



# Impact of heterogeneous beliefs and short sale constraints on security issuance decisions

Yahua Wang, Feng Xu\*, Angang Hu

School of Public Policy and Management, Tsinghua University, Beijing, 100084, PR China

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## ABSTRACT

Extant literatures discuss a firm's security issuance implications of heterogeneous beliefs with explicit assumption that short selling is forbidden. However, it is widely accepted that short sale constraints exist when investors are unable to short stock to the extent they desire. This paper presents a model to analyze how heterogeneous beliefs and short sale constraint conditions jointly affect a firm's security issuance decision. The main findings are: i) An increase in heterogeneity in investors' beliefs results in an increased likelihood of equity issuance over debt when public signal is favorable, whereas it results in a reduced likelihood when public signal is modestly adverse. ii) The tightness of short sale constraints has a positive effect on the likelihood of equity issuance only when public signal is highly favorable. These results indicate widely divergent conclusions about the relations between heterogeneous beliefs as well as short sale constraints and security issuance decision.

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## 1. Introduction

Whether and how heterogeneous beliefs among investors affect a firm's security issuance decision has been an important issue. In a main strand of extant literatures, the study of investors' heterogeneous beliefs is developed under a behavioral corporate finance theory whose underpinning foundation is the cognitive psychology literature with the belief that people are in general overconfident (see, e.g., [Alicke, 1985](#); [Scheinkman and Xiong, 2003](#)). Researchers have extended the psychology literature to behavioral corporate finance and find that participants in financial market, as a special group, are more likely to exhibit overconfidence than ordinary people (see, e.g., [Grinblatt and Keloharju, 2009](#); [Statman et al., 2006](#)).

Papers on security issuance implications of heterogeneous beliefs are relatively scarce. A notable exception in this regard, is [Chemmanur and Liu \(2006\)](#) who draw heterogeneity in beliefs from a uniform distribution and propose a security issuance model with explicit assumption that short selling is forbidden. They show that heterogeneous beliefs among investors will increase the likelihood to issue equity for a firm under the belief that the divergence of investors' opinions and the constraint of short selling generate a price bubble and thus create a window of opportunity for equity issuers to raise capital at a low cost. Consistent with such prediction, a few empirical studies have found that the characteristics of investors, particularly heterogeneous beliefs may lead to distortions in firms' security issuance decision and that the more heterogeneous the investors' beliefs are about the firm, the more likely a

firm is to issue equity rather than debt (see, e.g., [Chemmanur et al., 2009](#)). More recently, [Bayar et al. \(2010\)](#) incorporate significant issuance cost and financial distress cost into [Chemmanur and Liu \(2006\)](#) framework and predict that a firm issues equity when investors' beliefs are highly dispersed; straight debt when investors' beliefs are least dispersed; and convertible debt when outsider beliefs are between the above two extremes. Their analysis generates a pecking order of external financing under heterogeneous beliefs. Unfortunately, the above two theoretical papers suffer from a problem at least. They don't specify whether heterogeneous beliefs occur for an irrational reason or not. Actually, if an investor is willing to pay for equity with above average price, he must be overconfident (see, e.g., [Miller, 1977](#)). Moreover, the overvaluation of stocks with a divergence in investors' beliefs is not inevitable. Most of the previous empirical works on asset pricing implication of heterogeneous beliefs show that, the stock with dispersion in investors' opinion could be either overvalued or undervalued (see, e.g., [Cao and Ou-Yang, 2004](#); [Hong et al., 2006](#); [Daniel et al., 2001](#); [Varian, 1989](#)).

The above papers discuss the relation between heterogeneous beliefs and security issuance decision without invoking any assumption on short selling. Even though short selling is allowed, pessimistic investors are unable to short stock to the extent they desire when there is strong demand and limited supply. In previous papers, the tightness of short sale constraints, i.e., the difficulty of shorting stock for investors could be one explanation for financing distortions (see, e.g., [Chemmanur et al., 2009](#)). The short selling view argues that the greater the constraint on short sale, the greater the price bubble, for giving the amount of divergence in investors' beliefs (see, e.g., [Asquith et al., 2005](#); [Nagel, 2005](#)). An open question is how the interaction of

\* Corresponding author.

E-mail address: [xufeng830103@mail.tsinghua.edu.cn](mailto:xufeng830103@mail.tsinghua.edu.cn) (F. Xu).

heterogeneous beliefs among investors with short sale constraints may affect a firm's security issuance decision. It is likely that the tightness of short sale constraints may affect a firm's likelihood of equity issuance. Specifically, the difficulty of shorting for investors may change the effect of investors' characteristics on security issuance. In this paper, we develop a model of security issuance under heterogeneous beliefs in an equity market with short selling, and provide some novel answers to the above questions.

It is important to point out that, this paper is the first to analyze the effect of heterogeneous posterior beliefs on security issuance. In our model, heterogeneous beliefs arise from different interpretations of public information about the firm's future prospects between different types of investors. In contrast to our paper, [Dittmar and Thakor \(2007\)](#) focus on difference of opinion between firm insiders and outside investors as a group. In their setting, investors have heterogeneous priors "agree to disagree" about the project's payoff. In addition, unlike our paper, [Bayar et al. \(2010\)](#) use the dispersion of probability that the firm will achieve the high cash flow among investors to measure the prior heterogeneity in beliefs.

The purpose of this paper is to show how heterogeneous beliefs among investors and short sale constraint conditions jointly determine a firm's security issuance decision. Our findings show that the heterogeneity in investors' beliefs has a positive effect on the likelihood of equity issuance over debt when public signal is favorable, but has a negative effect on that when public signal is modestly adverse. We also show that the tightness of short sale constraints has a positive effect on the likelihood of equity issuance over debt only when public signal is highly favorable. Our results suggest that public signal has an impact on the relations between heterogeneous beliefs as well as short sale constraints and security issuance decision.

Our paper contributes to extant literatures in at least two ways. Considering a realistic assumption that investors are unable to short stock to the extent they desire, we explore the joint impact of the heterogeneity in investors' beliefs and the tightness of short sale constraints on a firm's security issuance decision. Furthermore, considering several scenarios that investors may face in reality, we stress security issuance implications of heterogeneous posterior beliefs generated by investors' overconfidence.

The remainder of this paper is organized as follows. [Section 2](#) develops the model. The analysis and numerical simulation of security issuance decision appear in [Section 3](#). [Section 4](#) concludes. The proofs of all theorems and propositions are in the appendixes.

## 2. The model

### 2.1. Preferences and timeline

Our model has four dates, which we label times 0, 1, 2 and 3. The details in the sequences of events in the process of security issuance are summarized in [Fig. 1](#). At the initial date 0, the firm is all equity financed. For convenience, the total number of the firm's shares is

normalized to one. Market participants start with identical prior beliefs about underlying security value. More specifically, it is known to all investors that the firm's liquidating dividend  $V_0$  at date 3 should be normally distributed with a mean of zero and a prior variance of  $h_v^{-1}$ .

At date 1, an investment opportunity for an innovative project arrives, and the firm decides to issue security to fund it. At this moment, all market participants lack information about the detailed characteristics of this project. At date 2, an identical public signal  $S$  about the innovative project will appear. This signal contains information about date 3 payoff of the innovative project. After observing this signal, all investors use the Bayesian rule to update beliefs, and then further allocate their remaining wealth. At date 3, conclusive public information arrives. The firm pays a liquidating dividend and all consumption takes place. For analytical tractability, we present basic assumptions of the market, the firm and the investors.

A competitive market consists of two securities available, a risky stock which pays an uncertain cash flow and a riskless bond with rate of zero in perfectly elastic supply. We assume that all investors are able to short stock with a limited supply. We use short interest ratio  $G \geq 0$  (shares sold short/shares outstanding) to measure the tightness of short sale constraints (see, e.g., [Asquith et al., 2005](#)). When short interest ratio increases or decreases, short sale constraints are either relaxed or tightened, respectively.

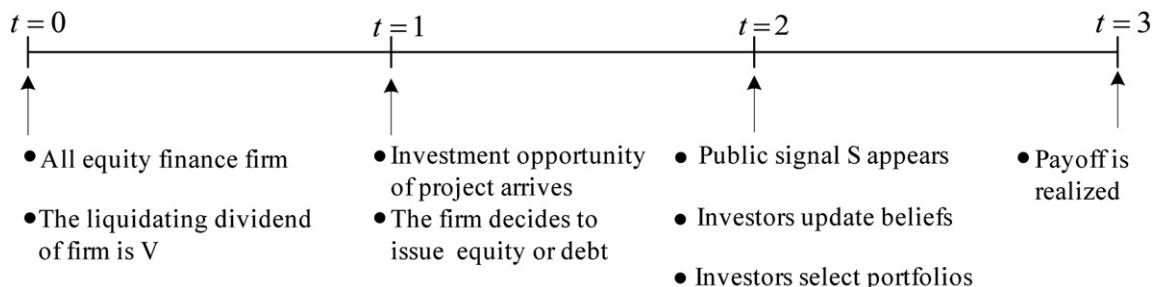
There exists a unique publicly traded firm in market. The manager, owning a certain fraction of the firm's equity, decides to issue security to fund the project. We assume that the manager has exhausted wealth and therefore cannot be a participant in new securities. We assume that the manager issues a fraction  $2Q \geq 0$  of the firm's equity. The financing source consists of two mutually exclusive securities: equity or straight debt. There are no security issuance cost and transaction cost.

The economy consists of two groups of risk-averse investors: those who are rational, denoted as  $L$ , and those who are overconfident, denoted as  $F$ . For simplicity, the total number of investors is normalized to one. We assume that investors in each group are identical and every group has an equal population. All investors are rational in all aspects except the interpretation of public signal about the project's payoff. To be specific, the rational investors estimate correctly the precision of the public signal, while the overconfident investors overestimate it (see, e.g., [Odean, 1998](#)). In addition, we assume that each investor has an initial endowment, denoted as  $W_0$ , and a CARA utility function with a risk aversion coefficient of one.

At date 2, each investor in two groups receives the same noisy public signal. We assume that public signal takes the form:

$$S = V_0 + e_i, \quad (1)$$

where  $e_i$  is the noise item of public signal, normally distributed with a mean of zero and a variance of  $h_{i,e}^{-1}$ . It is assumed that  $h_{L,e}^{-1} > h_{F,e}^{-1}$  for all investors.



**Fig. 1.** Sequence of events in the security issuance process.

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