the policy effect is smaller and less insignificant: (0.034, 0.048, 0.073) < (0.139, 0.131, 0.113). To sum up, results in Table 3.4 and Table 3.5 support our Hypothesis-2. Policy distortion effect of short sale ban is much stronger when good news comes than when bad news comes.

3.6 Robustness Check

3.6.1 Changing the Proxy for Illiquidity

Although we use turnover as a proxy for heterogeneous beliefs, some researches treat turnover as a proxy for liquidity rather than heterogeneous beliefs. (Datar, Naik, and Radcliffe (1998), Rouwenhorst (1999), Eckbo and Norli (2002, 2005), and Avramov and Chordia (2006)). To avoid the possibility that our finding is just a liquidity risk premium, we use Amihud's (2002) illiquidity measure to control the liquidity effect in turnover. We construct this variable as follows.

$$IL_{it} = \frac{1}{n}\sum_{i=1}^{n}\frac{|R_{itd}|}{VOL_{itd}} \times 10^6$$

Results are shown in Table 3.6. Panel A reports results when types of earnings announcement are not distinguished. Panel B and C reports results when good news and bad news comes. After controlling illiquidity, we find similar patten in the coefficients of TO and policy effect variables SS_{Effect}.

Table 3.6: Amihud Illiquidity Measure as Proxy for Illqiuidity

	CAR30			CAR60			CAR90		
	SS_{Before}	SS_{After}	*All*	SS_{Before}	SS_{After}	*All*	SS_{Before}	SS_{After}	*All*
[Panel A]									
UE	0.101	0.373^b	0.247	0.839	0.860^a	0.866^a	0.733	1.042^a	0.907^b
	(0.27)	(2.27)	(1.29)	(1.57)	(3.80)	(3.05)	(1.12)	(3.75)	(2.55)
TO	-0.069^b	-0.002	-0.068^a	-0.073^c	0.013	-0.056^c	-0.054	0.034	-0.029
	(-2.33)	(-0.09)	(-3.39)	(-1.70)	(0.54)	(-1.94)	(-1.04)	(1.17)	(-0.81)
PTO	-0.014	-0.008	-0.010	-0.031	-0.031	-0.030	-0.084^b	-0.087^a	-0.082^a
	(-0.57)	(-0.55)	(-0.72)	(-0.89)	(-1.53)	(-1.44)	(-1.99)	(-3.58)	(-3.19)
$SIZE$	-0.066^a	0.008	-0.020^a	-0.123^a	0.014^c	-0.041^a	-0.207^a	0.004	-0.079^a
	(-4.07)	(1.47)	(-2.79)	(-5.28)	(1.88)	(-3.93)	(-7.26)	(0.47)	(-5.99)
$ILLIQ$	-0.002	0.013	0.000	-0.005	0.052^a	-0.001	-0.006	0.049^b	-0.001
	(-0.40)	(1.36)	(0.09)	(-0.61)	(2.99)	(-0.10)	(-0.64)	(2.28)	(-0.07)
MOM	-0.008	-0.005	0.004	0.016	-0.025	0.011	0.025	0.015	0.017
	(-0.53)	(-0.33)	(0.54)	(0.88)	(-1.13)	(0.92)	(1.11)	(0.57)	(1.20)
VOL	-0.001	0.243	0.000	0.001	0.469	0.001	0.002	-0.283	0.001
	(-0.53)	(1.61)	(0.54)	(0.87)	(1.31)	(0.90)	(1.09)	(-0.66)	(1.16)
SS			-0.063^a			-0.099^a			-0.132^a
			(-3.78)			(-4.04)			(-4.31)
SS_{Effect}			0.061^b			0.053			0.041
			(2.15)			(1.24)			(0.78)
$Const.$	1.461^a	-0.183	0.488^a	2.672^a	-0.348^b	0.964^a	4.505^a	-0.126	1.816^a
	(4.30)	(-1.51)	(3.28)	(5.47)	(-2.10)	(4.36)	(7.52)	(-0.62)	(6.56)
N	636	944	1580	678	902	1580	678	873	1551
$Adj.R^2$	0.042	0.020	0.033	0.049	0.036	0.042	0.082	0.043	0.064
[Panel B]									
UE	-0.672	0.202	-0.127	1.590	0.899^b	1.396^b	1.191	0.588	1.140
	(-0.70)	(0.76)	(-0.29)	(1.34)	(2.14)	(2.31)	(0.90)	(1.08)	(1.63)
TO	-0.170^b	0.038^c	-0.127^a	-0.203^c	0.063^b	-0.154^b	-0.103	0.104^a	-0.062
	(-2.01)	(1.80)	(-2.63)	(-1.89)	(2.00)	(-2.31)	(-0.86)	(2.62)	(-0.81)
PTO	-0.001	-0.028	-0.019	0.008	-0.066^b	-0.033	-0.092	-0.137^a	-0.116^a

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Table 3.6 – continued from previous page

	CAR30			CAR60			CAR90		
	SS_{Before}	SS_{After}	*All*	SS_{Before}	SS_{After}	*All*	SS_{Before}	SS_{After}	*All*
	(-0.01)	(-1.64)	(-0.68)	(0.09)	(-2.58)	(-0.84)	(-1.01)	(-4.23)	(-2.59)
$SIZE$	-0.083^{b}	0.010	-0.015	-0.116^{b}	0.010	-0.032^{c}	-0.179^{a}	-0.005	-0.060^{a}
	(-2.18)	(1.34)	(-1.13)	(-2.46)	(0.93)	(-1.71)	(-3.39)	(-0.37)	(-2.76)
$ILLIQ$	-0.007	-0.000	-0.004	-0.009	0.025	-0.004	-0.003	0.014	0.001
	(-0.43)	(-0.02)	(-0.45)	(-0.45)	(1.28)	(-0.31)	(-0.12)	(0.54)	(0.05)
MOM	0.051	0.015	0.006	0.018	-0.014	0.009	0.025	0.040	0.016
	(1.00)	(0.74)	(0.32)	(0.43)	(-0.42)	(0.36)	(0.53)	(0.93)	(0.56)
VOL	0.004	-0.317	0.000	0.002	0.215	0.001	0.002	-0.981	0.001
	(1.00)	(-1.54)	(0.32)	(0.43)	(0.34)	(0.36)	(0.52)	(-1.21)	(0.55)
SS			-0.057^{c}			-0.072			-0.101^{b}
			(-1.80)			(-1.63)			(-1.99)
SS_{Effect}			0.152^{a}			0.183^{b}			0.138
			(2.68)			(2.33)			(1.54)
$Const.$	1.832^{b}	-0.202	0.412	2.483^{b}	-0.252	0.730^{c}	3.885^{a}	0.123	1.405^{a}
	(2.28)	(-1.25)	(1.43)	(2.47)	(-1.01)	(1.83)	(3.47)	(0.38)	(3.04)
N	268	412	680	292	388	680	292	377	669
$Adj.R^2$	0.039	0.026	0.028	0.046	0.037	0.040	0.057	0.055	0.054
[Panel C]									
UE	0.633	0.518	0.433	1.030	0.916^{c}	0.648	1.295	1.355^{b}	0.813
	(1.09)	(1.40)	(1.30)	(0.97)	(1.96)	(1.18)	(0.88)	(2.49)	(1.08)
TO	-0.050^{b}	-0.038	-0.052^{a}	-0.052	-0.061	-0.041	-0.060	-0.067	-0.040
	(-2.15)	(-1.35)	(-2.80)	(-1.25)	(-1.54)	(-1.35)	(-1.04)	(-1.49)	(-0.99)
PTO	-0.013	0.023	-0.006	-0.044	0.034	-0.028	-0.083^{c}	-0.000	-0.063^{b}
	(-0.69)	(0.92)	(-0.44)	(-1.31)	(1.03)	(-1.21)	(-1.77)	(-0.01)	(-2.01)
$SIZE$	-0.064^{a}	0.008	-0.025^{a}	-0.131^{a}	0.020^{c}	-0.049^{a}	-0.231^{a}	0.013	-0.096^{a}
	(-4.66)	(1.03)	(-3.42)	(-5.23)	(1.90)	(-4.02)	(-6.65)	(1.07)	(-5.73)
$ILLIQ$	-0.001	0.104^{a}	0.001	-0.004	0.150^{a}	0.000	-0.007	0.163^{a}	-0.001
	(-0.27)	(3.56)	(0.42)	(-0.49)	(4.05)	(0.05)	(-0.71)	(3.86)	(-0.19)
MOM	-0.002	-0.016	0.008	0.073^{b}	-0.026	0.042^{c}	0.086^{c}	0.008	0.050
	(-0.09)	(-0.74)	(0.55)	(2.00)	(-0.88)	(1.83)	(1.71)	(0.23)	(1.62)

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Table 3.6 – continued from previous page

	CAR30			CAR60			CAR90		
	SS_{Before}	SS_{After}	All	SS_{Before}	SS_{After}	All	SS_{Before}	SS_{After}	All
VOL	-0.155	0.586^{a}	-0.034	-0.504^{c}	0.481	-0.296	-0.547	-0.126	-0.326
	(-0.99)	(2.79)	(-0.29)	(-1.76)	(1.08)	(-1.53)	(-1.38)	(-0.25)	(-1.24)
SS			-0.063^{a}			-0.105^{a}			-0.144^{a}
			(-3.69)			(-3.71)			(-3.72)
SS_{Effect}			0.010			-0.014			-0.020
			(0.32)			(-0.26)			(-0.27)
$Const.$	1.422^{a}	-0.205	0.611^{a}	2.866^{a}	-0.489^{b}	1.139^{a}	5.034^{a}	-0.337	2.190^{a}
	(4.90)	(-1.16)	(3.87)	(5.36)	(-2.17)	(4.36)	(6.80)	(-1.30)	(6.13)
N	368	532	900	386	514	900	386	496	882
$Adj.R^2$	0.089	0.077	0.055	0.075	0.053	0.055	0.113	0.058	0.081

t statistics in parentheses

^{a} ^{b} ^{c} statistically significant at 1% level, 5% level, 10% level respectively.

3.6.2 Fixed Effect Model

We also use the fixed-effect panel regression model to control firms' time-invariant unobserved heterogeneity. Table 3.7 summarizes the estimated coefficients. Panel A reports the results without sorting the types of earnings announcements, whereas Panels B and C reports the results for good news and bad news comes, seperately. Note that the coefficients of SS_{Effect} become less significant in Panels A and B of Table 3.7. However, patten in signs and magnitudes remains true. Therefore, our previous pooled-OLS and the fixed-effect panel here should be interpreted complementary. The results shows similar patten in sign and magnitudes. However, the coefficients of SS_{Effect} become less significant in Panels A and B of Table 3.7. One possible reason for this results is the Our data is not big enough to estimate fixed effect model. Our sample period covers only 5 years from 2006 to 2010 and there is only one earnings announcement event every year for a stock. These events are separated into two groups – before and after the lift of short-sale ban based on the shortablity of a stock. To preserve the sample size, we employ within transformation rather than first-differencing method in fixed effect regression. Nevertheless, the number of events for each stock is still small with an average of 2 for both before and after groups.

Table 3.7: Fixed Effect Regressions, Bid-Ask Spread Measure as Proxy for Illqiuidity

	CAR30			CAR60			CAR90		
	SS_{Before}	SS_{After}	*All*	SS_{Before}	SS_{After}	*All*	SS_{Before}	SS_{After}	*All*
[Panel A]									
UE	-0.258	0.321	-0.101	0.763	0.583[c]	0.296	0.891	0.550	0.376
	(-0.46)	(1.28)	(-0.43)	(0.90)	(1.83)	(0.85)	(0.87)	(1.48)	(0.86)
TO	-0.044	-0.014	-0.068[a]	-0.126	-0.010	-0.062	-0.057	-0.002	-0.002
	(-0.82)	(-0.51)	(-2.63)	(-1.57)	(-0.29)	(-1.62)	(-0.58)	(-0.05)	(-0.05)
PTO	-0.143[a]	0.036	-0.041[c]	-0.204[b]	0.111[a]	-0.075[b]	-0.290[a]	0.096[b]	-0.121[a]
	(-2.72)	(1.10)	(-1.81)	(-2.58)	(2.71)	(-2.25)	(-3.06)	(2.08)	(-2.91)
$SIZE$	-0.142[a]	-0.088[a]	-0.108[a]	-0.269[a]	-0.217[a]	-0.201[a]	-0.435[a]	-0.331[a]	-0.295[a]
	(-3.63)	(-4.05)	(-6.66)	(-4.58)	(-7.84)	(-8.35)	(-6.15)	(-10.39)	(-9.73)
LIQ	0.015	-0.019	-0.009	-0.034	-0.037[b]	-0.030[a]	-0.056[c]	0.004	-0.038[a]
	(0.83)	(-1.54)	(-1.17)	(-1.26)	(-2.40)	(-2.63)	(-1.74)	(0.21)	(-2.58)
MOM	0.071[c]	0.044[c]	0.007	0.209[a]	0.055	0.030[b]	0.191[a]	0.143[a]	0.024
	(1.77)	(1.65)	(0.69)	(3.49)	(1.62)	(2.14)	(2.65)	(3.72)	(1.40)
VOL	-0.445	0.090	0.001	-1.222[a]	-0.063	0.003[b]	-1.083[b]	-1.527[a]	0.002
	(-1.49)	(0.22)	(0.70)	(-2.73)	(-0.12)	(2.13)	(-2.01)	(-2.60)	(1.38)
SS			-0.012			-0.021			-0.022
			(-0.57)			(-0.69)			(-0.56)
SS_{Effect}			0.086[b]			0.109[b]			0.085

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Table 3.7 – continued from previous page

	CAR30			CAR60			CAR90		
	SS_{Before}	SS_{After}	All	SS_{Before}	SS_{After}	All	SS_{Before}	SS_{After}	All
			(2.32)			(1.97)			(1.24)
$Const.$	14.335^c	1.919^a	2.367^a	36.771^a	4.671^a	4.387^a	36.838^a	7.104^a	6.435^a
	(1.85)	(4.06)	(6.95)	(3.17)	(7.79)	(8.66)	(2.64)	(10.31)	(10.11)
N	655	902	1557	655	902	1557	655	873	1528
$Adj.R^2$	0.085	0.067	0.081	0.150	0.163	0.117	0.202	0.222	0.146

[Panel B]

	CAR30			CAR60			CAR90		
	SS_{Before}	SS_{After}	All	SS_{Before}	SS_{After}	All	SS_{Before}	SS_{After}	All
UE	-2.191	0.087	-0.522	2.011	0.586	1.234	1.467	0.171	0.956
	(-0.83)	(0.18)	(-0.73)	(0.62)	(0.81)	(1.21)	(0.42)	(0.19)	(0.79)
TO	-0.089	-0.127	-0.178^c	0.055	-0.175	-0.101	0.229	-0.084	-0.068
	(-0.34)	(-1.47)	(-1.74)	(0.17)	(-1.38)	(-0.69)	(0.65)	(-0.56)	(-0.40)
PTO	-0.096	0.131^c	0.088	-1.491^a	0.223^b	-0.028	-1.924^a	0.172	-0.127
	(-0.25)	(1.91)	(0.93)	(-3.20)	(2.21)	(-0.21)	(-3.82)	(1.40)	(-0.81)
$SIZE$	-0.199	-0.059	-0.121^a	-0.164	-0.212^a	-0.197^a	-0.280	-0.385^a	-0.295^a
	(-1.04)	(-1.57)	(-2.91)	(-0.70)	(-3.85)	(-3.33)	(-1.11)	(-5.85)	(-4.22)
LIQ	-0.028	-0.059^c	-0.008	0.176	-0.098^b	-0.012	0.144	-0.037	0.007
	(-0.17)	(-1.91)	(-0.33)	(0.86)	(-2.14)	(-0.35)	(0.65)	(-0.68)	(0.17)
MOM	-0.054	0.132^a	0.037	-0.060	0.124^c	0.071	-0.093	0.295^a	0.183^b
	(-0.24)	(2.95)	(0.67)	(-0.22)	(1.88)	(0.90)	(-0.31)	(3.69)	(1.99)
VOL	15.234	-3.069^b	-0.493	12.661	-3.878^c	-0.744	18.396	-5.762^b	-1.625
	(0.57)	(-2.22)	(-0.83)	(0.39)	(-1.90)	(-0.88)	(0.52)	(-2.38)	(-1.64)
SS			0.051			0.017			0.018
			(0.98)			(0.24)			(0.21)
SS_{Effect}			0.117			0.168^b			0.239^b
			(1.39)			(2.05)			(2.16)
$Const.$	-876.528	1.294	14.695	-728.467	4.623^a	22.521	-1057.448	8.384^a	47.063^c
	(-0.57)	(1.58)	(1.00)	(-0.39)	(3.83)	(1.08)	(-0.52)	(5.81)	(1.90)
N	283	388	671	283	388	671	283	377	660
$Adj.R^2$	0.059	0.151	0.047	0.190	0.225	0.070	0.273	0.343	0.102

[Panel C]

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Table 3.7 – continued from previous page

	CAR30			CAR60			CAR90		
	SS_{Before}	SS_{After}	All	SS_{Before}	SS_{After}	All	SS_{Before}	SS_{After}	All
UE	0.118	0.425	-0.146	4.153^c	0.233	-0.204	6.858^b	0.587	0.947
	(0.11)	(0.54)	(-0.28)	(1.71)	(0.25)	(-0.23)	(2.09)	(0.60)	(0.78)
TO	0.054	-0.086	-0.061^b	-0.336^b	-0.088	-0.120^b	-0.175	-0.037	-0.088
	(0.92)	(-1.38)	(-2.04)	(-2.45)	(-1.19)	(-2.36)	(-0.95)	(-0.48)	(-1.27)
PTO	-0.084^b	0.013	-0.022	-0.045	0.090	-0.029	-0.211^c	0.040	-0.075
	(-2.07)	(0.24)	(-0.90)	(-0.48)	(1.40)	(-0.69)	(-1.66)	(0.61)	(-1.35)
$SIZE$	-0.163^a	-0.074	-0.120^a	-0.324^a	-0.202^a	-0.245^a	-0.557^a	-0.317^a	-0.345^a
	(-4.31)	(-1.48)	(-5.64)	(-3.69)	(-3.40)	(-6.75)	(-4.70)	(-4.93)	(-6.94)
LIQ	0.005	-0.001	-0.015	-0.139^a	-0.002	-0.055^a	-0.190^a	0.024	-0.094^a
	(0.31)	(-0.08)	(-1.60)	(-4.05)	(-0.09)	(-3.50)	(-4.09)	(1.12)	(-4.14)
MOM	0.058^c	0.059	0.008	0.235^a	0.164^b	0.101^a	0.129	0.235^a	0.080^c
	(1.74)	(0.91)	(0.42)	(3.02)	(2.14)	(2.93)	(1.23)	(2.98)	(1.74)
VOL	-0.472^b	10.131	-0.091	-1.512^a	1.921	-0.663^b	-0.722	-14.686	-0.444
	(-2.02)	(1.29)	(-0.58)	(-2.80)	(0.21)	(-2.49)	(-0.99)	(-1.46)	(-1.25)
SS			-0.053^c			-0.021			-0.013
			(-1.96)			(-0.46)			(-0.21)
SS_{Effect}			0.067			0.056			0.106
			(0.79)			(0.27)			(0.43)
$Const.$	3.498^a	1.555	2.632^a	7.125^a	4.275^a	5.281^a	12.251^a	6.816^a	7.518^a
	(4.42)	(1.41)	(5.88)	(3.88)	(3.28)	(6.95)	(4.95)	(4.84)	(7.21)
N	372	514	886	372	514	886	372	496	868
$Adj.R^2$	0.184	0.067	0.159	0.300	0.117	0.182	0.346	0.164	0.203

t statistics in parentheses

$^{a\ b\ c}$ statistically significant at 1% level, 5% level, 10% level respectively.

3.7 Conclusions

The empirical evidence in this study lends credence to claim that the short sale restriction has affect the price discovery process. From our results, heterogeneous beliefs and future returns are negatively related under short sale ban. After the short sale ban is lifted, the evidence of negative relation disappears. Varian (1985) demonstrates heterogeneous belief is one kind of risk resources and investors should be compensated for bearing this risk. Negative relation between heterogeneous beliefs and future returns suggests such compensation does not exist under short sale ban. The relation between heterogeneous beliefs and future returns is changed by short sale ban. Our results are consistent with Liu (2011) and Chang (2007) to show that short sale ban leads to decrease in future returns and makes an extra cost to investors. We also find that the policy effect is much stronger when good public news comes. This supports Miller (1977)'s idea that the short sale ban changes the investors composition. If there are more optimists in the market, their opinion will more easily be confirmed by good news. As a result, prices increase more and future returns decrease more.

Chapter 4

Short-Sale Ban and Liquidity in Financial Crisis and Non-Crisis Periods: Evidence from Hong Kong

4.1 Introduction

The short-sale constraint is an important example of departure from the frictionless market. Several authors have investigated its influence on liquidity of individual stock on the basis of security-market equilibrium models. In theoretical works, Diamond and Verrecchia (1987) build a rational expectation model of the competitive and risk-neutral market makers, informed traders and uninformed traders and suggest that short sellers are more likely to be informed investors. His theory has two implications: *i)* investors in the market face redless adverse selection under short-sale ban, therefore would like to trade more and provide more liquidity to the market, which will increase liquidity; *ii)* short sale ban tends to delay the revelation of the fundamental uncertainty, thereby increases the bid-ask spread. Scheinkman and Xiong (2003) analyze the psychological overconfidence of investors and build a continuous-time equilibrium model on speculative bubbles which usually are associated with high trading volume under a short sale ban. According to their theory, given short sale constraints, investors tend to pay a higher price than their own evaluation of the value of a stock because they believe there is another investor willing to buy it for more. The reason is that short sale constraint keeps short sellers who have negative view out of the market and only optimistic investors stay in the market. Trade happens whenever a investor believes he/she can sell the stock at a higher price. This speculative process raises bubble and trading volume in the market. If short sale ban is lifted, such bubble related trading will disappear and liquidity will decrease. In sum, the theoretical impact of heterogeneous beliefs on asset returns is mixed. The theoretical inconclusiveness of the effect of a short-sale on liquidity poses a real danger in terms of regulatory objectives and should be complemented by robust empirical analyses, especially given the recent interest in banning the naked short-selling of credit default swaps in the European market.[1] Unfortunately, the empirical results are also mixed. Beber and Pagano (2013), Boehmer, Jones and Zhang (2013) find evidence that short sale bans lead to a decrease in liquidity during 2008-2009 financial crisis. On the other hand, Jones (2012) reports that during the

[1] `http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/ecofin/128081.pdf`, retrieved as of April 1, 2014.

Great Depression in US, 1932 requirement on written authorization reduces liquidity, while 1931 and 1938 requirements on the upticks rules increase liquidity. In sum, empirical studies show ambiguous results in terms of the impact of short sale ban on stock liquidity. Nevertheless, previous studies in the literature typically rely on data in a crisis period without a comparision with a non-crisis period. A crisis period is usually regarded as a speculation bubble burst period. Literature on the behavior finance (e.g., Hoffmanna, Posta and Penningsa, 2013) find that investors tend to decrease their expectations on returns and risk tolerance during a financial crisis. Considering the view of Scheinkman and Xiong (2003), short sale ban would not easily raise speculative trading during financial crisis in which investors are less confident and more risk-averse. Therefore, short sale ban may have a different impact on liquidity in crisis and non-crisis periods.

I focus on HKEx, which provides us a rare data to test the effect of short sale ban because (i) the HKEx regulator revises the list of shortable stock at a quarterly basis and each time several stocks are banned from short sale; (ii) the selection criteria of trading volume and market capitalization have been applied consistently during our sample period, from 2006 to 2010, which covers crisis time and non-crisis time.

I investigate the different impacts of short sale ban on liquidity of individual stocks during crisis and non-crisis periods by applying a difference-in-difference method to matched pair-day panel data. I employ a propensity score matching method to find a pair of shortable and unshortable stocks of similar characteristics in other dimensions. My data are the difference of several measures between the two stocks in each pair over year 2006 to 2010. According to shortable criteria in Hong Kong

Stock Exchange (HKEx), I use trading volume and market capitalization to calculate propensity for each stock to be selected as a target of short sale ban. Trading volume and market capitalization are matching standard also used by Boehmer, Jones and Zhang (2013) . The propensity score based pair-day sample has several advantages over firm-day sample: (i) it helps one to isolate an effect of ban on liquidity by controlling other features, and (ii) it is relatively free of the selection bias emerging from the liquidity-based criterion for shortability.

The contributions of this study are two-fold. First, I find a negative relationship between short sale ban and stock illiquidity during non-financial crisis. In other words short sale ban improves liquidity. The evidence is robust to controlling for pair-level difference in several characteristics such as volume, capitalization, return uncertainty, price volatility, and price level. Second, I distinguish the impact during financial crisis and non-crisis period, which has been overlooked so far. My results show that in financial crisis period, the liquidity-supporting effect diminishes. This paper complements the recent investigations by e.g., Beber and Pagano (2013), on the urgent short-sale ban amid the financial crisis from 2007 to 2009.

4.2 Market Background, Data and Methodology

4.2.1 Market Background and the regulation on Short Sale Ban implementation

In January 1994, along with the reform of the securities borrowing and lending regime, HKEx introduced a pilot scheme for regulated short selling. From then on, selective stocks, also know as *designated securities*, can be sold short. The HKEx regulator revises the list of designated securities on a quarterly basis. The main criteria for a specific security to be listed for short-selling are its market capitalization and turnover according to regulation explanation [2]. In more detail, (I)shortable stocks should have a market capitalization of not less than HK dollar 3 billion, and (II)an aggregate turnover during the preceding 12 months to market capitalization ration of not less than 50%.

The criterion-II is indeed about liquidity of individual stock, because (i) daily turnover is the ratio of daily volume to total shares outstanding, (ii) the outstanding does not change frequently, and (iii) trading volume is often used as a measure for liquidity, see e.g. Charoenrook and Daouk (2005).

From January 1994 to the end of year 2013, the list of designated securities has been changed 119 times. Among them, in 56 times, there are stocks being deleted from the list. The total number of shortable stocks in the market at the end of 2013 is 583, while the number of common stocks traded in the HKEx main board is 1477.

4.2.2 Data Descriptions

My data cover the period from January 1, 2006 to December 31, 2010. Data are collected from Datastream, including daily bid price, ask price, volume weighted average price, closing price, trading volume, market capitalization and volatility of 90-day returns.

Table 4.1 shows the information on the 20 revisions of the list of designated securties in my sample. *Effect Date* is the date on which the list change goes into

[2]See the selection criteria No.6 in `http://www.hkex.com.hk/eng/market/sec_tradinfo/regshortsell.htm`, retrieved Match, 2014

effect. *Deletion* is the number of stocks deleted from the list. *On list* is the number of stocks on the list after changes. In each revision, stocks which satisfy the criteria of liquidity and market capitalization become shortable, while stocks do not satisfy these criteria become unshortable. Table 4.1 in Bai and Qin (2014) reports all of the historical revisions of the shortable list from January 3, 1994 to August 12, 2011. Distinctive from Bai and Qin (2014), this study focuses on those revisions with stocks deletions because deletions indicate the imposing of short-sale ban on those stocks. Revisions that only contain additions are not included in my sample.

Table 4.1: 20 revisions of designated stocks

Effective Date	Deletion	On list	Effective Date	Deletion	On list
2006/2/20	8	276	2008/8/7	51	501
2006/5/29	17	284	2008/11/14	144	363
2006/8/25	10	314	2009/2/12	27	361
2006/12/1	9	363	2009/5/14	22	352
2007/3/5	24	369	2009/8/5	16	386
2007/5/21	14	394	2009/11/5	11	433
2007/8/13	9	527	2010/2/1	8	503
2007/11/26	23	567	2010/5/10	12	553
2008/2/18	41	560	2010/8/4	19	575
2008/5/13	47	536	2010/10/29	18	605

All data are between January 1, 2006 and December 31, 2010. *Deletion* shows the number of stocks deleted from the list. *On list* shows the number of stocks on the list after changes.

4.2.3 Propensity Scoring Matching Method

I create treated-control matched stock pairs using a propensity score matching method, proposed by Rosenbaum and Rubin (1983) to reduce the sample selection bias in estimating the treatment effect. This method has been used in the financial literature when dealing with dynamic panel data (e.g. Li and Zhao (2006); Behr and Heid (2011)). The propensity score matching method includes two steps[3]. Step 1 deals with the target selection process for a specific policy. Stocks (firms) which are treated by some policy belong to group E and untreated stocks (firms) belong to group NE. The probability for being selected into treated group E is calculated by the following a probit model:

$$Pr(E \mid Z) = Pr(Z \cdot \gamma + \eta > 0), \tag{4.1}$$

where Z denotes the vector of explanatory variables, γ is the vector of coefficients and η is the error term.

Step 2 is to confirm if there exists treatment effects by test the difference between treated group E and untreated group NE.

$$E(Y_{E,j} - Y_{NE,j}) = 0 \tag{4.2}$$

$Y_{E,j}$ and $Y_{NE,j}$ liquidity variables for stocks (firms) after the policy takes into effect; j is the matched pair index.

Matching

Employing this method, I match each unshortbale stock with a shortable stock by their propensity to be deleted from the designated stock list. In more detail, for each deletion event date T, I use all stocks on the designated stock list before T to

[3] *Handbook of Corporate Finance, Volume 1. Chapter 2*

run a probit regression (4.3).

$$Ban_i = \beta_1 \cdot MV_i + \beta_2 \cdot Vol_i + \epsilon_i, \qquad (4.3)$$

where the dependent variable Ban_i is a dummy variable and equals to 1, when stock i becomes subject to short sale ban in T, otherwise equals to 0. Its coefficient measures the impact of deletion of stocks from the shortable list on the illquidity differential. MV_i is 90 days averaged market capitalization of individual stock i before T. Vol_i is 90 days averaged market capitalization of individual stock i before T. I choose 90 days as the regressor formation period because designated stock list is revised for every three months in HKEx. Capitalization and volume data in preceding three months are considered as the determinants for short sale qualification. I repeat this regression for 20 times based on different T (T from 1 to 20 in my sample period)[4]. In each time T, this regression is a cross-section one, for notational convenience, I drop subscript T in the model.

The first step regression reports a propensity score for each stock i, which measures the propensity for each stock to be subject to short sale ban. Based on these scores, I find a control stock for each treated stock by finding nearest neighbor (see stata command option: caliper). In each pair, one stock is from the treated group E, where Ban dummy equals to 1 and the other is from the control group NE, where Ban dummy equals to 0. After 20 times matching process, the total number of formed pairs is 131.

[4] using stata program *psmatch2*

A pair-based Dynamic Panel Test

The second step, I use a pair-based dynamic panel to test short sale impact over a period from 2006 to 2010. As is parallel to Boehmer, Jones and Zhang (2013), the estimation method relies on a stock-pair fixed effect regression. My panel regression analyses incorporate all 131*2=262 stocks in the sample by performing regression (4.4):

$$ILQ_{j,t} = \alpha_j + \beta_1 \cdot Ban_{j,t} + \beta_2 \cdot Crisis_{j,t} + \beta_3 \cdot MV_{j,t} + \beta_4 \cdot Vo_{j,t}$$
$$+\beta_5 \cdot Rvol_{j,t} + \beta_6 \cdot Vol90_{j,t} + \beta_7 \cdot VWAPj,t + \beta_8 \cdot Ban_{j,t} * Crisis + \epsilon_{j,t}, \quad (4.4)$$

where $ILQ_{j,t}$ is the illiquidity measure for the banned stock less the illiquidity measured for its unbanned match. My first illiquidity measure is Amihud illiquidity index. In a robustness analysis, I also use the bid-ask spread as an alternative illiquidity measure. In the right-hand side, a matched pair's fixed effect, α_j, is present. $Ban_{j,t}$ is a dummy variable equals to one if and only if ban takes effect for treated stock in matched pair j on day t. $Crisis_{j,t}$ is a dummy variable indicates the crisis period from August 2008 to December 2009, which equals 1 if day t is within this period and otherwise 0. 5 convariates are included in the regression to control other effects on liquidity. They are the pair level differences of: market cap, trading volume, the proportional daily range of transaction prices, the daily volume-weighted average share price (VWAP) and price volatility in 90 trading days .

Dependent Variables

The first measure of illiquidity is given by Amihud (2002, p.35), in which turnover is interpreted as a proxy for the liquidity demand because it is related to the ability to trade sufficiently large amounts of securities over a short period of time. It is formed as follow for each stock i in day t:

$$ILQ_{i,t} = \frac{|RET_{i,t}|}{V_{i,t}} \cdot 10^6.$$

Because the scale of $|RET_{i,t}|/V_{i,t}$ tends to be very small, I multiply it by 10^6 as Amihud (2002) does. It causes no changes in the subsequent statistical inference on slope coefficients based on t-values. The difference of ILQ between the stocks in each pair j is used in (4.4) as dependent variable.

$Spread_{i,t}$

Bid-ask spread is usually used as a measure of illiquidity. Beber and Pagano (2013) employ daily quoted percentage bid-ask spread to proxy illiquidity. Following Conroy (1990), I calculated spread as second proxy for illiquidity

$$Spread_{i,t} = PA_{i,t} - PB_{i,t}$$

where $PA_{i,t}$ and $PB_{i,t}$ are ask price and bid price for stock i in day t, respectively. $price_{i,t}$ is the daily closing price.

4.3 Results and Discussions

The second to fifth columns in Table 4.2 summarize the estimates of coefficients fixed effect regression coefficients in (4.4). Model-I omits the *Crisis*, Model-III and -IV use sub-samples in crisis time and non-crisis time, respectively, to see if the estimated coefficient of *Ban* varies over two regimes. Model-II includes an interaction term of ban and crisis and use whole samples to see if crisis has an additional impact on the coefficient of *Ban*. Numbers in parentheses are t-values based on heteroskedasticity and autocorrelation-consistent (HAC) standard errors. $Adj.R^2$ is the coefficient of determination with the degree-of-freedom adjustment.

The estimated coefficients of *Ban* are significantly negative in all models from Model-I to Model-IV, suggesting that short sale supports liquidity of individual stocks. This effect is large (8.07, 17.00 and 16.87 percentage points) and significant in three of four models, shown in Model-I, II, and IV. The only exception is coefficient of ban in Model-III. The coefficient of *Ban* in Model-III become much smaller and less significant (-0.00026 significant at the 5% level) than those in other models. This result indicates that in financial crisis, short sale ban has much more liquidity decreasing impact than in usual time. The aggregating results of these two directions impact lead to the small coefficient. Correspondingly, interaction term of short sale ban and crisis in Model II is significantly positive, which confirms that during financial crisis, short sale ban has a negative impact on liquidity. My results are consistent with Bohhmer, Jones and Zhang (2013, Table 4) and Fang and Jiang (2013, Table IV) in financial crisis. However, in non-crisis period, my results reveal a novel liquidity-supporting effect of short-sale ban of a Hong Kong style. Such a discrepancy may be generated because during financial crisis investors become less aggressive and reduce their risk tolerance as stated by Hoffmanna, Posta and Penningsa (2013). The overconfidence conjecture by Scheinkman and Xiong (2003) may be applied to the period of financial crisis, in the sense that short sale ban would not easily raise speculative trading during financial crisis than during non-financial crisis time. My findings support this conjecture and complement aforementioned literature which only study either the financial crisis period or non-crisis.

Coefficients of control variables are consistent with prior results in the literature. The coefficients of volume and market capitalization are small and negatively related with illiquidity. This is natural because these two measures take care of the amount of trading activities and the availability of stocks in the market for trading, so that more frequently trading happens in the market with more liquidity. The coefficient of $VWAP$ is significantly positive with a great magnitude, suggesting that a higher stock price tends to have an adverse impact on illiquidity. This is consistent with the intuition that a lower price is more affordable for inverters to buy. $Rvol$ and $Vol90$ suggest that higher range amd volatility of price worsen liquidity, as Boehmer, Jones and Zhang (2013) confirm.

4.4 Robustness Check

Table 4.3 reports my results by using pair difference of absolute bid-ask spread as dependent variables. The negative coefficients of short sale ban in Model I, Model II and Model IV and the positive coeffecient in Model III show similar impact of short sale ban on liquidity.

Table 4.2: Ban effect on liquidity, in financial crisis year 2006 to year 2010 with Amihud illiquidity as dependent variable

	I	II	III	IV
ban	-8.071**	-17.00**	-2.16e-4*	-16.87**
	(-5.69)	(-8.26)	(-2.22)	(-6.07)
VO	-1.33e-08	-1.31e-08	-5.00e-13	-8.74e-08†
	(-1.15)	(-1.13)	(-0.82)	(-1.74)
MV	-5.49e-10*	-5.32e-10*	6.42e-15	-1.96e-09**
	(-2.40)	(-2.33)	(0.48)	(-2.94)
VWAP	0.194**	0.194**	1.63e-4**	0.194**
	(305.73)	(305.60)	(20.98)	(225.05)
Rvol	1.407**	1.404**	-1.85e-5*	2.379**
	(12.12)	(12.09)	(-1.99)	(11.67)
Vol90	-0.113**	-0.114**	4.56e-6**	-0.189**
	(-6.08)	(-6.11)	(3.26)	(-5.59)
Ban· Crisis		16.92**		
		(5.98)		
_cons	7.645**	9.767**	6.48e-4**	17.86**
	(7.62)	(9.18)	(10.90)	(7.85)
N	162449	162449	73213	89236
Adj. R^2 %	36.7	36.7	36.0	36.7

Adj.R^2 is in percentages. Numbers in parentheses are t-values based on HAC standard errors. †, $*$, $**$ on estimates show statistical significance at 1%, 5% and 10% significance levels, respectively, according to two-tailed t-tests.

Table 4.3: Ban effect on liquidity, in financial crisis year 2006 to year 2010 with bid-ask spread as dependent variable

	I	II	III	IV
ban	-584.4†	-1336.3**	7.902	-1268.4†
	(-1.67)	(-2.63)	(0.70)	(-1.85)
vo	-50.9e-08	-49.5e-08	2.11e-08	-39.8e-08
	(-0.18)	(-0.17)	(0.30)	(-0.32)
mv	7.30e-08	7.44e-08	1.01e-09	3.38e-08*
	(1.29)	(1.32)	(0.65)	(2.05)
vwap	-0.262†	-0.267†	-0.846	-0.309
	(-1.67)	(-1.71)	(-0.94)	(-1.45)
pvol	43.46	43.19	0.107	70.51
	(1.52)	(1.51)	(0.10)	(1.40)
vol90	-12.67**	-12.72**	-0.435**	-22.89**
	(-2.75)	(-2.77)	(-2.69)	(-2.74)
Ban· Crisis		1424.6*		
		(2.04)		
_cons	679.3**	857.9**	-2.163	1461.3**
	(2.74)	(3.26)	(-0.31)	(2.60)
N	162458	162458	73217	89241
Adj. R^2%	26.4	26.3	21.0	26.3

Adj.R^2 is in percentages. Numbers in parentheses are t-values based on HAC standard errors. †, $*$, $**$ on estimates show statistical significance at 1%, 5% and 10% significance levels, respectively, according to two-tailed t-tests.

4.5 Conclusions

The impact of short sale ban on liquidity of individual stock is theoretically ambiguous. It is further blurred by the characteristics and behavior of investors in crisis and non-crisis periods. This paper isolates the effect of ban by combining two empirical strategies. First, I use the Hong Kong Stock Exchange data in which the profile of shortable stocks changes regularly at a quarter basis and short sale ban is imposed and lift both during financial crisis time and non-crisis time.

On the basis of a fixed effect panel regression model, I find that short sale ban has improved liquidity during regular period but such an effect diminishes during financial crisis, as is consistent with the implication by Scheinkman and Xiong (2003) model. Second, I use the propensity score matching method where volume and market capitalization are two matching criteria, and perform a difference-in-difference estimation of the effect of short-sale ban on the differential in liquidity between shortable and nonshortable stocks in pairs.

The Hong Kong stock market is a representative developed securities market in Asia. The analyses of the effect of limiting short-selling in this study will be useful for inferring the effect of a similar regulation in other local markets as well. Moreover, during 2008-2009 financial crisis, over 30 markets in the world banned short sale. Therefore, our study will serve as a reference for evaluating government policies regarding the short-sale restriction.

Chapter 5

Conclusion and Policy Implications

Given various implementations of short-sale bans around the world, especially during the financial crisis period, it is important for regulators, investors and academics to understand the impacts of short-sale ban in financial markets. This dissertation attempts to empirically examine such impacts on the relationship between heterogeneity of investors' beliefs and future return and on stock liquidity.

The key findings in this study are as follows. First, a negative relationship between heterogeneity of investors' beliefs and future returns under short sale ban is confirmed in Shanghai Security Exchange, where short-sale ban is imposed for decades. This relationship is robust with controlling for several stock characteristics such as size, leverage, book-to-market ratio, momentum, and different quantiles of the distribution of returns. These results suggest that, under short sale ban, security prices tend to be overvalued as investors' beliefs become more dispersed.

Second, although a similarly negative heterogeneity-return relationship is found in Hong Kong Stock Exchange under short-sale ban, such a relationship disappears if short-sale ban is lifted. Moreover, such a changing effect of short-sale ban is much stronger if good news of earnings are announced than bad news are. These results confirm the findings in Shanghai market and furthermore they suggest that short-sale ban changes the composition of investors in the market. Because of short-sale ban, investors with relatively optimistic opinions would stay in the market while those with relatively pessimistic opinions would leave. These findings have implications to the urgent implementation of short-sale ban during financial crises. Although the prices may be elevated during the ban, this effect cannot persist for a long period of time. As prices revert to their fundamental levels, short-sale ban would lead to a significant decease in future returns. By including data over a long period, my results complement the recent investigations about short-sale ban amid the financial crisis from 2007 to 2009.

Third, short-sale ban has a positive effect on stock liquidity during non-financial crisis periods. This is somewhat surprising because it means that some restrictions on trades may have a good impact on liquidity. It suggests that regulators in the world should pay more attention to the constraint of a Hong Kong-style, as least as a policy tool during a normal period.

Fourth, during a crisis period in which investors are typically less confident about future profitability of firms and more risk-averse, short-sale ban may loose its supportive effect on liquidity; the effect may turn to be insignificant or even negative. Therefore, regulators should recognize that the adverse impact on future returns and the lack of, or even negative impact on current liquidity are the cost of the short-sale ban to save the market during financial crisis periods.

This thesis can be extended in three aspects by future works. First, given a gradual promotion of marginal trading and securities lending by China Securities Regulatory Commission since March 2010, this study can serve as a basis for evaluating the lift of regulation when sufficient post-ban data are available in the future. Second, my research methods can be applied to other financial crises, such as Asian Financial Crisis in 1997 to examine the time-varying effect of short-sale ban during financial crisis and non-crisis periods. Third, although the short-sale ban has an adverse impact on future return and null impact, at best, on liquidity during the crisis period, the role of short-sale ban to save the market in distress still requires further work, such as a counter-factual analysis.

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