Do Institutional Investors Improve Capital Allocation?*

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January 2014

Abstract

Whereas the existing literature shows that portfolio managers' career concerns generate inefficiencies, I show that they have a positive side in the presence of feedback effects between stock prices and corporate decisions. Specifically, career-concerned portfolio managers induce more efficient capital allocation than individual investors, thus facilitating greater investment and growth. Funding markets require information, but large individuals are sometimes disinclined to acquire it; in contrast, the career concerns of portfolio managers lead them to embed information into prices and trade more often. Surprisingly, it is the excessive trading of uninformed portfolio mangers that increases price informativeness and decreases good firms' cost of capital.

1 Introduction

A fundamental role of the economy is to allocate capital and foster efficient investment. Adverse selection in the funding market may inhibit capital from flowing to good firms, preventing them from investing in positive NPV projects. The stock market mitigates this problem: secondary market prices aggregate information that guides the flow of capital.

*I am grateful to Ulf Axelson, the late Sudipto Bhattacharya, Sugato Bhattacharya, Mike Burkart, Amil Dasgupta, James Dow, Jason Roderick Donaldson, Alex Edmans, Daniel Ferreira, Itay Goldstein, Radhakrishnan Gopalan, Denis Gromb, Christian Julliard, Ohad Kadan, Peter Kondor, Daniel Paravisini, Christopher Polk, Uday Rajan, Anjan Thakor, David Thesmar, Dimitri Vayanos, Michela Verardo, Kathy Yuan, Konstantinos Zachariadis, and audiences at Amsterdam Business School, Arizona Sate University, Bocconi University, the EFA 2013 conference, EIEF, Federal Reserve Board of Governors, the FIRS 2013 conference, HEC Paris, UBC, UNC, University of Maryland, University of Michigan, Stockholm School of Business, University of Pennsylvania, University of Warwick, and Washington University in St. Louis.

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In the US, delegated portfolio managers have replaced individual investors as the main owners of shares in public companies.[1] The existing theoretical literature focuses mostly on the negative effects of delegated portfolio managers' agency frictions. For example, using funds' career concerns to capture fund managers' agency frictions, Dasgupta and Prat (2008) and Guerrieri and Kondor (2012) find that funds' career concerns have adverse effects on asset prices.[2]

Given that capital allocation is guided by secondary market prices but fund managers' career concerns distort them, do career-concerned fund managers cause mis-allocation of capital and thus real investment inefficiency? In a market microstructure model with feedback effects and speculators' endogenous information acquisition, I show that career-concerned speculators (funds) acquire more information and trade more than profit-maximizing speculators (individuals), thus increasing price efficiency and helping the stock market in its allocative role.

Two main forces are behind this result. The first is that skilled funds are more willing to acquire information than individuals when prices are informative. As pointed out by Dow, Goldstein, and Guembel (2011), in models with feedback effects, skilled profit-maximizing speculators have weak incentives to acquire information when prices are high. This can lead to a market breakdown. I show that speculators' career concerns may dampen this effect. The second force is that unskilled funds trade more than unskilled individuals—they trade with no information, engaging in what has been termed "churning" by Dow and Gorton (1997). In their model, churning generates noise in the price, similar to that generated by noise traders. Perhaps surprisingly, in my model, unskilled funds' churning does not reduce price informativeness but rather enhances it.

Financial commentators have suggested that delegated portfolio managers should charge performance fees to align fund managers' interests with those of their clients,[3] but limited

[1]Michaely and Vincent (2012) find that, by the end of 2009, institutional investors held 70 percent of the aggregate US market capitalization. French (2008) reports the percentage of US equity held by various investors between 1980 and 2007. He shows that the proportion of direct holdings steadily decline over time, whereas the proportion of institutional holdings increase over time.

[2]Further, Goldman and Slezak (2003) and Vayanos and Woolley (2013)) study the negative effect on asset prices, Dasgupta and Piacentino (2014) study the negative effect on corporate governance and Berk and Green (2004) study the negative effect on investors' wealth. An exception is Dow and Gorton (1997) who show that while portfolio managers trade excessively, they increase market liquidity and thus others' incentives to acquire information.

[3]For example, in July 2013, John Kay, as part of a UK government-commissioned report into the workings of the UK equity market, called for an overhaul of fund manager pay. The report called on asset management firms to align the pay of their fund managers with the interests and timescales of their clients.

evidence supports the benefits of such fees.[4] My model challenges this regulatory prescription. Specifically, it suggests that low-powered contracts improve capital allocation for firms.

I model an environment with asymmetric information between firms and capital providers. Good firms have positive NPV projects while bad firms have negative NPV projects. Managers of bad firms wish to undertake their projects nonetheless in order to obtain private benefits. Firms rely on external finance to fund their own projects, but projects have on average negative NPV so no outsider is willing to fund them.[5] Since with no other information the market breaks down and no investment takes place, firms rely on speculators to acquire information and to impound their information into prices via their trades.

Secondary markets in my model are populated by a large speculator and a number of liquidity traders. The speculator is either profit maximizing or career concerned, and is either skilled or unskilled. While a profit-maximizing speculator wishes to maximize expected profits, a career-concerned speculator wishes to maximize the market's perception of his ability.[6] After a fund trades, the market updates its beliefs about the fund's skill using two pieces of information, namely, the fund's returns and the fund's actions.[7]

The timing is as follows. First, the firm decides to raise funds. Second, if skilled, the speculator decides whether to acquire information. Third, regardless of skill, the speculator trades with liquidity traders. Finally, after observing the aggregate order flow, competitive risk-neutral market makers set the price, taking into account the effect that the price will have on a firm's ability to raise the required funds.

I focus on equity finance because it is the most relevant form of funding for the firms I model: listed corporations that have projects with negative average NPV, little cash, and limited pledgeable assets.[8] In the baseline model, the mechanism through which firms issue equity is in reduced form: the price set by the market maker determines the success of fund-

[4]For example, Elton, Gruber, and Blake (2003) show that on average mutual funds that charge higher performance fees take on more risk but with weak evidence of higher returns.

[5]In Section 5.1 I show that the trading of career-concerned speculators relaxes firms' funding constraints even when firms have on average positive NPV projects as long as primary market investors are sufficiently risk-averse.

[6]Dasgupta and Prat (2008) show that funds maximize the market's perception of their ability to attract new clients. I take this behavior as an axiomatic definition of a fund and do not model client behavior explicitly.

[7]While it is rational that the market updates its beliefs using all available information, the assumption that funds' actions are observable is not critical. Alternatively, the market must be able to distinguish zero returns due to the fund's inaction from zero returns due to the firm's failure to invest.

[8]Equity, as Myers and Majluf (1984) predict, is the financing instrument of last resort. Recent empirical evidence (see, e.g., DeAngelo, DeAngelo, and Stulz (2010) and Park (2011)) suggests a strong correlation between a firm's decision to issue equity and financial distress—in line with my assumption of negative average NPV projects.

raising because it contains information that allows capital providers to update their beliefs about a firm's quality.

I begin by studying two cases in which the skilled speculator acquires information: one case in which he is profit maximizing and one case in which he is career concerned. Next I characterize the equilibria in each of the two cases. This leads to the main result that career-concerned speculators allocate capital more efficiently than profit-maximizing speculators. This more efficient capital allocation loosens firms' constraints, enabling firms to fund a larger fraction of projects that have positive average NPV. Below I elaborate the forces behind this result.

Since projects have negative average NPV, firms can raise capital only when prices are high, that is when they reflect the speculator's private information that the firm is good. To avoid a market breakdown in which no firm is able to invest, it is thus critical for a skilled speculator to be willing to acquire information even when it is reflected by the price. The skilled career-concerned speculator welcomes high and informative prices because they maximize the firm's investment—only when investment is undertaken can the market learn the firm's true quality, thus allowing a skilled speculator to signal his ability of trading in the right direction. In contrast, a profit maximizer does not benefit from the firm undertaking good investments when prices are already high.

Turning to the unskilled speculator, an unskilled profit-maximizing speculator does not trade in equilibrium as he would suffer a loss from trading due to price impact. In contrast, an unskilled career-concerned speculator always trades. Because skilled speculators always trade, the unskilled speculator would reveal his lack of skill if he were not to trade. But since he has no information about the firm's quality, he randomizes between buying and selling. Fortunately, the extra noise generated in the order flow by the random trade of the unskilled speculator does not destroy the informativeness of the price, but makes prices more informative when it matters for investment. In my model unskilled speculators sell relatively more often than they buy owing to the feedback (between prices and investment) that makes firm value endogenous. When the firm does not invest, speculators' types are indistinguishable. Since selling increases the possibility of investment failure, and thus of the unskilled pooling with the skilled, it follows that the feedback effect induces an unskilled speculator to sell frequently. Because the unskilled speculator is usually selling, buy orders are likely to have come from a positively informed speculator and thus are more informative that the firm is good, reducing good firms' cost of capital.

I next explore the effects of career concerns on economic welfare. I find that career-concerned speculators increase output efficiency compared to profit-maximizing speculators. The key reason is that the unskilled speculator's excessive selling depresses equilibrium prices and hence curtails investment. There is less investment on average when speculators are career concerned than when they are profit motivated. This has two competing effects: it prevents bad projects from being undertaken, and it prevents good projects from being undertaken. When projects have on average negative NPV, undertaking bad projects is more costly than not undertaking good ones, and thus career-concerned speculators reduce output inefficiency.

In Section 3, I extend the baseline model to accommodate a specific mechanism through which firms raise funds: seasoned equity offerings (SEOs). I show that all the results from the baseline model still hold, and I prove the additional result that career-concerned speculators reduce the SEO discount.

This extension builds on the model of Gerard and Nanda (1993). Extending the baseline model to incorporate SEOs requires adding some features—mainly, a stage that follows secondary market trading and in which firms choose the price at which to raise funds. The firm sets the SEO price so as to ensure its success and to compensate uninformed bidders for the "winner's curse" (à la Rock (1986)). The result is that SEO prices are often set lower than secondary market prices; the difference is known as the discount. The SEO mechanism may exacerbate the effect of insufficient information on capital allocation given that firms' discounts further inhibit their ability to raise funds. In addition to making market prices more informative, career-concerned speculators reduce the discount firms must offer by mitigating the effects of rationing (via the winner's curse) on capital providers' willingness to pay.

Is there evidence that institutional investors lessen firms' underinvestment by decreasing their cost of capital? Lev and Nissim (2003) use 13F data to measure institutional investors' stock ownership. Two of their main findings are consistent with my model. First, they show that institutional ownership mitigates firms' underinvestment, whether measured in terms of capital expenditures, business acquisitions, or R&D. Second, they show that institutional ownership mitigates underinvestment primarily by reducing information asymmetries, which in turn reduce the wedge between the cost of internal and external funds.

While my model is stylized, it seems to match some of the empirically observed behavior of career-concerned institutions. For example, Wermers (1999) analyzes mutual funds' trading between 1975 and 1994 to discern whether funds churn. He finds evidence of funds' churning behavior on the sell-side. According to his definition, funds churn when stocks have large imbalances between buys and sells. In my model, stocks would show imbalances only on the sell-side, due to unskilled funds' excessive selling.

This paper is related to recent empirical literature investigating the role of institutional investors in SEOs, which has uncovered positive effects that are consistent with my theoretical results. Chemmanur, He, and Hu (2009) analyze a sample of 786 institutions (mutual funds and plan sponsors) that traded between 1999 and 2005. They find that greater secondary market institutional net buying and larger institutional share allocations are associated with a smaller SEO discount, consistent with my finding that the discount is larger when individual investors than when institutional investors trade. In particular, more net buying in the secondary market is associated with more share allocations in the SEO and more post-offer net buying. Gao and Mahmudi (2008) highlight the substantial monitoring role of institutional investors in SEOs, finding that firms with a higher proportion of institutional shareholders have better SEO performance and are more likely to complete announced SEO deals. This evidence supports my model's prediction that firms whose SEO is subscribed to by institutional investors can invest in more expensive projects and thus on average perform better post-SEO than those subscribed to by individual investors. This evidence also supports the idea that institutional investors reduce the probability that bad projects are undertaken.

This paper is related to two strands of the theoretical literature: (i) the literature on feedback effects and (ii) the literature on managerial career-concerns.

The first strand of the literature studies the feedback loop whereby prices both reflect information about cash flows and influence them. This literature can be divided roughly into papers that study the feedback from prices to managerial learning (Boot and Thakor (1997), Dow and Gorton (1997), Subrahmanyam and Titman (2001), Dow and Rahi (2003), Bond, Goldstein, and Prescott (2010), and Dow, Goldstein, and Guembel (2011)) and those that study the feedback from prices to firms' financing decisions (Baker, Stein, and Wurgler (2003), Fulghieri and Lukin (2001) and Goldstein and Yang (2014)). Two papers in this literature that are very related to mine in that they study the link between market efficiency and real efficiency are Dow and Gorton (1997) and Goldstein and Yang (2014). Dow and Gorton (1997) identify mechanisms for the informationally-efficient price to enhance economic efficiency, whereas Goldstein and Yang (2014) study under what circumstances increased market efficiency leads to higher real efficiency. In my model, in contrast, higher market efficiency always results in higher real efficiency and I study what types of investors increase real efficiency.

The second strand of literature includes papers on the career concerns of a manager whose type determines his ability to understand the state of the world rather than his ability to exert effort (unlike in Holmstrom (1982)). Examples are Holmstrom and Ricart i Costa (1986), Scharfstein and Stein (1990), Gibbons and Murphy (1992), Prendergast and Stole (1996), Milbourn, Shockley, and Thakor (2001), Dasgupta and Prat (2006, 2008), and Guerrieri and Kondor (2012), among others. It is worth noting the distinction between my main result and the findings in Milbourn, Shockley, and Thakor (2001). The interaction between feedback effects and career-concerns is also critical for their key insight: career-concerned CEOs overinvest in information to alter the market's inference about their ability. As in my paper, when projects are rejected the market cannot learn the manager's type. However, in contrast to my paper, their model has a single manager who does not know his own ability. Letting the manager know his type introduces signaling. The skilled speculator acquires information and trades to show off his ability, whereas the unskilled sells frequently to tilt probabilities to outcomes that are reputationally more favorable, that is, to outcomes that allow him to pool with skilled speculators. The behavior of the unskilled speculator drives the main result that career concerns help firms raise funds.

The rest of the paper is organized as follows. Section 2 solves the baseline model and Section 3 solves for the model with an SEO. Section 4 extends the baseline model to include preferences of a more general nature, and simultaneous trading of profit-maximizing and career-concerned speculators, and discusses other applications of the model's main mechanism. In Section 5, I examine the robustness of my model to modifications of several assumptions. Section 6 concludes.

2 Baseline Model

2.1 Model

2.1.1 Firms and Projects

In my model economy there are two types of firms $\Theta \in \{\mathrm{G}, \mathrm{B}\}$, where G stands for "good" and B for "bad". A firm of type Θ is endowed with a project that costs I and pays off V_Θ. The firm's type is private information, and outsiders hold the prior belief $\theta = 1/2$ that the firm is good. Only good firms' projects are profitable, that is, $V_{\mathrm{G}} - I > 0 > V_{\mathrm{B}} - I$. Managers are in charge of the investment decision. Whereas the incentives of good firms' managers are aligned with those of shareholders, bad firms' managers obtain private benefits when projects are implemented and thus are willing to undertake negative NPV projects.[9]

[9]This is in line with Jensen's (1986) overinvestment and empire building.

For simplicity, I assume that firms have no cash or any other assets in place.[10] I relax this assumption in Section 5.3. Each firm holds a project that cannot be mortgaged and that is viewed by the market as having negative NPV:

$$\bar{V} - I := \frac{V_{\mathrm{G}} + V_{\mathrm{B}}}{2} - I < 0. \tag{1}$$

I relax this assumption in Section 5.1.

Firms are publicly traded with n shares outstanding.

2.1.2 The Speculator and Liquidity Traders

The firm's equity is traded by a risk-neutral speculator and liquidity traders. The speculator is one of two types, $\tau \in \{\mathrm{S}, \mathrm{U}\}$, where $\mathbb{P}(\tau = \mathrm{S}) = \gamma \in (0, 1)$. The skilled speculator ($\tau = \mathrm{S}$) can acquire information at a finite cost whereas the unskilled one ($\tau = \mathrm{U}$) faces an infinite cost of acquiring information. The skilled speculator can acquire information $\eta = 1$ at cost c to observe a perfect signal $\sigma \in \{\sigma_{\mathrm{G}}, \sigma_{\mathrm{B}}\}$ of firm's quality, that is, $\mathbb{P}(\Theta \mid \sigma_{\Theta}) = 1$.[11] Regardless of skill, the speculator can buy ($a^{\tau} = +1$), not trade ($a^{\tau} = 0$), or sell ($a^{\tau} = -1$) a unit of the firm's equity. Liquidity traders submit orders $l \in \{-1, 0, 1\}$ each with equal probability.

2.1.3 Timing and Prices

Firms can invest only by raising I. Firms in my model raise capital by issuing equity. Section 5.2 shows that, conditional on a firm's raising capital by issuing debt, the analysis remains unchanged. For simplicity, I assume that firms raise equity at the market price. The mechanism through which firms issue equity is temporarily left unmodeled. I address this issue in Section 3 by explicitly modeling SEOs.

There are four dates: $t = 0, 1, 2, 3$. At $t = 0$ the firm decides whether to raise I and then the skilled speculator decides whether to acquire information ($\eta = 1$) and thus observe a signal of the firm's quality. At $t = 1$, the speculator trades $a = \{-1, 0, 1\}$ with liquidity traders and prices are set by a competitive market maker. After observing the total order flow $y = a + l$, the market maker sets the price $p_1(y)$ in anticipation of the effect that this price will have on the firm's ability to raise the required funds from capital providers. Competitive capital

[10] In fact, my results depend only on the non-pledgeability of assets in place—in other words, on the assumption that firms can no longer mortgage their assets to fund themselves.

[11] In Section 5.4 I relax this assumption by allowing both the skilled speculator and the unskilled speculator to observe imperfect signals about the quality of the firm.

providers invest I in the firm by buying a proportion α of its shares that makes them break even. Capital providers are uninformed about the quality of the firm, but observing prices enables them to update their beliefs about that quality to $\hat{\theta}(y)$. When prices indicate that the firm is more likely to be good than bad, capital providers may be willing to fund it at $t = 2$. If not, then the issue fails and the project is not undertaken. Let $\iota \in \{0, 1\}$ denote the firm's investment, where $\iota = 0$ if fund-raising fails and the firm is unable to invest and $\iota = 1$ if fund-raising succeeds and the firm is able to invest.

At $t = 2$, the firm can raise the required funds I from capital providers whenever it can issue a proportion α of shares such that competitive capital providers break even:

$$\alpha\, \mathbb{E}\left[V_{\tilde{\Theta}} \,|\, y\right] = I. \tag{2}$$

Because the firm cannot issue more than 100 percent of its shares, a necessary condition for the issue to succeed is that $\alpha \leq 1$; put differently, we must have

$$\mathbb{E}\left[V_{\tilde{\Theta}} \,|\, y\right] - I \geq 0. \tag{3}$$

The manager is willing to invest whenever the issue is successful, so inequality (3) is also a sufficient condition for the issue to succeed. By investing, a bad firm's manager earns private benefits whereas a good firm's manager maximizes shareholder wealth. Therefore,

$$\iota \equiv \iota(\alpha) := \begin{cases} 0 & \text{if } \alpha > 1 \\ 1 & \text{otherwise.} \end{cases} \tag{4}$$

Anticipating the effect of prices on the firm's fund-raising and hence on investment, the market maker sets the price according to

$$p_1^y := p_1(y) = \iota(1 - \alpha) \cdot \mathbb{E}\left[V_{\tilde{\Theta}} \,|\, y\right]. \tag{5}$$

If the firm's fund-raising is successful, then it raises a proportion α of shares and the secondary market price takes into account the dilution $(1 - \alpha)$ as well as the new capital. If fund-raising is unsuccessful, then the firm cannot invest and the price is zero. Substituting α from (2) and ι from (4), we can re-write (5) as

$$p_1(y) = \mathbb{E}\left[\tilde{v} \,\middle|\, y, \iota\right], \tag{6}$$

where $\tilde{v} \in \{V_{\mathrm{B}} - I, 0, V_{\mathrm{G}} - I\}$ is the firm's endogenous payoff. The price setting is similar to the discrete version of Kyle (1985) due to Biais and Rochet (1997). Unlike in those models, here the final realization of the firm's value depends on its ability to raise funds via prices. In other words, that value is endogenous: there is a feedback effect from prices to realized asset values.

2.1.4 A Speculator's Payoff

Speculators' payoffs take different forms in different parts of the paper, reflecting different preferences. For example, in practice speculators can be hedge funds, mutual funds, or individual investors.

Today most equity holders are delegated portfolio managers who invest on behalf of clients and are subject to different types of compensation contracts. This compensation typically consists of two parts: a percentage of the returns earned by the manager (the *performance fee*) and a percentage of the assets under management (the *fixed fee*). These percentages vary from fund to fund and sometimes are zero; for example, most mutual funds do not charge a performance fee.[12]

Whereas the ability to make profits is key to obtaining the performance fee, the ability to build a good reputation is key to obtaining the fixed fee. Thus, one way for funds to expand their compensation is to increase assets under management by retaining old clients and winning new ones. Contracts based on fixed fees drive delegated asset managers to behave differently from purely profit-maximizing speculators, whose rewards depend entirely on portfolio returns.

The following expected utility function captures these two main features of speculators' preferences—that is, the performance and reputation components:

$$U = w_1 \Pi + w_2 \Phi - c\eta, \tag{7}$$

where $w_1 \geq 0$ is the weight that a speculator assigns to expected net returns on investment and $w_2 \geq 0$ is the weight that the speculator assigns to his expected reputation. Note that $\eta = 1$ whenever the speculator acquires information at cost c (and $\eta = 0$ otherwise). More

[12] Elton, Gruber, and Blake (2003) find that, in 1999, only 1.7 percent of all bond and stock mutual funds charged performance fees.

explicitly, expected net returns are

$$\Pi := \Pi(a, \sigma, \tau) = \mathbb{E}\left[a\tilde{R} \,|\, \tau, \sigma\right] \equiv a\,\mathbb{E}\left[\tilde{v} - \tilde{p}_1 \,\middle|\, \tau, \sigma\right]; \tag{8}$$

here the net return R is computed as the firm's net value v minus the price p, and expected reputation is

$$\Phi := \Phi(a, \sigma, \tau) = \mathbb{E}\left[\tilde{r} \,|\, \tau, \sigma\right] \equiv \mathbb{E}\left[\mathbb{P}(\mathrm{S} \,|\, \Theta\iota, a, y) \,|\, \tau, \sigma\right]. \tag{9}$$

I define *reputation* r as the probability $\mathbb{P}$ that the speculator is skilled. In other words, reputation consists of a fund client's posterior belief about the manager's type based on all observables; these include the firm's type, which is observable only if $\iota = 1$, in addition to the fund's action a[13] and the order flow y.[14] The speculator maximizes his reputation and returns conditional on knowing his type τ and his signal σ.

I adopt funds' career concerns from the dynamic setting of Dasgupta and Prat (2008) to a static one.[15] Reputation concerns usually arise in a repeated setting: a fund will seek to influence clients' beliefs about its type to increase the fund's future fees, and clients seek to employ skilled funds that will earn them higher future returns. By considering career concerns in a static setting, I implicitly assume an unmodelled continuation period. In so doing I abstract from the relationship of the fund with its clients, which I take as given, to concentrate on the fund's relationship with firms.

For most of the analysis I study only the two limiting cases of a pure profit maximizer ($w_2 = 0$) and a pure careerist ($w_1 = 0$). In Section 4.1 I study the case in which the speculator cares about both profits and reputation. Throughout, the subscripts PM and CC denote quantities for the profit-maximizing and career-concerned speculators, respectively.

2.2 Equilibria

2.2.1 No Information Acquisition: The Impossibility of Firm Financing

Lemma 1 *When the skilled speculator does not acquire information, the firm is unable to raise I.*

[13]While it is rational that the market updates its beliefs using all available information, the assumption that funds' actions are observable is not critical. Alternatively, the market must be able to distinguish between zero returns due to the fund's inaction and zero returns due to the firm's failure to invest.

[14]The order flow is a sufficient statistic for the price because the price is determined by the market maker according to that order flow.

[15]For a microfoundation of these payoffs, see Dasgupta and Prat (2008).

Proof. If the skilled speculator does not acquire information about the firm's quality, then capital providers' posterior belief about the quality of the firm is equal to their prior belief. Since by condition (1) the prior belief is that the firm has negative average NPV, inequality (3) is not satisfied, and thus fund raising fails and no firm invests. ■

Because acquiring information is essential for firm financing, I next study the effect of speculators' preferences on information acquisition.

2.2.2 Information Acquisition: Firms' Financing with Profit-Maximizing Speculators

I characterize the equilibrium in which a speculator is profit maximizing and acquires information if he is skilled. Here the speculator's payoff takes the form of equation (7) with $w_1 = 1$ and $w_2 = 0$.

Lemma 2 *For $I \leq \bar{I}_{\text{pm}}$ and $c \leq \bar{c}_{\text{pm}}$, there exists a perfect Bayesian equilibrium in which the skilled speculator acquires information and follows his signal, the unskilled speculator does not trade, and the firm chooses to issue equity.*

Proof. Appendix 7.1.1 shows that this is an equilibrium. ■

Intuitively, as long as the firm's project is not too expensive and the cost of acquiring information is not too high, the skilled speculator acquires information and follows his signal. The unskilled speculator does not trade because he suffers a loss due to price impact.

Corollary 3 *If prices are sufficiently informative, then there is no perfect Bayesian equilibrium in which a skilled profit-maximizing speculator acquires information.*

Proof. The proof is given in Appendix 7.1.2. ■

Intuitively, when prices are sufficiently informative, the skilled speculator has little room to profit and so his information loses its speculative value.

A Note on Equilibrium Selection

When $w_2 = 0$ the game in which a profit-maximizing speculator trades has multiple equilibria that are characterized by indifference (see Appendix 7.1.3). Two refinements lead to selecting two different equilibria.[16] I introduce these refinements in Appendix 7.1.3 and show that with

[16] This is a common problem in Bayesian games with multiple equilibria (see Weinstein and Yildiz (2007)).

one refinement the unique equilibrium is that of Lemma 2 but with another refinement the unique equilibrium is one in which the skilled speculator never acquires.

The main point of the paper is to show that career-concerned speculators reduce market inefficiencies as compared to profit-maximizing speculators. Therefore, I focus the analysis on the most efficient equilibrium of the game in which a profit-maximizing speculator trades—the equilibrium of Lemma 2, and I show that even this equilibrium is dominated by the equilibrium of the game in which career-concerned speculators trade.

2.2.3 Information Acquisition: Firm Financing with Career-Concerned Speculators

I now characterize the equilibrium in which a speculator is career concerned and acquires information if he is skilled. Here the speculator's payoff takes the form of equation (7) with $w_1 = 0$ and $w_2 = 1$.

Lemma 4 *For $I \leq \bar{I}_{\text{cc}}$ and $c \leq \bar{c}_{\text{cc}}$, there exists a perfect Bayesian equilibrium in which the skilled speculator acquires information and follows his signal, the unskilled speculator buys with probability $\mu^* < 1/2$, and the firm chooses to issue equity.*

Proof. The proof is given in Appendix 7.1.4. ■

The intuition for this result relies on the skilled speculator acquiring information and following his signal to reveal his type and on the unskilled speculator buying and selling randomly not to reveal his type. In fact, feedback effects will lead the unskilled speculator to sell more often than he buys, because when he sells firms will not invest and therefore less information about his type will be conveyed to the market. To understand the feedback effect on the mixing probabilities, it is useful to first consider the benchmark with no feedback effects.

Lemma 5 *In the model without feedback effects, there is a perfect Bayesian equilibrium in which the speculator behaves as in Lemma 4, except that the unskilled speculator buys with probability $\mu^{**} = 1/2$.*

Proof. The proof is in Appendix 7.1.5. ■

The intuition for this result is as follows. The payoff of the career-concerned speculator is linear in his ability, that is, in the client's posterior probability of being skilled. Clients observe the hired fund's action a and the firm's type Θ. Thus, they can observe whether the fund has bought a bad firm or sold a good firm and infer that the fund is unskilled. The unskilled speculator must minimize the probability that he reveals his type. In an equilibrium in which the skilled speculator acquires and follows his signal, the unskilled career-concerned speculator must trade or else reveal his type. He therefore randomizes between buying and selling, where he buys with probability μ; $\mu^{**} = 1/2$ is the probability at which he is indifferent between buying and selling.

To see why μ^{**} must equal $1/2$, suppose, in anticipation of a contradiction, that (i) the skilled speculator follows his signal and (ii) the unskilled speculator mixes between buying and selling with $\mu^{**} > 1/2$. Since the market believes that the unskilled speculator is buying most of the time ($\mu^{**} > 1/2$), it thinks that it is likely that a correct sale comes from a skilled speculator. Thus, the payoff from being right when selling is higher than the payoff from being right when buying. Since the payoff from being wrong is always zero and, for the unskilled speculator, the probabilities of being right and wrong are equal, the unskilled strictly prefers to sell than to buy. This contradicts the supposition of his playing a mixed strategy with $\mu^{**} > 1/2$. Similarly, if $\mu^{**} < 1/2$, the speculator would strictly prefer to sell. Thus, $\mu^{**} = 1/2$. The key element of this proof is that μ^{**} is the *unique* probability that makes the unskilled speculator indifferent between buying and selling because that probability affects the payoff from either buying or selling: the less likely he is to sell, the higher is the payoff from selling (and vice versa).

Now, resuming the analysis of the game with feedback effects, it is no longer true that clients can always observe the hired fund's action a and the firm's type Θ. If the firm's fund raising fails ($\iota = 0$), then the value of the firm is endogenously zero and an inference channel is shut: clients' inferences are limited to the hired fund's action. Note that a fund's selling *always* results in failure to raise capital from the market because the order flow is $y \in \{-2, -1, 0\}$, which allows the unskilled speculator to *pool* with the skilled speculator on the selling action. Because selling allows the unskilled speculator to pool with the skilled speculator, whereas buying may reveal that he is unskilled, the unskilled speculator is more likely to sell than to buy and μ^{*} is always less than $1/2$. But if selling allows the unskilled speculator to pool with the skilled speculator, why doesn't he always sell? This is because the probability with which he sells feeds back into his utility. If the client believes that the fund always sells, then her posterior upon observing such action is that the fund is most likely to be unskilled. Hence the unskilled speculator may have an incentive to deviate. Again, the key element of this proof is that μ^{*} is the *unique* probability that makes the unskilled speculator indifferent between buying and selling.

Corollary 6 *As long as the cost of acquiring information is not too high, there is always an equilibrium in which a skilled career-concerned speculator acquires information and follows his signal—even when prices are perfectly informative.*

Proof. Perfectly informative prices obtain when $\mu^* = 0$. In Lemma 4 I show that, for sufficiently low costs, a skilled speculator acquires information and follows his signal whenever $\mu^* = 0$. ■

2.3 Results: Benefits of Career Concerns

2.3.1 Career Concerns and Firms' Financial Constraints

Proposition 1 *For c small enough, firms can obtain funding for a larger fraction of projects when speculators are career concerned than when they are profit maximizing. In other words: there is a range of projects with funding costs $I \in (\bar{I}_{\text{pm}}, \bar{I}_{\text{cc}}]$ that can be undertaken only with career-concerned speculators, where*

$$\bar{I}_{\text{cc}} = \frac{[\gamma + (1-\gamma)\mu^*]V_{\text{G}} + (1-\gamma)\mu^* V_{\text{B}}}{\gamma + 2(1-\gamma)\mu^*}$$

and

$$\bar{I}_{\text{pm}} = \frac{V_{\text{G}} + (1-\gamma)V_{\text{B}}}{2-\gamma}.$$

Proof. Since $\bar{I}_{\text{cc}}$ is decreasing in μ and $\bar{I}_{\text{cc}} = \bar{I}_{\text{pm}}$ whenever $\mu = 1$, it follows that $\bar{I}_{\text{cc}} > \bar{I}_{\text{pm}}$ for any $\mu < 1$. Note that μ is always less than $1/2$ by Lemma 4. Hence, there is a range of projects with costs $I \in (\bar{I}_{\text{pm}}, \bar{I}_{\text{cc}}]$ that can be undertaken only when career-concerned speculators trade. ■

I now make three remarks that build the intuition for this main result and clarify the forces behind it.

Remark 1 *A skilled speculator acquires information if and only if the equity issue succeeds at $y = 1$; this makes $y = 1$ the "pivotal" order flow for investment.*

I refer to an order flow as *pivotal* if it is the minimum order flow such that the market breaks down unless investment is undertaken in that order flow.

In equilibrium, if $y < 1$ then the equity issue fails and investment is not undertaken; this is shown in Lemmas 2 and 4. To prove that $y = 1$ is pivotal we need only demonstrate that, unless investment is undertaken in $y = 1$, the market breaks down and no capital flows to firms. I shall prove that a skilled speculator does not acquire information if the cost of capital is so high that investment succeeds only when $y = 2$. This is true for both skilled profit-maximizing and skilled career-concerned speculators, but for different reasons.

The skilled profit-maximizing speculator is unwilling to acquire information at any cost if investment succeeds only when $y = 2$. When $y = 2$ the price fully reflects his private information, which then loses its speculative value (see Corollary 3), and thus he is unwilling to pay its cost.

When speculators are career concerned, order flows $y = 1$ and $y = 2$ contain identical information about firm quality. Because a career-concerned speculator always trades, each order flow occurs only when the speculator buys; hence, the difference between these events is only the volume of noise trade. Since the information in order flows $y = 1$ and $y = 2$ is identical, investment succeeds given $y = 1$ if and only if it succeeds given $y = 2$. Thus, the skilled career-concerned speculator acquires information if and only if investment succeeds in both order flows $y = 1$ and $y = 2$.

Remark 2 *The cost of capital in the pivotal order flow is always lower when career-concerned speculators trade than when profit-maximizing speculators trade.*

Having identified in Remark 1 that $y = 1$ is the pivotal order flow for investment, I show that, conditional on information being acquired, when career-concerned speculators trade the cost of capital in this order flow is always lower than when profit-maximizing speculators trade. Observe that a low cost of capital is equivalent to high secondary market prices that are more informative about the firm's being good.

Conditional on acquiring information, the actions of liquidity traders and of the skilled speculator are identical in the two models—the model in which only career-concerned speculators trade and that in which only profit-maximizing speculators trade. Therefore, key to the result of Remark 2 is the different behavior of *unskilled* speculators in the two models. In particular, when the order flow is $y = 1$, do prices reveal more of the skilled speculator's private information in the model in which career-concerned speculators trade?

Unskilled profit-maximizing speculators never trade and so noise is exogenously determined by liquidity traders. In contrast, an unskilled career-concerned speculator always trades and thereby generates endogenous noise in the order flow. But why is it that, if career-concerned speculators trade, the price when $y = 1$ then reveals more of the skilled speculator's private information?

Order flow $y = 1$ can obtain when a skilled trader buys and when liquidity traders do not submit an order. This is the only way in which this order flow can be informative to the market. However, other actions can lead to this order flow, resulting from trades that do not contain information. The other ways of achieving $y = 1$ confound the information that is contained in $y = 1$ when it follows from a skilled speculator's order. The higher is the probability of achieving $y = 1$ from trades that are not informative—i.e., not $a^{\mathrm{S}} = 1$ and $\ell = 0$—the less informative is $y = 1$. To see why more information is in the $y = 1$ order flow in the career-concerned model than in the profit-motivated model, compare the likelihood of achieving $y = 1$ without an informed trade across the two models. First, consider the profit-motivated model. In this case, there is exactly one way to achieve order flow 1 without information: if the speculator is unskilled and the liquidity traders submit order 1. The likelihood that this occurs is the product of the probabilities of the following three events: that the speculator is uninformed, that the uninformed speculator stays out, and that the liquidity traders buy. Thus, the probability of achieving $y = 1$ without information is $(1 - \gamma) \cdot 1 \cdot \frac{1}{3} = (1 - \gamma)/3$. Now, consider the career-concerned model. In this case, the only uniformed way to arrive at order flow 1 is if the unskilled trader buys and the liquidity traders do not submit orders. The likelihood that this occurs is the product of the probabilities of the following three events: that the speculator is uninformed, that the uninformed speculator buys, and that the liquidity traders stay out. Thus, the probability of achieving $y = 1$ without information is $(1-\gamma) \cdot \mu^* \cdot \frac{1}{3}$. This is lower than the probability of a confounding path to $y = 1$ in the profit motivated model—i.e., $(1 - \gamma)\mu^*/3 < (1 - \gamma)/3$—because $\mu^* < 1$. Thus, the order flow $y = 1$ is a stronger indication that the firm in the career concerned model than in the profit-motivated model.

The next remark illustrates the importance of the fact that the unskilled career-concerned speculator sells relatively often. It does so conducting a comparative static with respect to the mixing probability μ. Note that μ is endogenous so the exercise is illustrative and not rigorous.

Remark 3 *Given that the skilled career-concerned speculator follows his signal and that the unskilled career-concerned speculator buys with probability μ, the bound on investment $\bar{I}_{\mathrm{cc}}$ is decreasing in μ^*.*

Since

$$\frac{\partial \bar{I}_{\mathrm{cc}}}{\partial \mu} = -\frac{\gamma(1-\gamma)\Delta V}{[\gamma + 2(1-\gamma)\mu^*]^2} < 0,$$

the stronger are the career-concerned speculator's incentives to sell, the larger is the range of projects that can be undertaken only by career-concerned speculators. But as μ decreases, price informativeness increases and one may wonder whether that reduces the skilled speculator's incentives to acquire information. Corollary 6 demonstrates that even when $\mu = 0$, the skilled speculator is willing to acquire information as long as the cost of acquiring it is not too high.

2.3.2 Project Quality and Career-Concerned Speculators

Career-concerned speculators allow both good and bad firms to invest, so one may wonder whether the economy would be better off without such speculators. I show that the overall effect of career concerns is positive.

Proposition 2 *Career concerns allow firms to undertake on average positive NPV projects.*

Proof. Since $\tilde{v} \in \{V_{\mathrm{B}} - I, 0, V_{\mathrm{G}} - I\}$, we have

$$\mathbb{E}(\tilde{v}) = \frac{1}{2}\mathbb{P}(\iota = 1 \,|\, \mathrm{G})(V_{\mathrm{G}} - I) + \frac{1}{2}\mathbb{P}(\iota = 1 \,|\, \mathrm{B})(V_{\mathrm{B}} - I) \geq 0.$$

In the model,

$$\mathbb{E}(\tilde{v}) = \frac{1}{3}(\gamma + (1-\gamma)\mu^*)(V_{\mathrm{G}} - I) + \frac{1}{3}(1-\gamma)\mu^*(V_{\mathrm{B}} - I) \geq 0. \tag{10}$$

This follows because the expectation is a decreasing function of I and the equilibrium in which career-concerned speculators acquire information exists if and only if $I \leq \bar{I}_{\mathrm{cc}}$, that is, if and only if

$$I \leq \frac{[\gamma + (1-\gamma)\mu^*]V_{\mathrm{G}} + (1-\gamma)\mu^* V_{\mathrm{B}}}{\gamma + 2(1-\gamma)\mu^*}.$$

Since inequality (10) holds for the largest I, the proposition follows. ■

2.3.3 Output Inefficiency

Two output inefficiencies arise in my model, one from not funding good projects and the other from funding bad ones. These two inefficiencies have an asymmetric effect on the economy because, by (1), the average losses that result from not funding good projects are smaller than those that result from funding bad ones. In fact, condition (1) can be re-written as

$$|V_{\mathrm{G}} - I| < |V_{\mathrm{B}} - I|. \tag{11}$$

I define *output inefficiency* as the weighted average of these two inefficiencies, where the weight is the probability that each of them is realized. Thus,

$$\text{output inefficiency} = \mathbb{P}(\iota = 0 \,|\, \mathrm{G})|V_{\mathrm{G}} - I| + \mathbb{P}(\iota = 1 \,|\, \mathrm{B})|V_{\mathrm{B}} - I|. \tag{12}$$

Proposition 3 *Output inefficiency resulting from over- and underinvestment is lower when speculators are career concerned than when they are profit maximizing.*

Proof. The proof is in Appendix 7.1.6 ■

Intuitively, when $\mu^* < \frac{1}{2}$, underinvestment always occurs with career-concerned speculators: the probabilities of a good or a bad project being undertaken, $\mathbb{P}(\iota = 1 \,|\, \mathrm{G})$ and $\mathbb{P}(\iota = 1 \,|\, \mathrm{B})$, are always lower with career-concerned speculators than with profit-maximizing speculators. Since (11) holds and since the sum of $\mathbb{P}(\iota = 0 \,|\, \mathrm{G})$ and $\mathbb{P}(\iota = 1 \,|\, \mathrm{B})$ is the same in both models, it follows that the average economic losses generated by undertaking bad projects are greater than those generated by not undertaking good ones and that both loss types are minimized when underinvestment occurs (i.e., when $\mu^* < \frac{1}{2}$). So if $\mu^* < \frac{1}{2}$, inefficiency is minimized with career-concerned speculators.

3 Seasoned Equity Offerings

3.1 Model

So far I have assumed that secondary market prices determine a firm's ability to raise funds, and I have refrained from explicitly modeling a firm's equity issue. A popular way for public firms to raise capital is through an SEO, which I model by building on Gerard and Nanda's (1993) model.

Key to my model is the interaction between the secondary market price and the issuing price, which is typical of SEOs and central to Gerard and Nanda's paper: the issuer usually sets the SEO price lower than the secondary market price, where the difference in prices is referred to as the *discount*.

3.1.1 Timing and Prices

Extending the model to incorporate an SEO requires adding a few assumptions to the baseline model of Section 2. First, at $t = 0$, the firm announces the SEO and the number n' of shares to be offered in the SEO; second, after the trading date and prior to the realization of the payoffs, the issuer sets the SEO price and bidding occurs. Finally, at the time of the SEO, uninformed bidders (retail investors) bid for the firm's equity along with the speculator.

The issuer sets the SEO price p_2^y at $t = 2$ to ensure that enough bidders subscribe to the SEO while taking into account the public information—the order flow. In the trading stage, the speculator trades with liquidity traders; in the bidding stage, uninformed bidders and the speculator submit bids.[17] Uninformed speculators have no information about the firm and may refrain from bidding if they expect losses (conditional on their available information), which is especially harmful because they are crucial for the SEO's success. The speculator cannot absorb the entire issue since $N_\tau < n' < N_\mathrm{N}$, where N_τ denotes the shares held by the speculator (where $\tau \in \{\mathrm{S}, \mathrm{U}\}$), N_N denotes the shares held by uninformed bidders, and the total number of shares bid by each group is known. Once the SEO price is set, the speculator and the uninformed bidders bid. If the offering is oversubscribed, then shares are distributed to participants on a pro rata basis. The uninformed bidders end up with the following proportion of shares:

$$\alpha_\mathrm{N} = \begin{cases} 1 & \text{if the speculator does not trade,} \\ \dfrac{N_\mathrm{N}}{N_\tau + N_\mathrm{N}} = \dfrac{1}{\beta} & \text{if the speculator trades;} \end{cases} \tag{13}$$

$1/\beta$ is the proportion of SEO shares allocated to the uninformed bidders when both the speculator and the uninformed bidders bid.

Prices in the SEO stage are set differently from prices in the secondary market trading stage. Recall that the issuer must set the SEO price so as to ensure the success of the equity offering and compensate the uninformed investors for the winner's curse. Thus, the SEO price p_2^y is set according to

$$\mathbb{E}\left[\tilde{\alpha}_\mathrm{N}\left(\tilde{V} - p_2^y\right) \,\middle|\, y\right] = 0, \tag{14}$$

where $\tilde{V} \in \{V_\mathrm{B}, 0, V_\mathrm{G}\}$. In other words, it is set so that uninformed bidders break even conditional on public information.

The SEO price is often lower than the trading price, and the difference is a function of the secondary market price's informativeness and the rationing that occurs at $t = 2$. Prices in the secondary market ($t = 1$) are set in anticipation of the firm's successful fund raising and

[17] Although both the unskilled speculator and the uninformed bidders are unaware of the firm's underlying value, at $t = 1$ the latter have less information than the former—who knows whether the order flow is a consequence of his own trade.

investment at $t = 2$. The investment succeeds if the firm can raise I by issuing n' new shares, that is, if

$$\frac{n'}{n + n'}\, p_2^y \geq I.$$

A necessary and sufficient condition for the success of the SEO is that

$$p_2^y > I. \tag{15}$$

Hence,

$$\iota = \begin{cases} 1 & \text{if } p_2^y > I, \\ 0 & \text{otherwise.} \end{cases} \tag{16}$$

Anticipating the effect of prices on firms' fund raising and subsequent investment, the market maker sets the secondary market price according to

$$p_1^y := p_1(y) = \iota(1 - \alpha) \cdot \mathbb{E}\left[V_{\tilde{\Theta}} \,|\, y\right], \tag{17}$$

just as in equation (5).

3.1.2 Payoff to the Speculator

The speculator's payoff is similar to the one introduced in equation (7), but is adjusted to account for the model's new ingredients. In particular,

$$\Pi = \mathbb{E}\left[a(\tilde{v} - \tilde{p}_1) \,|\, \tau, \sigma\right] + \alpha_\tau \mathbb{E}\left[\tilde{V} - \tilde{p}_2 \,|\, \tau, \sigma\right],$$

because now, in addition to profiting from trades in the secondary market, the speculator can profit from acquiring the proportion α_τ of shares in the equity issue. Further,

$$\Phi = \mathbb{E}\left[\mathbb{P}(\mathrm{S} \,|\, \Theta\iota, a_1, a_2, y) \,|\, \tau, \sigma\right],$$

because the fund's clients now have an additional updating variable, namely, the fund's action at $t = 2$.

3.2 Equilibria

3.2.1 Information Acquisition: SEO with Profit-Maximizing Speculators

Here I characterize the equilibrium in which the skilled speculator acquires information. The speculator's payoff takes the form of equation (7) with $w_1 = 1$ and $w_2 = 0$.

Lemma 7 *For $I \leq \mathcal{I}_{\text{pm}}$ and $c \leq \mathcal{C}_{\text{pm}}$, there exists a perfect Bayesian equilibrium in which the skilled speculator acquires information and follows his signal, the unskilled speculator does not trade at $t = 1$ and stays out at $t = 2$, and firms issue the number of shares that maximizes the probability that investment succeeds.*

Proof. The proof is given in Appendix 7.2.1. ■

3.2.2 Information Acquisition: SEO with Career-Concerned Speculators

Here I characterize the equilibrium in which a skilled career-concerned speculator acquires information. The speculator's payoff takes the form of equation (7) with $w_1 = 0$ and $w_2 = 1$.

Lemma 8 *For $I \leq \bar{I}_{\text{cc}}$ and $c \leq \bar{c}_{\text{cc}}$, there exists a perfect Bayesian equilibrium in which the skilled speculator acquires information and follows his signal, the unskilled speculator at $t = 1$ buys with probability $\mu^* < 1/2$ and at $t = 2$ buys if and only if he has bought at $t = 1$, and firms issue the number of shares that maximizes the probability that investment succeeds.*

Proof. The proof is provided in Appendix 7.2.2. ■

3.3 Results: Benefits of Career Concerns

There are two main differences between the baseline model and the SEO model, and both arise at $t = 2$—the participants in the equity offering and the issuer's price setting. In the baseline model, only uninformed capital providers participate in the capital raising. They all have the same information at the funding stage, namely, the public information contained in the price. In the SEO model, both uninformed capital providers and the speculator participate in the bidding stage, and the speculator may have private information. This additional asymmetric information may distort $t = 2$ prices, which must be set to make the uninformed bidders break even. This distortion affects prices only when speculators are profit maximizing, which leads to the following result.

Proposition 4 *The SEO price may be set at a discount only if the speculator is profit maximizing (i.e., not if he is career concerned).*

Proof. The proof is in Appendix 7.2.3. ■

The intuition behind this result is that career-concerned speculators mitigate the effect of the winner's curse: by subscribing to the SEO even if they are unskilled, they reduce the likelihood of uninformed bidders ending up with too many shares in overpriced firms or, equivalently, of being rationed only when the firm is good.

Corollary 9 *When profit-maximizing speculators trade, the cost of capital may be higher in an SEO than in the baseline model.*

It follows from Proposition 4 that the winner's curse exacerbates the effect of underprovision of information on capital allocation in an SEO, since firms' discounts further inhibit their ability to raise funds. But the winner's curse rationing takes effect in equilibrium only when speculators are profit maximizing. Therefore, when speculators are career concerned, the cost of capital is as high in the SEO as in the baseline model.

3.3.1 Loosening Firms' Financial Constraints

Here I show that the SEO analogue of Proposition 1 holds, and is even starker when firms raise funds via an SEO.

Proposition 5 *For c small enough, firms can obtain funding for a larger fraction of projects when speculators are career concerned. In other words, there is a range of projects with funding costs $I \in (\mathcal{I}_{\text{pm}}, \mathcal{I}_{\text{cc}}]$ that can be undertaken only with career-concerned speculators, where*

$$\mathcal{I}_{\text{cc}} = \frac{[\gamma + (1-\gamma)\mu^*]V_{\text{G}} + (1-\gamma)\mu^* V_{\text{B}}}{\gamma + 2(1-\gamma)\mu^*},$$
$$\mathcal{I}_{\text{pm}} = \frac{[\gamma + (1-\gamma)\beta]V_{\text{G}} + (1-\gamma)\beta V_{\text{B}}}{\gamma + 2(1-\gamma)\beta}.$$

Proof. Since $\mathcal{I}_{\text{cc}}$ and $\mathcal{I}_{\text{pm}}$ are decreasing functions of μ and β, respectively, and since these functions are equal when $\mu = \beta$, it follows that $\mathcal{I}_{\text{cc}} > \mathcal{I}_{\text{pm}}$ for any $\mu < \beta$. This inequality is always satisfied because $\beta > 1$ and $\mu < 1$. ■

In an SEO the winner's curse rationing—which arises when profit-maximizing speculators trade—increases firms' cost of capital even further (see Corollary 9). Hence, the benefits brought by career-concerned speculators are even greater in an SEO than in the baseline model.

3.3.2 Other Benefits

Although differences between the baseline model and the SEO model affect prices, they do not affect speculators' behavior. Since the proofs of Propositions 2 and 3 depend only on speculators' behavior, they apply to the SEO model unchanged.

4 Extensions

4.1 A Career-Concerned Speculator Who Also Cares about Profits

I now study the behavior of a speculator whose payoff is given by equation (7).

Proposition 6 *Depending on the relative degree to which speculators care about profits compared with their reputation, there are three types of equilibria:*

1. *For w_2 sufficiently large, a speculator behaves as in Lemma 4.*
2. *For w_2 sufficiently small, a speculator never acquires information.*
3. *For w_2 sufficiently small and fixed $\epsilon > 0$ (the equilibrium refinement introduced in Appendix 7.1.3), a speculator behaves as in Lemma 2.*

As shown in Section 2.2.2, when $w_2 = 0$ there are multiple equilibria. Different refinements select different equilibria. In particular, if one adds a small concern for his career to the profit-maximizing speculator's payoff, then there is no equilibrium in which a skilled speculator acquires information. Further, if one adds uncertainty to the profit-maximizing speculator's payoff, then the equilibrium behavior is the same as that in Lemma 2 (the proofs are in Appendix 7.1.3).

Thus, a non-monotonic effect of career concerns arises when one adds explicit compensation to the profit-maximizing speculator's payoff: absent career concerns, the speculator behaves as in Lemma 2. As the strength of the career concerns increases, at first a speculator never acquires information; then, only for large career concerns, the most efficient equilibrium is achieved, namely, that of Lemma 4.

Chevalier and Ellison (1999) demonstrate that the strength of fund managers' career-concerns varies over their careers: young fund managers have stronger career concerns than older fund managers. This model predicts that distortions introduced by old fund managers are substantially larger than those introduced by young fund managers.

4.2 Simultaneous Trading by Profit-Maximizing and Career-Concerned Speculators

Now suppose that the speculator can be one of four types: skilled and profit-maximizing, unskilled and profit-maximizing, skilled and career-concerned, or unskilled and career-concerned. There is a proportion r of career-concerned speculators and a proportion $1 - r$ of profit-maximizing ones. A speculator can be skilled or unskilled with respective probabilities γ and $1 - \gamma$. The timing and the other players are as in the baseline model.

Proposition 7 *For each r, γ, V_{G}, and V_{B}, there exists a $\hat{c}_{\mathrm{cc}} > 0$ such that, as long as $c_{\mathrm{cc}} \in (\hat{c}_{\mathrm{cc}}, c^*_{\mathrm{cc}}]$, the main result of the baseline model (Proposition 1) obtains.*

Proof. The proof is in Appendix 7.3. ■

Here I provide a brief intuition. In the baseline model I showed that career-concerned speculators loosen firms' financial constraints (compared with profit-maximizing ones) by increasing price informativeness in the pivotal state for investment, that is, in $y = 1$. Here, I show that if $y = 1$ is the pivotal state for investment, then, as the proportion of career-concerned speculators increases, so does price informativeness and hence the fraction of projects that can be undertaken in equilibrium. In fact, keeping the proportions of skilled speculators constant, I show that price informativeness when $y = 1$ increases as the proportion of career-concerned speculators increases.

According to Corollary 3, if investment fails in $y = 1$, then profit-maximizing speculators do not acquire information in $y = 2$ because there is no noise in the price. However, when career-concerned speculators are allowed to trade together with profit-maximizing speculators, this is no longer true in general. The trade of unskilled career-concerned speculators generates some extra noise in $y = 2$ that may leave some room for the skilled profit-maximizing speculators to profit—even when the equity issue fails in $y = 1$. But, as long as $c_{\mathrm{cc}} > \hat{c}_{\mathrm{cc}}$, I show that if investment fails in $y = 1$ then career-concerned speculators are unwilling to acquire information in $y = 2$. Thus, prices given $y = 2$, are perfectly informative and the skilled profit-maximizing speculator is unwilling to acquire information, just as in Proposition 1. Thus, $c_{\mathrm{cc}} > \hat{c}_{\mathrm{cc}}$ is a sufficient condition for $y = 1$ to be pivotal.

4.3 Other Applications: Rating Agencies and Investment Analysts

While I study the effect of career-concerned speculators on capital allocation, the mechanism underlying this paper's results is more general and can be applied to other settings. For example, Manso (2013) shows the importance of the feedback effects of credit ratings: when market participants rely on credit ratings for investment decisions, ratings not only reflect but also affect the probability of issuers' survival. He suggests that rating agencies should take this effect into account. Replacing rating agencies with institutional investors, my model would predict that when firms have on average negative NPV, an unskilled rating agency would in fact downgrade firms most of the time. The downgrade may lead the firm to default, shutting down the market's inference about the quality of the rating agency.

This mechanism could also help us understand the behavior of career-concerned financial advisors and the welfare implications of their advice. Financial advisors give recommendations to buy, hold, or sell stocks to market participants—primarily to institutional investors. These analysts, when unskilled, may have strong incentives to recommend selling constrained firms that rely on the market to raise funds. Doing so, they may cause firms' funding to fail, and thus, just as in my model, shut down the market's inference about their ability. On the other hand, skilled advisors may have strong incentives to recommend buying stocks of constrained firms that have high growth and that are relatively expensive as a buy recommendation for these stocks allows them to signal their type. This behavior is consistent with the behavior of analysts found, for example, in Jegadeesh, Kim, Krische, and Lee (2004).

5 Discussion about Various Assumptions

In this section I discuss the robustness of my results to weakening various assumptions of my model.

5.1 Positive NPV

In this section I argue that the assumption that projects have on average negative NPV is less restrictive than it may appear to be at first. I do this by demonstrating that if capital providers were risk-averse—as opposed to risk-neutral as above—then career-concerned speculators would relax firms' funding constraints relative to profit-maximizing speculators even when projects have on average positive NPV.

In order to proceed with the analysis of the case with risk-averse capital providers, note first that, in general, risk-averse capital providers will acquire shares only if their posterior probability that the project is good is above a threshold π that depends on their risk-aversion. This threshold π captures the capital providers' utility function u in reduced-form. More risk-averse capital providers have higher thresholds π.

I now proceed to make the argument that with positive NPV projects and risk-averse capital providers the result will go through. Suppose that projects have positive NPV, so

$$\frac{1}{2}V_{\mathrm{G}} + \frac{1}{2}V_{\mathrm{B}} > I.$$

In this case with risk-averse speculators, the analogue of equation (2) above, which defines the proportion α of shares acquired, is

$$\mathbb{E}\left[u\big(\alpha V_{\tilde{\Theta}}\big) \,|\, y\right] = u(I).$$

Now, for this generalized model to behave analogously to the version above, we must have that the firm raises capital successfully given the order flow $y = 1$ but fails to raise capital given the order flow $y = 0$. In other words, there is a fraction $\alpha \in (0, 1)$ such that the equation above is satisfied given $y = 1$, but, in contrast, there is no fraction α such that the equation above is satisfied given $y = 0$. Given the reduced-form expression for risk-aversion in terms of the threshold π described above, these two conditions—for successful funding given $y = 1$ but not given $y = 0$—read

$$\mathbb{P}\left(V_{\mathrm{G}} \,|\, y = 1\right) > \pi$$

and

$$\mathbb{P}\left(V_{\mathrm{G}} \,|\, y = 0\right) < \pi.$$

Plugging in for the equilibrium quantities above (and using the tighter upper bound, i.e. the one that comes from the model with profit-maximizing speculators), these inequalities become

$$\frac{1}{2-\gamma} > \pi$$

and

$$\frac{1}{2} < \pi.$$

The argument above shows that whenever the capital provider's threshold is in the half-open interval $\left(\frac{1}{2}, \frac{1}{2-\gamma}\right]$, career-concerned speculators relax firms' funding constraints relative to profit-maximizing speculators. The reason is that all that is necessary for the result is that the capital providers acquire in the pivotal order flow and above, but not below. This is where the bounds on π come from. The lower bound of 1/2 ensures that the capital providers do not acquire shares with no information. The upper bound of $1/(2-\gamma)$ ensures that the capital providers do acquire when $y = 1$.

In summary, Proposition 1 above is robust to the average project quality having positive NPV as long as speculators are risk averse but not too risk averse.

5.2 Raising Capital via Debt

I have shown that career-concerned speculators—more so than profit-maximizing speculators—reduce a firm's financial constraints when they acquire information and embed it into prices in anticipation of an equity issue. One may wonder whether this beneficial effect of career concerns persists when speculators acquire information in anticipation of a debt issue. Here I establish that, conditional on issuing debt or equity, the beneficial effect persists. It is beyond the scope of this paper, however, to identify the conditions under which a firm chooses debt versus equity. (That question is addressed in a different setting by Fulghieri and Lukin (2001) for the case of profit-maximizing speculators.)

Prices must now be set at $t = 1$ in anticipation of a debt issue. At $t = 2$ the firm is able to raise the required funds I whenever it can issue debt with face value $F > I > V_{\mathrm{B}}$ such that capital providers break even:

$$\hat{\theta}(y)F + \big(1 - \hat{\theta}(y)\big)V_{\mathrm{B}} = I,$$

where $\hat{\theta}(y)$ is the market posterior upon observing y. Thus,

$$F = \frac{I - \big(1 - \hat{\theta}(y)\big)V_{\mathrm{B}}}{\hat{\theta}(y)}. \tag{18}$$

Note that I assume (for simplicity) that a good firm and a bad firm pay off V_{G} and V_{B}, respectively, for certain.

A necessary condition for the debt issue to succeed is that

$$\mathbb{E}\left[V_{\tilde{\Theta}} \,|\, y\right] - I = \hat{\theta}(y)V_{\mathrm{G}} + \big(1 - \hat{\theta}(y)\big)V_{\mathrm{B}} - I \geq 0. \tag{19}$$

If this inequality is not satisfied, then there is no F that satisfies equation (18), since F must be less than or equal to V_{G}.

Inequality (19) is also a sufficient condition for the debt issue to succeed. A good firm issues debt as long as its shareholders gain, which they do if

$$V_{\mathrm{G}} - F = \frac{\mathbb{E}\left[V_{\tilde{\Theta}} | y\right] - I}{\hat{\theta}(y)} > 0, \tag{20}$$

that is, if

$$\mathbb{E}\left[V_{\tilde{\Theta}} \,|\, y\right] - I \geq 0.$$

Since inequalities (19) and (3) are equivalent, it follows that a debt issue succeeds if and only if an equity issue succeeds. As in the equity issue case, I indicate by $\iota = 1$ the success of a debt issue and by $\iota = 0$ its failure.

In anticipation of a debt issue and its success, prices in the secondary market are set according to

$$p_1^y = \left[\hat{\theta}(y)(V_{\mathrm{G}} - F)\right] \iota,$$

which—after plugging in (20)—is equivalent to

$$p_1^y = \left(\mathbb{E}\left[V_{\tilde{\Theta}} \,\middle|\, y\right] - I\right) \iota = \mathbb{E}\left[\tilde{v} \,\middle|\, y, \iota\right].$$

Secondary market prices in anticipation of a debt issue thus coincide with those in anticipation of an equity issue.

5.3 Assets in Place

Extending the model to include assets in place while preserving my qualitative results requires two additional assumptions. The first is that the assets in place are not too large relative to the cost of the project. Large assets in place loosen financial constraints, obviating the need for prices to reflect information about the project. Indeed, with large assets in place, firms can raise capital from new shareholders diluting the old ones, allowing inequality (3) to hold always. Thus, to preserve my qualitative results I rule out this possibility by assuming that

$$|\bar{V} - I| > A,$$

where A are the assets in place.

The additional assumption is that assets in place, if risky, have low (or no) correlation with the firm's growth opportunities. Assets in place, if risky, may contain information about the quality of the project that allows good firms to separate from bad firms, again potentially obviating the need for prices to be informative about the quality of the project and thus loosening firms financial constraints. To preserve my qualitative results, a sufficient condition is that assets in place are uncorrelated with the project.

5.4 Imperfect Signals

In the body of the paper I assume that a skilled speculator, upon acquiring information, observes a perfect signal of the underlying quality of the project, while an unskilled speculator observes no signal. One might ask whether the results would go through if both agents received imperfect signals, but the unskilled speculator's signal were less precise than that of the skilled speculator.

Suppose that the skilled speculator observes a private signal $\sigma \in \{\sigma_{\mathrm{B}}, \sigma_{\mathrm{G}}\}$ about the underlying value of the firm such that $\rho := \mathbb{P}(V_{\mathrm{G}}|\sigma_{\mathrm{G}}) = \mathbb{P}(V_{\mathrm{B}}|\sigma_{\mathrm{B}}) > 1/2$. Analogously, suppose the unskilled speculator observes a private signal $\phi \in \{\phi_{\mathrm{B}}, \phi_{\mathrm{B}}\}$ about the underlying value of the firm of such that $\delta := \mathbb{P}(V_{\mathrm{G}}|\phi_{\mathrm{G}}) = \mathbb{P}(V_{\mathrm{B}}|\phi_{\mathrm{B}}) > 1/2$. Assume further that $\rho >> \delta$.

The equilibrium behavior of the profit-maximizing speculator is straightforward: the equilibrium characterized in Lemma 2 holds as long as the unskilled speculator's signal is sufficiently imprecise relative to that of the skilled speculator. See Appendix 7.4.

The equilibrium behavior of the career-concerned speculator who receives an imperfect signal is less straightforward; Appendix 7.4 describes the equilibrium. In this equilibrium the skilled speculator follows his signal and the unskilled speculator sells upon observing a negative signal and randomizes when observing a positive signal. Intuitively, if the unskilled speculator observes a bad signal, he sells with probability one: selling allows him to pool with the skilled speculator and to trade in the right direction. If he observes a good signal instead, he may be inclined to buy and follow his signal. But if his signal is sufficiently imprecise, his incentive to pool with the skilled speculator dominates his incentive to trade in the right direction, inducing him to sell sometimes (playing a mixed strategy).

Proposition 8 demonstrates that the imperfect signal analogue of Proposition 1 holds.

Proposition 8 *For c sufficiently small, firms can obtain funding for a larger fraction of projects when speculators are career concerned. In other words, there is a range of projects with funding costs $I \in (\hat{\mathcal{I}}_{\mathrm{pm}}, \hat{\mathcal{I}}_{\mathrm{cc}}]$ that can be undertaken only when career-concerned speculators trade, where*

$$\hat{\mathcal{I}}_{\mathrm{cc}} = \frac{[\gamma\rho + (1-\gamma)\delta\bar{\mu}]\, V_{\mathrm{G}} + [\gamma(1-\rho) + (1-\gamma)(1-\delta)\bar{\mu}]\, V_{\mathrm{B}}}{\gamma + (1-\gamma)\bar{\mu}}$$

and

$$\hat{\mathcal{I}}_{\text{pm}} = \frac{(\gamma\rho + 1 - \gamma)V_{\text{G}} + [\gamma(1-\rho) + 1 - \gamma]V_{\text{B}}}{2-\gamma}.$$

Proof. Since

$$\frac{\partial \hat{\mathcal{I}}_{\text{cc}}}{\partial \mu} = -\frac{(1-\gamma)\gamma(\rho-\delta)\Delta V}{(\gamma+\mu-\gamma\mu)^2} < 0,$$

and whenever $\mu = 1$ and $\rho > \delta \geq 1/2$

$$\hat{\mathcal{I}}_{\text{cc}} - \hat{\mathcal{I}}_{\text{pm}} = \frac{(1-\gamma)\left[(2-\gamma)\delta + \gamma\rho - 1\right]\Delta V}{2-\gamma} > 0,$$

it follows that $\hat{\mathcal{I}}_{\text{cc}} > \hat{\mathcal{I}}_{\text{pm}}$ for any $\mu < 1$. Note that μ is always less than one by Lemma 16. Hence, there is a range of projects with costs $I \in (\hat{\mathcal{I}}_{\text{pm}}, \hat{\mathcal{I}}_{\text{cc}}]$ that can be undertaken only when career-concerned speculators trade. ■

6 Conclusions

Traditional corporate finance theories—including the trade-off theory and the pecking order theory—identify the type of capital (internal funds, debt, equity) as an important determinant of its cost. In this paper I identify another determinant of the cost of capital: the type of market participant. This approach is based on the dichotomy between an individual investor and a delegated portfolio manager, where I represent the former as purely profit oriented and the latter as purely career concerned. I show that delegated portfolio managers reduce firms' cost of capital both indirectly, by participating in the secondary market and directly, by subscribing to firms' capital in the primary market. Understanding the impact of delegated asset managers' trading in primary and secondary markets is particularly salient since today the main market participants are portfolio managers and not individual investors.

I show that when the feedback loop caused by firms' financial constraints leads to a severe underprovision of information, career-concerned speculators provide more information to the stock market than profit-maximizing speculators, so the former are better able to loosen firms' financial constraints. These speculators care about signaling their skills to current and potential clients. However, they can do this only by inducing firm investment and showing that they traded in the right direction—even if their price impact results in limited returns. Yet, career-concerned speculators trade even when they have no information, which distorts order flows and therefore may hamper the allocative role of prices. I show that, in equilibrium, the trade of unskilled speculators augments the positive effects of delegated portfolio management on capital allocation. Direct empirical evidence on the role of institutional investors in SEOs (Chemmanur, He, and Hu (2009), Gao and Mahmudi (2008)) showing that institutional investors have beneficial effects on the SEO discount and on the likelihood of a successful SEO, is consistent with my results.

While I study the effect of career-concerned speculators on capital allocation, the mechanism underlying this paper's results is more general and can be applied to other settings. For example, it could shed light on the behavior of uninformed career-concerned rating agencies or uninformed career-concerned financial advisors. In particular, the mechanism in this paper could be used to examine whether uninformed rating agencies strategically choose to downgrade firms as a downgrade may lead a firm to default, shutting down the market's inference about the quality of the rating agency.

7 Appendix

7.1 Baseline Model

7.1.1 Proof of Lemma 2

Here I show that there are no profitable deviations from the equilibrium of Lemma 2. I prove uniqueness in the next section.

Prices: Secondary market prices are

$$\begin{aligned} p_1^{-2} &= p_1^{-1} = p_1^0 = 0, \\ p_1^1 &= \frac{V_{\mathrm{G}} + (1-\gamma)V_{\mathrm{B}}}{2-\gamma} - I, \\ p_1^2 &= V_{\mathrm{G}} - I. \end{aligned} \tag{21}$$

If the order flow is $y \in \{-2, -1, 0\}$, then inequality (3) does not hold and firms are unable to raise I from capital providers. For those order flows, the posterior probability of the firm being good is either lower than the prior (when $y \in \{-2, -1\}$) or equal to it (when $y = 0$). Since, by Lemma 1, firms are unable to raise I when the market believes that the firm is of average quality, it follows that this will also be the case for any posterior belief lower than the one associated with $y = 0$. When the order flow is $y \in \{1, 2\}$, firms are able to raise I and invest as long as inequality (3) holds. A sufficient condition for (3) to hold is that $p_1^1 \geq 0$ or

$$I \leq \frac{V_{\mathrm{G}} + (1-\gamma)V_{\mathrm{B}}}{2-\gamma} =: \bar{I}_{\mathrm{pm}}.$$

Unskilled speculator: The unskilled speculator has no information on the underlying value of the firm. He prefers not to trade rather than to buy if his payoff from not trading is higher than that from buying, that is,

$$\Pi(a^{\mathrm{U}} = 0) = 0 \geq \frac{1}{3}(\bar{V} - I - p_1^2) + \frac{1}{3}(\bar{V} - I - p_1^1) = \Pi(a^{\mathrm{U}} = +1).$$

This inequality is satisfied since $p_1^y > \bar{V} - I$ for $y \in \{1, 2\}$. The unskilled speculator prefers not to trade rather than to sell if

$$\Pi(a^{\mathrm{U}} = 0) = 0 \geq 0 = \Pi(a^{\mathrm{U}} = -1). \tag{22}$$

Given the feedback effect between prices and investment, selling always triggers a firm's funding failure because $y \in \{-2, -1, 0\}$ and inequality (3) is never satisfied. The unskilled speculator is therefore indifferent to selling and not trading, and inequality (22) is satisfied.

Skilled negatively informed speculator: A skilled negatively informed speculator prefers to sell rather than not to trade if his payoff from selling is higher than that from not trading, that is,

$$\Pi(a^{\mathrm{S}} = -1,\, \sigma = \sigma_{\mathrm{B}}) = 0 \geq 0 = \Pi(a^{\mathrm{S}} = 0,\, \sigma = \sigma_{\mathrm{B}}).$$

The inequality is satisfied because he is indifferent between selling and not trading: selling triggers a firm's investment failure. He prefers to sell than to buy a bad firm if

$$\Pi(a^{\mathrm{S}} = -1,\, \sigma = \sigma_{\mathrm{B}}) = 0 \geq \Pi(a^{\mathrm{S}} = +1,\, \sigma = \sigma_{\mathrm{B}}) = \frac{1}{3}\left(V_{\mathrm{B}} - I - p_1^2\right) + \frac{1}{3}\left(V_{\mathrm{B}} - I - p_1^1\right),$$

which is satisfied since $p_1^y > V_{\mathrm{B}} - I$ for $y \in \{1, 2\}$.

Skilled positively informed speculator: A skilled positively informed speculator prefers to buy rather than to sell or not trade since

$$\Pi(a^{\mathrm{S}} = +1,\, \sigma = \sigma_{\mathrm{G}}) = \frac{1}{3}\left(V_{\mathrm{G}} - I - p_1^1\right) \geq 0 = \Pi(a^{\mathrm{S}} = -1,\, \sigma = \sigma_{\mathrm{G}}) = \Pi(a^{\mathrm{S}} = 0,\, \sigma = \sigma_{\mathrm{G}}),$$

which is satisfied since $p_1^1 < V_G - I$.

Information acquisition: A skilled speculator who acquires information ($\eta = 1$) and plays according to the equilibrium strategy just described (denote it by s_{pm}^{S}) receives

$$\Pi(s_{\text{pm}}^{\text{S}}(\sigma),\, \eta = 1) - c = \frac{1}{6}\left(V_G - I - p_1^1\right) - c.$$

If this speculator does not acquire information, it is optimal for him to behave like the unskilled speculator and not to trade. He therefore acquires information and follows his signal only if his payoff from doing so is positive or

$$c < \frac{(1-\gamma)\Delta V}{6(2-\gamma)} =: \bar{c}_{\text{pm}}.$$

Good firms: A firm that does not issue equity cannot invest, and its shareholders earn zero profits. Thus, shareholders are better off if the firm invests whenever it has the opportunity because

$$(1-\alpha)V_G \geq 0,$$

where $\alpha \leq 1$ in equilibrium. Since at $t = 0$ there is a positive probability that the equity issue will succeed, the manager of the good firm will always choose to raise I.

Bad firms: Managers of bad firms receive a private benefit from investing. Hence, they always choose to issue equity at $t = 0$ because doing so maximizes the likelihood of raising I.

7.1.2 Proof of Corollary 3

Suppose there exists an equilibrium in which the strategies of the players are as described in Lemma 2 but $I > \bar{I}_{\text{pm}}$. Then secondary market prices are

$$\begin{aligned} &p_1^{-2} = p_1^{-1} = p_1^0 = p_1^1 = 0, \\ &p_1^2 = V_G - I. \end{aligned}$$

This cannot be an equilibrium because the skilled speculator has a profitable deviation. If he acquires information and follows his signal he gets zero profits while incurring a cost c. He then prefers not to acquire information.

7.1.3 Multiple Equilibria When the Speculator is Profit-Maximizing

Lemma 10 *For $I \leq I_{\text{pm}}$ and $c \leq c_{\text{pm}}$, there exist perfect Bayesian equilibria in which the following hold. (i) The skilled speculator acquires information; if he is positively informed he follows his signal and if he is negatively informed he randomizes between selling and not trading. (ii) The unskilled speculator randomizes between selling and not trading. (iii) The firm chooses to issue equity.*

Proof. Call $\nu \in [0,1)$ the probability with which the negatively informed speculator does not trade and call $\rho \in [0,1]$ the probability with which the unskilled speculator does not trade.

Prices: Secondary market prices are

$$\begin{aligned}
p_1^{-2} &= p_1^{-1} = p_1^0 = 0, \\
p_1^1 &= \frac{[\gamma + (1-\gamma)\rho]V_{\text{G}} + [\gamma\nu + (1-\gamma)\rho]V_{\text{B}}}{\gamma + 2(1-\gamma)\rho + \gamma\nu} - I, \\
p_1^2 &= V_{\text{G}} - I.
\end{aligned}$$

The same argument as in the proof of Lemma 2 holds here; when $y \in \{1,2\}$ firms are able to raise I as long as $p_1^1 \geq 0$ or

$$I \leq \frac{[\gamma + (1-\gamma)\rho]V_{\text{G}} + [\gamma\nu + (1-\gamma)\rho]V_{\text{B}}}{\gamma + 2(1-\gamma)\rho + \gamma\nu} =: I_{\text{pm}}.$$

Unskilled and negatively informed speculator: For any $\nu \in [0,1)$ and $\rho \in [0,1]$, the negatively informed and unskilled speculators' indifference conditions are satisfied. This is because the feedback between prices and investment renders the payoff from selling equal to the payoff from not trading. In fact, by selling, the speculator induces the firm's investment to fail and thus he makes zero profits.

With a similar argument to that of the proof of Lemma 2 it is easy to show that neither speculator has any incentive to deviate. If either the skilled negatively informed or the unskilled speculator deviates and buys, he gets negative profits.

Positively informed speculator: The skilled positively informed speculator has no incentive to deviate from buying when observing a positive signal. In fact,

$$\Pi(a^{\text{S}} = +1, \sigma = \sigma_{\text{G}}) = \frac{1}{3}(V_{\text{G}} - I - p_1^1) > 0 = \Pi(a^{\text{S}} = 0, \sigma = \sigma_{\text{G}}) = \Pi(a^{\text{S}} = -1, \sigma = \sigma_{\text{G}}).$$

Information acquisition: A skilled fund that acquires and plays according to the equilibrium strategy above gets

$$\Pi(s^{\mathrm{S}}_{\mathrm{pm}}, \eta^* = 1) - c = \frac{\Delta V}{6}\left[\frac{\gamma\nu + (1-\gamma)\rho}{\gamma + 2(1-\gamma)\rho + \gamma\nu}\right] - c.$$

He acquires information and follows his signal only if his payoff from doing so is positive or if

$$c < \frac{\Delta V}{6}\left[\frac{\gamma\nu + (1-\gamma)\rho}{\gamma + 2(1-\gamma)\rho + \gamma\nu}\right] := c_{\mathrm{pm}}.$$

Firms: The same argument as in the proof of Lemma 2 applies here. ■

Adding Some Uncertainty to the Speculator's Payoff

Corollary 11 *If firms have an old project $\tilde{\chi}$ that pays off I with probability ϵ and 0 with probability $1-\epsilon$, then the model has a unique equilibrium that converges to the equilibrium in Lemma 2 as $\epsilon \to 0$.*

Proof. I show that the equilibrium of Lemma 2 is unique by iterative deletion of strictly dominated strategies.

First, note that after introducing the refinement, prices become

$$\begin{aligned}
p_1^{-2} &= \epsilon\, V_{\mathrm{B}}, \\
p_1^{-1} &= \epsilon\, \frac{(1-\gamma)V_{\mathrm{G}} + V_{\mathrm{B}}}{2-\gamma}, \\
p_1^{0} &= \epsilon\, \bar{V}, \\
p_1^{1} &= \frac{V_{\mathrm{G}} + (1-\gamma)V_{\mathrm{B}}}{2-\gamma} - (1-\epsilon)I, \\
p_1^{2} &= V_{\mathrm{G}} - (1-\epsilon)I.
\end{aligned}$$

Next, observe that

$$\mathbb{E}\left[\tilde{p}_1 \middle| \iota,\, \Theta,\, a\right] \in (\epsilon V_{\mathrm{B}}, V_{\mathrm{G}} - I + \epsilon I),$$

since after any action there is at least one order flow that is not fully revealing. In particular, $y = 0$ is never fully revealing and $\mathbb{P}(y = 0|\iota, \Theta, a) > 0$. Now a positively informed speculator strictly prefers to buy because

$$\mathbb{E}\left[\tilde{p}_1\middle|\iota,\,\Theta=\mathrm{G},\,a\right] < V_{\mathrm{G}} - I + \epsilon I,$$

and a negatively informed speculator strictly prefers to sell because

$$\mathbb{E}\left[\tilde{p}_1\middle|\iota,\,\Theta=\mathrm{B},\,a\right] > \epsilon V_{\mathrm{B}}.$$

From these inequalities it follows that the unskilled speculator prefers not to trade rather than buying or selling due to his price impact. ■

Adding A Small w_2 to the Profit-Maximizing Speculator's Payoff

Corollary 12 *For $w_1 = 1$ and w_2 sufficiently small, there is no perfect Bayesian equilibrium in which a skilled profit-maximizing speculator acquires information.*

Proof. I will prove this by contradiction. Suppose an equilibrium in which the skilled speculator acquires information. First note that the unskilled speculator is no longer indifferent between selling and not trading as in Lemma 10; instead, he prefers to sell. By selling he gets

$$U\left(a^{\mathrm{U}}=-1\right) = w_1\Pi\left(a^{\mathrm{U}}=-1\right) + w_2\Phi\left(a^{\mathrm{U}}=-1\right) = w_2\Phi\left(a^{\mathrm{U}}=-1\right) > 0.$$

Appendix 7.1.4 proves that $\Phi\left(a^{\mathrm{U}}=-1\right) > 0$. For brevity, I omit the proof here.

By not trading the unskilled speculator gets

$$U\left(a^{\mathrm{U}}=0\right) = w_1\Pi\left(a^{\mathrm{U}}=0\right) + w_2\Phi\left(a^{\mathrm{U}}=0\right) = 0;$$

Again, I show that $\Phi\left(a^{\mathrm{U}}=0\right) = 0$ in Appendix 7.1.4. The unskilled speculator also prefers selling to buying. His payoff from buying is

$$\begin{aligned} U\left(a^{\mathrm{U}}=+1\right) =& w_1\Pi\left(a^{\mathrm{U}}=+1\right) + w_2\Phi\left(a^{\mathrm{U}}=+1\right) = \\ =& w_1\left[\frac{1}{3}(\bar{V} - I - p_1^1) + \frac{1}{3}\left(\bar{V} - I - p_1^2\right)\right] + w_2\Phi\left(a^{\mathrm{U}}=+1\right). \end{aligned}$$

Since, by assumption, a skilled speculator follows his signal, $p_1^y > \bar{V} - I$ for $y \in \{1, 2\}$ and, therefore, $\Pi\left(a^{\mathrm{U}}=+1\right) < 0$. Thus, for w_2 sufficiently small, the unskilled speculator's payoff from buying is negative.

But if the unskilled speculator sells all the time, the skilled speculator's private information loses its speculative value. Indeed, if the unskilled speculator sells with probability one, then when $y \in \{1, 2\}$ prices are perfectly informative of the skilled speculator's positive signal and when $y \in \{-2, -1, 0\}$ prices are zero because investment fails. It follows immediately that, as $w_2 \to 0$, for any $c > 0$ the skilled speculator never acquires information. ■

7.1.4 Proof of Lemma 4

Prices: Secondary market prices are

$$p_1^{-2} = p_1^{-1} = p_1^{0} = 0,$$
$$p_1^{1} = p_1^{2} = \frac{[\gamma + (1-\gamma)\mu^*]V_{\mathrm{G}} + (1-\gamma)\mu^* V_{\mathrm{B}}}{\gamma + 2(1-\gamma)\mu^*} - I.$$

If the order flow is $y \in \{-2, -1, 0\}$, condition (3) is not satisfied and the equity issue fails. When $y \in \{1, 2\}$, the firm is able to raise I from capital providers provided that condition (3) holds. A sufficient condition for (3) to hold is that $p_1^1 \geq 0$ or

$$I \leq \frac{[\gamma + (1-\gamma)\mu^*]V_{\mathrm{G}} + (1-\gamma)\mu^* V_{\mathrm{B}}}{\gamma + 2(1-\gamma)\mu^*} := \bar{I}_{\mathrm{cc}}.$$

Beliefs: Clients observe the hired fund's action and the firm's type when the investment is undertaken, after which they update their beliefs about the fund's ability.[18] The client's posteriors are as follows:

$$\mathbb{P}(\mathrm{S} \,|\, \Theta\iota, a, y) \begin{cases} = 0 & \text{if } \Theta\iota = \mathrm{B} \text{ and } a = +1 \\ = \dfrac{\gamma}{\gamma + 2(1-\gamma)\mu^*} & \text{if } \Theta\iota = 0 \text{ and } a = +1, \\ = \dfrac{\gamma}{\gamma + 2(1-\gamma)(1-\mu^*)} & \text{if } \Theta\iota = 0 \text{ and } a = -1, \\ = \dfrac{\gamma}{\gamma + (1-\gamma)\mu^*} & \text{if } \Theta\iota = \mathrm{G} \text{ and } a = +1, \\ \in [0, 1] & \text{if } a = 0. \end{cases}$$

Action $a = 0$ is off the equilibrium path. Perfect Bayesian equilibrium imposes no restrictions.

[18] The fund's action and the firm's type when the project is undertaken are a sufficient statistic for the order flow.

I choose to set

$$\mathbb{P}(\mathrm{S} \,|\, a = 0) = 0. \tag{23}$$

In the next section I provide a microfoundation for these out-of-equilibrium beliefs.

Unskilled speculator: An unskilled speculator who does not trade obtains no payoff owing to the out-of-equilibrium beliefs of equation (23). He mixes between buying and selling if his utility from the the two actions is the same and is greater than zero. His utility from buying is

$$\Phi(a^{\mathrm{U}} = +1) = \frac{1}{3}\left[\frac{\gamma}{\gamma + 2(1-\gamma)\mu}\right] + \frac{1}{3}\left[\frac{\gamma}{\gamma + (1-\gamma)\mu}\right]. \tag{24}$$

When this speculator buys, the equity issue can either succeed or fail. If it succeeds, then the firm's value realizes, and the client can infer the correctness of the fund's trade. If the issue fails, the project is not undertaken, the firm's value does not realize and the client can observe only the fund's action. The firm's equity issue succeeds when the order flow is $y \in \{1, 2\}$, that is, with overall probability $\frac{2}{3}$. The speculator is wrong with probability 1/2 and earns nothing (the project is undertaken but the firm is bad) and he is right with probability 1/2. With remaining probability the firm's offering fails and clients can only make inferences from the buying action.

The unskilled speculator's utility from selling is

$$\Phi(a^{\mathrm{U}} = -1) = \frac{\gamma}{\gamma + 2(1-\gamma)(1-\mu)}. \tag{25}$$

When a speculator sells, the firm can never invest and clients can only make inferences from the selling action.

The fund mixes between buying and selling if $\mu^*(\gamma)$ solves

$$f(\mu, \gamma) := \Phi(a^{\mathrm{U}} = +1) - \Phi(a^{\mathrm{U}} = -1) = 0. \tag{26}$$

In equilibrium, $\mu^*(\gamma) \in [0, 1/2)$. In fact, $\mu^*(\gamma) \in (0, 1/2)$ by the intermediate value theorem when one considers that $\gamma \in (0, 1)$ and f is continuous in μ, as well as $f(\mu = 1/2, \gamma) < 0$ and $f(\mu = 0, \gamma) > 0$ for $\gamma < \frac{4}{5}$. Whenever $\gamma \in \left[\frac{4}{5}, 1\right]$, we have that $\mu^* = 0$. And, since f is strictly decreasing in μ, it follows that μ^* is unique. The equation for μ^* is

$$\mu^*(\gamma) = \frac{3 - 8\gamma}{12(1-\gamma)} + \frac{1}{12}\sqrt{\frac{9 + 4\gamma^2}{(1-\gamma)^2}}. \tag{27}$$

Skilled speculator: I show that (i) the skilled speculator has no profitable deviation from following his signal after acquiring information and (ii) he prefers to acquire. A skilled speculator who acquires and obtains a positive signal prefers buying to selling or not trading. In fact,

$$\Phi\left(a^{\mathrm{S}}=+1,\, \sigma=\sigma_{\mathrm{G}},\, \eta^{*}=1\right)>\max\left\{\Phi(a^{\mathrm{S}}=0,\, \sigma=\sigma_{\mathrm{G}},\, \eta^{*}=1), \Phi(a^{\mathrm{S}}=-1,\, \sigma=\sigma_{\mathrm{G}},\, \eta^{*}=1)\right\}.$$

Since the payoff from not trading is always zero, I must only show that the payoff from buying is always greater than that from selling or that

$$\bar{f}(\mu^{*},\gamma):=\Phi\left(a^{\mathrm{S}}=+1,\, \sigma=\sigma_{\mathrm{G}},\, \eta^{*}=1\right)-\Phi\left(a^{\mathrm{S}}=-1,\, \sigma=\sigma_{\mathrm{G}},\, \eta^{*}=1\right)>0, \tag{28}$$

where

$$\bar{f}(\mu^{*},\gamma)=\frac{1}{3}\left[\frac{\gamma}{\gamma+2(1-\gamma)\mu^{*}}\right]+\frac{2}{3}\left[\frac{\gamma}{\gamma+(1-\gamma)\mu^{*}}\right]-\frac{\gamma}{\gamma+2(1-\gamma)(1-\mu^{*})}.$$

Since $\bar{f}>f\ \forall\mu$ and $f(\mu^{*},\gamma)=0$, it follows that $\bar{f}(\mu^{*},\gamma)>0$ and inequality (28) is satisfied.

Upon observing a bad signal, the skilled speculator must prefer to sell rather than to buy or not trade:

$$\Phi(a^{\mathrm{S}}=-1,\, \sigma=\sigma_{\mathrm{B}},\, \eta^{*}=1)>\max\left\{\Phi(a^{\mathrm{S}}=0,\, \sigma=\sigma_{\mathrm{B}},\, \eta^{*}=1), \Phi(a^{\mathrm{S}}=+1,\, \sigma=\sigma_{\mathrm{B}},\, \eta^{*}=1)\right\}.$$

Since the payoff from not trading is always zero, I must only show that the payoff from selling is always greater than that from buying or that

$$\Phi(a^{\mathrm{S}}=-1,\, \sigma=\sigma_{\mathrm{B}},\, \eta^{*}=1)-\Phi(a^{\mathrm{S}}=+1,\, \sigma=\sigma_{\mathrm{B}},\, \eta^{*}=1)>0. \tag{29}$$

Since $\Phi(a^{\mathrm{S}}=-1,\, \sigma=\sigma_{\mathrm{B}},\, \eta^{*}=1)=\Phi(a^{\mathrm{U}}=-1)\quad\forall\mu$ and in equilibrium $\Phi(a^{\mathrm{U}}=-1)=\Phi(a^{\mathrm{U}}=+1)$, inequality (29) can be re-written as

$$\Phi(a^{\mathrm{U}}=+1)-\Phi(a^{\mathrm{S}}=+1,\, \sigma=\sigma_{\mathrm{B}},\, \eta^{*}=1),$$

or expanding, as

$$\frac{1}{3}\left[\frac{\gamma}{\gamma+2(1-\gamma)\mu^{*}}\right]+\frac{1}{3}\left[\frac{\gamma}{\gamma+(1-\gamma)\mu^{*}}\right]-\frac{1}{3}\left[\frac{\gamma}{\gamma+2(1-\gamma)\mu^{*}}\right]=\frac{1}{3}\left[\frac{\gamma}{\gamma+(1-\gamma)\mu^{*}}\right]>0,$$

and it is always satisfied.

Having proved that the skilled speculator prefers to follow his signal, I must now show that he prefers to acquire information. His payoff from acquiring information and following his signal is

$$\Phi(s^{\mathrm{S}}(\sigma),\, \eta^* = 1) - c = \frac{\gamma}{6[\gamma + 2(1-\gamma)\mu^*]} + \frac{\gamma}{3[\gamma + (1-\gamma)\mu^*]} + \frac{\gamma}{2[\gamma + 2(1-\gamma)(1-\mu^*)]} - c.$$

If the speculator does not acquire information, then what is his optimal deviation? When $\mu^* \in (0, 1/2)$, the payoff from buying and selling is the same in equilibrium and is higher than the payoff from not trading, and thus selling is an optimal deviation. When $\mu^* = 0$, selling is the unique most profitable deviation. Thus, for all $\mu^* \in [0, 1/2)$, selling is the most profitable deviation. I must therefore show that

$$g(\mu^*, \gamma) := \Phi(s^{\mathrm{S}}(\sigma),\, \eta^* = 1) - \Phi(a^{\mathrm{S}} = -1,\, \eta^* = 1) > 0.$$

Substituting,

$$g(\mu^*, \gamma) = \frac{1}{6}\left[\frac{\gamma}{\gamma + 2(1-\gamma)\mu^*}\right] + \frac{1}{3}\left[\frac{\gamma}{\gamma + (1-\gamma)\mu^*}\right] - \frac{1}{2}\left[\frac{\gamma}{\gamma + 2(1-\gamma)(1-\mu^*)}\right] > 0.$$

Since $\gamma > 0$, it follows that $g > 0$ exactly when $\frac{g}{\gamma} > 0$. Since $\frac{\partial(\frac{g}{\gamma})}{\partial\gamma} < 0$ for all $\mu, \gamma \in (0, 1)$ and $\frac{g}{\gamma} = 0$ when $\gamma = 1$, $\frac{g}{\gamma}$ is strictly positive for $\gamma \in (0, 1)$.

Thus, the skilled speculator is better off acquiring than not acquiring if $g(\mu^*, \gamma) - c > 0$ or

$$c < \frac{1}{6}\left[\frac{\gamma}{\gamma + 2(1-\gamma)\mu^*}\right] + \frac{1}{3}\left[\frac{\gamma}{\gamma + (1-\gamma)\mu^*}\right] - \frac{1}{2}\left[\frac{\gamma}{\gamma + 2(1-\gamma)(1-\mu^*)}\right] =: \bar{c}_{\mathrm{cc}}. \tag{30}$$

Firms: Firms have the same incentives as those described in the proof of Lemma 2.

Microfoundation of Out-of-Equilibrium Beliefs

The equilibria in Lemma 4 rely on the out-of-equilibrium belief that

$$\mathbb{P}(\mathrm{S}|a = 0) = 0,$$

that is, on the career-concerned speculator's earning no profit if he abstains from trading. But is it reasonable to impose such a strict out-of-equilibrium belief?

Suppose there exists a small proportion of "naive" managers who always follow their signals; accordingly, they do not trade when they receive a signal $\sigma = \emptyset$. In this case, to refrain from trading is no longer an out-of-equilibrium event. I use $r(\cdot)$ to denote the equilibrium reputation. Now suppose that $r(\text{right})$—the reputation from being right—is greater than $r(\text{wrong})$—the reputation from being wrong. Suppose also that $r(\text{right}) > 0 \geq r(\text{wrong})$.[19]

In any equilibrium in which these assumptions hold, it is optimal for a skilled speculator to follow his signal. Then, when the client observes his fund playing $a = 0$, it must be the case that the fund is unskilled, that is, $r(a = 0) = 0$. Moreover, since a skilled speculator can never be wrong, it must also be the case that a wrong speculator is unskilled, that is, $r(\text{wrong}) = 0$. Then, for any randomizing probability, the unskilled speculator is better off randomizing between buying and selling than not trading, since by randomizing he at least has a chance of being right.

7.1.5 Proof of Lemma 5

The proof is similar to that of Lemma 4. Here I highlight only the points of departure.

Beliefs: With no feedback effects the value of the firm always realizes, and thus clients observe the hired fund's action and the firm's type, after which they update their beliefs about the fund's ability. The client's posteriors are as follows:

$$\mathbb{P}(\mathrm{S} \,|\, \Theta, a, y) \begin{cases} = 0 & \text{if } \Theta = \mathrm{B} \text{ and } a = +1 \\ & \text{or if } \Theta = \mathrm{G} \text{ and } a = -1, \\ = \dfrac{\gamma}{\gamma + (1-\gamma)\mu^{**}} & \text{if } \Theta = \mathrm{G} \text{ and } a = +1, \\ = \dfrac{\gamma}{\gamma + (1-\gamma)(1-\mu^{**})} & \text{or if } \Theta = \mathrm{B} \text{ and } a = -1, \\ \in [0, 1] & \text{if } a = 0. \end{cases}$$

Action $a = 0$ is off the equilibrium path. I choose to set $\mathbb{P}(\mathrm{S} \,|\, a = 0) = 0$.

Unskilled speculator: An unskilled speculator who does not trade obtains no payoff owing to the out-of-equilibrium beliefs. He mixes between buying and selling if his utility from the the two actions is the same and is greater than zero, or if

$$\Phi(a^{\mathrm{U}} = +1) - \Phi(a^{\mathrm{U}} = -1) = \frac{1}{2}\frac{\gamma}{\gamma + (1-\gamma)\mu} - \frac{1}{2}\frac{\gamma}{\gamma + (1-\gamma)(1-\mu)} = 0.$$

[19]It is possible to show that this is always the case when the career-concerned speculator cares enough about profits.

In equilibrium, $\mu^{**} = 1/2$.

Skilled speculator: Similar to the proof of Lemma 4, it is easy to show that the skilled speculator has no profitable deviation from following his signal after acquiring information. I omit the proof here. I show next that he prefers to acquire information. His payoff from acquiring information and following his signal is

$$\Phi(s^{\mathrm{S}}(\sigma),\, \eta^* = 1) - c = \frac{1}{2}\frac{\gamma}{\gamma + (1-\gamma)\mu^{**}} + \frac{1}{2}\frac{\gamma}{\gamma + (1-\gamma)(1-\mu^{**})} - c.$$

If the speculator does not acquire information, then selling is an optimal deviation. Thus, the skilled speculator is better off acquiring and following his signal than not acquiring information and selling if

$$\Phi(s^{\mathrm{S}}(\sigma),\, \eta^* = 1) - c \geq \Phi(a^{\mathrm{S}} = -1,\, \eta = 0)$$

or

$$c < \frac{\gamma}{1+\gamma}.$$

7.1.6 Proof of Proposition 3

Plugging in for $\mathbb{P}(\iota = 1 \,|\, \mathrm{B})$ and $\mathbb{P}(\iota = 0 \,|\, \mathrm{G})$ in equation (12), one finds that when profit-maximizing speculators trade, output inefficiency is

$$\frac{1}{2}\left(1 - \frac{2}{3}\gamma - \frac{1}{3}(1-\gamma)\right)|V_{\mathrm{G}} - I| + \frac{1}{6}(1-\gamma)|V_{\mathrm{B}} - I|,$$

and when career-concerned speculators trade output inefficiency is

$$\frac{1}{2}\left(1 - \frac{2}{3}\gamma - \frac{2}{3}(1-\gamma)\mu^*\right)|V_{\mathrm{G}} - I| + \frac{1}{3}(1-\gamma)\mu^*|V_{\mathrm{B}} - I|.$$

Subtracting the second expression from the first, yields

$$-\frac{(1-\gamma)}{6}(1-2\mu^*)(V_{\mathrm{G}} - I) - \frac{(1-\gamma)}{6}(1-2\mu^*)|V_{\mathrm{B}} - I| = -\frac{(1-\gamma)}{3}(1-2\mu^*)\left(\bar{V} - I\right),$$

which is greater than zero if and only if $\mu^* < \frac{1}{2}$; this proves Proposition 3 which says that output inefficiency is higher with profit-maximizing speculators than with career-concerned speculators.

7.2 Seasoned Equity Offering

7.2.1 Proof of Lemma 7

Prices: Using equation (14), SEO prices are

$$p_2^1 = \frac{[\gamma + (1-\gamma)\beta]V_{\mathrm{G}} + (1-\gamma)\beta V_{\mathrm{B}}}{\gamma + 2(1-\gamma)\beta}, \tag{31}$$
$$p_2^2 = V_{\mathrm{G}}.$$

The equity issue fails for $y \in \{-2,-1,0\}$ because inequality (15) is not satisfied, whereas it succeeds for $y \in \{1,2\}$ if $p_2^1 \geq I$ or

$$I \leq \frac{[\gamma + (1-\gamma)\beta]V_{\mathrm{G}} + (1-\gamma)\beta V_{\mathrm{B}}}{\gamma + 2(1-\gamma)\beta} =: \mathcal{I}_{\mathrm{pm}}.$$

Using equation (17), prices at $t = 1$ are

$$p_1^{-2} = p_1^{-1} = p_1^0 = 0,$$
$$p_1^1 = \left(1 - \frac{n'}{n+n'}\right)\frac{V_{\mathrm{G}} + (1-\gamma)V_{\mathrm{B}}}{2-\gamma} < V_{\mathrm{G}} - I, \tag{32}$$
$$p_1^2 = V_{\mathrm{G}},$$

where $n'/(n+n') = I/p_2^1$. This is the proportion of shares that the firm must issue in order to raise capital in $y = 1$ (see equation (33) below).

Unskilled speculator: I check that his strategy at $t = 2$ is subgame perfect. For $y \in \{1,2\}$, this speculator prefers staying out to buying if

$$0 > \alpha_{\mathrm{U}}\,(\bar{V} - p_2^y) \quad \forall y \in \{1,2\}.$$

This follows because $p_2^y > \bar{V}$ for $y \in \{1,2\}$. For $y \in \{-2,-1,0\}$, the SEO fails and the speculator is indifferent between buying and staying out. Note that the unskilled speculator has more information than the uninformed capital provider after observing y. Indeed, he knows that a high order flow is the result of noise traders buying and not of the speculator's order to buy. So his assessment of the firm is that it is of average quality.

By the one deviation property, to prove that his strategy at $t = 1$ is subgame perfect, I need only to check that the unskilled speculator has no incentive to deviate at $t = 1$. The proof is similar to that of Lemma 2.

Skilled positively informed speculator: I check that his strategy at $t = 2$ is subgame perfect. When $y = 1$, he prefers buying to staying out if

$$\alpha_{\mathrm{S}} \left(V_{\mathrm{G}} - p_2^1\right) > 0.$$

This follows since $p_2^1 < V_{\mathrm{G}}$. For any other y this speculator is indifferent. When $y = 2$, his private information is revealed and the price reflects the firm's fair value, in which case he makes zero profit regardless of his action. When $y \in \{-2, -1, 0\}$, the SEO fails and he is indifferent between buying and staying out.

To show that the speculator's strategy at $t = 1$ is subgame perfect, it is enough to check deviations at $t = 1$. The proof is similar to that of Lemma 2 for the skilled speculator.

Skilled negatively informed speculator: At $t = 2$, when $y \in \{-2, -1, 0\}$, this speculator is indifferent between buying and staying out because the SEO fails. When $y \in \{1, 2\}$, he prefers to stay out since he does not want to buy a bad firm that is overpriced. In fact,

$$0 > \alpha_{\mathrm{S}}(V_{\mathrm{B}} - p_2^y), \quad \text{for} \quad y \in \{1, 2\}.$$

The proof that this speculator has no incentive to deviate at $t = 1$ is similar to the proof of Lemma 2.

Information acquisition: The skilled speculator prefers to acquire information and follow his signal if

$$\Pi(s^{\mathrm{S}}(\sigma), \eta^* = 1) = \frac{1}{6}\left(V_{\mathrm{G}} - I - p_1^1\right) + \frac{1}{6}\alpha_{\mathrm{S}}\left(V_{\mathrm{G}} - p_2^1\right) - c > 0,$$

that is, if

$$c < \frac{(1-\gamma)\Delta V}{6}\left[\frac{1}{2-\gamma}\left(1 - \frac{\gamma(1-\beta)I}{[\gamma + (1-\gamma)\beta]V_{\mathrm{G}} + (1-\gamma)\beta V_{\mathrm{B}}}\right) + \frac{\beta\alpha_{\mathrm{S}}}{\gamma + 2(1-\gamma)\beta}\right] =: \mathcal{C}_{\mathrm{pm}}.$$

Good firm: The manager of the good firm seeks to maximize the probability of investment in order to maximize shareholders' wealth. Whenever investment succeeds (i.e., $p_2^y > I$), shareholders receive

$$\left(1 - \frac{I}{p_2^y}\right) V_{\mathrm{G}};$$

this value is greater than zero, which is all any shareholders would receive if the manager did not issue shares or issued too small a number of shares.

At $t = 0$, the firm's manager issues the number of shares that will warrant the equity issue's success when the level of price informativeness is the lowest (i.e., when $y = 1$):

$$\frac{n'}{n+n'} p_2^1 = I. \tag{33}$$

Issuing a number of shares that satisfies equation (33) guarantees that, when the order flow is $y \in \{1, 2\}$, the firm can raise capital to undertake the project and shareholders are better off.

Bad firm: The manager of the bad firm pools with the manager of the good firm by issuing the same number of shares, since choosing any other number of shares would reveal him to be bad. Therefore, with positive probability, the firm obtains funding and its manager earns private benefits.

7.2.2 Proof of Lemma 8

The proof is similar to that of Lemma 4. I present here only the points of departure from that proof.

Prices: Using equation (14), the SEO prices are

$$p_2^1 = p_2^2 = \frac{[\gamma + (1-\gamma)\mu^*]V_{\mathrm{G}} + (1-\gamma)\mu^* V_{\mathrm{B}}}{\gamma + 2(1-\gamma)\mu^*}.$$

The equity issue fails for $y \in \{-2, -1, 0\}$ because inequality (15) is not satisfied. It succeeds for $y \in \{1, 2\}$ if and only if $p_2^1 \geq I$, or

$$I \leq \frac{[\gamma + (1-\gamma)\mu^*]V_{\mathrm{G}} + (1-\gamma)\mu^* V_{\mathrm{B}}}{\gamma + 2(1-\gamma)\mu^*} =: I_{\mathrm{cc}}.$$

Note that since the uninformed capital providers gets rationed regardless of whether the speculator is skilled, they do not face the winner's curse.

At $t = 1$ prices are the same as those in Lemma 4. Using equation (17),

$$p_1^1 = p_1^2 = \left(1 - \frac{n'}{n+n'}\right) \frac{[\gamma + (1-\gamma)\mu^*]V_{\mathrm{G}} + (1-\gamma)\mu^* V_{\mathrm{B}}}{\gamma + 2(1-\gamma)\mu^*},$$

or, substituting for $n'/(n+n')$ from equation (33),

$$p_1^1 = p_1^2 = \frac{[\gamma + (1-\gamma)\mu^*]V_{\mathrm{G}} + (1-\gamma)\mu^* V_{\mathrm{B}}}{\gamma + 2(1-\gamma)\mu^*} - I.$$

For $y \in \{-2, -1, 0\}$, secondary market prices are zero since the SEO fails.

Beliefs: Clients' posteriors are now

$$\mathbb{P}(\mathrm{S} \,|\, \Theta\iota, y, a_1, a_2) \begin{cases} = 0 & \text{if } \Theta\iota = \mathrm{B} \text{ and } a_1 = a_2 = +1, \\ = \dfrac{\gamma}{\gamma + 2(1-\gamma)\mu^*} & \text{if } \Theta\iota = 0 \text{ and } a_1 = a_2 = +1, \\ = \dfrac{\gamma}{\gamma + 2(1-\gamma)(1-\mu^*)} & \text{if } \Theta\iota = 0 \text{ and } a_1 = -1 \text{ and } a_2 = 0, \\ = \dfrac{\gamma}{\gamma + (1-\gamma)\mu^*} & \text{if } \Theta\iota = \mathrm{G} \text{ and } a_1 = a_2 = +1, \\ \in [0,1] & \text{if } a_1 = 0, \\ \in [0,1] & \text{if } a_1 \ncong a_2. \end{cases}$$

where $a_1 \cong a_2$ means that (i) if the speculator buys at $t = 1$ then he buys at $t = 2$ and (ii) if the speculator sells at $t = 1$ he stays out at $t = 2$.

Since perfect Bayesian equilibrium does not impose any restrictions on the out-of-equilibrium beliefs, I choose to set

$$\mathbb{P}\left(\mathrm{S} \,\middle|\, a_1 = 0\right) = 0 \tag{34}$$

and

$$\mathbb{P}\left(\mathrm{S} \,\middle|\, a_1 \ncong a_2\right) = 0. \tag{35}$$

By imposing the out-of-equilibrium belief of (35), the problem reduces to the one already solved in Lemma 4. Clients observe two actions that, in equilibrium, contain the same information as what can be inferred by observing a_1 in the baseline model. Hence, the proof of the equilibrium behavior of unskilled and skilled speculators mirrors the proof of Lemma 4.

7.2.3 SEO Discount

An SEO succeeds if and only if $y \in \{1, 2\}$, as shown in Propositions 7 and 8.

When profit-maximizing speculators trade and $y = 2$, the price per share at $t = 1$ equals the price at $t = 2$—since the speculator's private information is revealed in the $t = 1$ price and uninformed bidders do not face the winner's curse. When $y = 1$, the $t = 1$ price per share is higher than its $t = 2$ counterpart. To see this, notice that if $y = 1$ then n' (the number of shares issued at $t = 0$) solves for

$$\frac{n'}{n+n'}p_2^1 = I,$$

as described in equation (33). Then, after substituting for n' from the previous equation in the $t = 2$ price per share, we have

$$\frac{p_2^1}{n+n'} = \frac{p_2^1}{n + \frac{I \cdot n}{p_2^1 - I}} = \frac{p_2^1 - I}{n},$$

which is always lower than the $t = 1$ price per share (p_1^1/n). Comparing the SEO price of equation (31) to the secondary market price of equation (32), it is clear that

$$p_1^1 > p_2^1 - I.$$

Indeed, substituting for the prices from equations (31) and (32) in the inequality above, I find that

$$\left(1 - \frac{I}{p_2^1}\right) \frac{V_{\mathrm{G}} + (1-\gamma)V_{\mathrm{B}}}{2-\gamma} > p_2^1 - I$$

since

$$\frac{V_{\mathrm{G}} + (1-\gamma)V_{\mathrm{B}}}{2-\gamma} > \frac{[\gamma + (1-\gamma)\beta]V_{\mathrm{G}} + (1-\gamma)\beta V_{\mathrm{B}}}{\gamma + 2(1-\gamma)\beta} = p_2^1.$$

To see that the left-hand side of the inequality above is greater than the right-hand side, notice that (i) the two terms are equal for $\beta = 1$, (ii) the right-hand side is decreasing in β, and (iii) $\beta > 1$.

When career-concerned speculators trade, the price per share at $t = 1$ and that at $t = 2$ are equal if the SEO succeeds. According to the equilibrium prices given in Lemma 8, if $y \in \{1, 2\}$ then

$$p_1^y = p_2^y - I.$$

7.3 Proof of Proposition 7

Proof. I use Lemmas 13 and 14 to prove Proposition 7. Lemma 13 finds the equilibrium in which profit-maximizing and career-concerned speculators trade simultaneously and investment succeeds in $y \in \{1, 2\}$, whereas Lemma 14 finds the equilibrium in which profit-maximizing and career-concerned speculators trade simultaneously and investment succeeds only in $y = 2$.

Lemma 13 *For $I \leq \bar{I}$, $c_{\text{pm}} \leq c^*_{\text{pm}}$, and $c_{\text{cc}} \leq c^*_{\text{cc}}$, there exists a perfect Bayesian equilibrium in which the unskilled profit-maximizing speculator does not trade, the unskilled career-concerned speculator buys with probability $\mu^* \in [0, 1/2)$, the skilled speculator acquires information and follows his signal, and the firm chooses to issue equity.*

Proof. This equilibrium is not unique, but I focus on the equilibrium that would be unique using the refinement introduced in Corollary 11.

Prices: Using equation (5), secondary market prices are

$$
\begin{aligned}
p_1^{-2} &= p_1^{-1} = p_1^0 = 0, \\
p_1^1 &= \frac{\gamma V_{\text{G}} + 2(1-\gamma)[(1-r) + \mu^* r]\bar{V}}{\gamma + 2(1-\gamma)(1-r) + 2(1-\gamma)\mu^* r} - I, \\
p_1^2 &= \frac{\gamma V_{\text{G}} + 2(1-\gamma)\mu^* r \bar{V}}{\gamma + 2(1-\gamma)\mu^* r} - I.
\end{aligned}
$$

If the order flow is $y \in \{-2, -1, 0\}$, condition (3) is not satisfied and the equity issue fails. When $y \in \{1, 2\}$, the firm is able to raise I from capital providers as long as condition (3) holds. A sufficient condition for (3) to hold is that $p_1^1 \geq 0$ or

$$
I < \frac{\gamma V_{\text{G}} + 2(1-\gamma)[(1-r) + \mu^* r]\bar{V}}{\gamma + 2(1-\gamma)(1-r) + 2(1-\gamma)\mu^* r} =: \bar{I}. \tag{36}
$$

Career-concerned speculator: The equilibrium behavior of career-concerned speculators is identical to that of Lemma 4 because (i) I assume that fund clients can distinguish between profit-maximizing and career-concerned speculators[20] and (ii) the presence of profit-maximizing speculators does not affect the states in which investment is undertaken when condition (36) holds. Thus, career-concerned speculators play the signaling game of Lemma 4 and the upper bound on the cost for the career-concerned speculator c^*_{cc} is the same as that in equation (30).

Profit-maximizing speculator: The proof of the behavior of profit-maximizing speculators is not identical to that of Lemma 2 because prices are affected by the behavior of career-concerned speculators. Hence, the proof (which I omit) consists of showing that there are no

[20]This assumption does not contradict the assumption that market makers cannot distinguish between career-concerned and profit-maximizing speculators. Whereas market makers observe only the aggregate order flow and do not observe who submitted the trades, fund clients can tell the difference between a career-concerned and profit-maximizing speculator when they make the hiring decision.

profitable deviations for each speculator. After showing that the unskilled profit-maximizing speculator does not trade and the skilled profit-maximizing speculator follows his own signal, I show that the latter acquires information if

$$c_{\mathrm{pm}} < \frac{(1-\gamma)}{3}\left[\frac{2\mu^* r\Delta V}{\gamma+(1-\gamma)\mu^* r} + \frac{(1-r+\mu^* r)\Delta V}{\gamma+2(1-\gamma)(1-r+\mu^* r)}\right] =: c^*_{\mathrm{pm}}.$$

Firms: Firms have the same incentives as those described in the proof of Lemma 2. ■

Lemma 14 *For $I \in (\bar{I}, \hat{I}]$, $c_{\mathrm{pm}} \leq \hat{c}_{\mathrm{pm}}$, and $c_{\mathrm{cc}} \leq \hat{c}_{\mathrm{cc}}$, there exists a perfect Bayesian equilibrium in which the unskilled profit-maximizing speculator does not trade, the unskilled career-concerned speculator buys with probability $\hat{\mu} \in [0, 1/2)$, the skilled speculator acquires information and follows his signal, and the firm chooses to issue equity.*

Proof. This equilibrium is not unique, but I focus on the equilibrium that would be unique using the refinement introduced in Corollary 11.

Prices: From Lemma 13, if $I > \bar{I}$, then the equity issue fails for $y \in \{-2, -1, 0, 1\}$. Thus, secondary market prices are

$$p_1^{-2} = p_1^{-1} = p_1^0 = p_1^1 = 0,$$
$$p_1^2 = \frac{\gamma V_{\mathrm{G}} + 2(1-\gamma)\hat{\mu} r\bar{V}}{\gamma+2(1-\gamma)\hat{\mu} r} - I,$$

as long as condition (3) holds, that is, $p_1^2 > 0$ or

$$I < \frac{\gamma V_{\mathrm{G}} + 2(1-\gamma)\hat{\mu} r\bar{V}}{\gamma+2(1-\gamma)\hat{\mu} r} =: \hat{I}. \tag{37}$$

Profit-maximizing speculator: The proof of the behavior of the speculator is similar to that of Lemma 2; it consists of showing that each speculator has not profitable deviations (I omit it here). After showing that the unskilled speculator does not trade and that the skilled speculator follows his signal, I show that the skilled speculator acquires information provided that

$$c_{\mathrm{pm}} < \frac{1}{3}\left[\frac{(1-\gamma)\hat{\mu} r\Delta V}{\gamma+2(1-\gamma)\hat{\mu} r}\right] =: \hat{c}_{\mathrm{pm}}.$$

Career-concerned speculator: Similar to the proof of Lemma 4, I show that the unskilled career-concerned speculator is indifferent between buying and selling if the payoff from buying is identical to that from selling, or if

$$\frac{2}{3}\left[\frac{\gamma}{\gamma+2(1-\gamma)\mu}\right]+\frac{1}{6}\left[\frac{\gamma}{\gamma+(1-\gamma)\mu}\right]=\frac{\gamma}{\gamma+2(1-\gamma)(1-\mu)};$$

this condition is satisfied for $\hat{\mu}\in[0,1/2)$, where

$$\hat{\mu}=\frac{6-23\gamma+17\gamma^2+(1-\gamma)\sqrt{36+36\gamma+25\gamma^2}}{24(1-\gamma)^2}. \tag{38}$$

It is easy to show that a skilled speculator follows his signal (I omit the proof). He also prefers to acquire information given that his most profitable deviation when he does not acquire is to sell if

$$c_{\text{cc}}<\frac{\gamma}{6[\gamma+(1-\gamma)\hat{\mu}]}+\frac{\gamma}{3[\gamma+2(1-\gamma)\hat{\mu}]}-\frac{\gamma}{2[\gamma+2(1-\gamma)(1-\hat{\mu})]}=:\hat{c}_{\text{cc}}. \tag{39}$$

Firms: Firms have the same incentives as those described in the proof of Lemma 2. ■

I use Lemmas 13 and 14 to prove Proposition 7.

If $c_{\text{cc}}>\hat{c}_{\text{cc}}$, then, if the equity issue fails given $y=1$, the skilled career-concerned speculator is not willing to acquire when $y=2$. So, given reasonable out-of-equilibrium beliefs, neither the skilled nor the unskilled career-concerned speculator trades conditional on the investment's failing in $y=1$. Hence, prices become perfectly informative of the skilled profit-maximizing speculator's order to buy and so he will not acquire information.

Therefore, a sufficient condition for $y=1$ to be pivotal is that $c_{\text{cc}}>\hat{c}_{\text{cc}}$. The inequality $c^*_{\text{cc}}>\hat{c}_{\text{cc}}$ guarantees that if the skilled career-concerned speculator does not acquire given $y=2$, then he acquires given $y=1$. The proof (which I omit) consists of showing that, keeping γ fixed: (i) $\mu^*<\hat{\mu}$, which follows by comparing (27) and (38), (ii) the upper bounds on costs are decreasing in μ, and (iii) given the same μ, $c^*_{\text{cc}}>\hat{c}_{\text{cc}}$.

Having shown that $y=1$ is the pivotal state for investment, the cost of capital in the associated order flow decreases as the proportion of career-concerned speculators increases; this result is in line with Proposition 1, which states that career-concerned speculators loosen firms' financial constraints. From equation (36) I compute

$$\frac{d\bar{I}(r;\gamma)}{dr}=\frac{(1-\gamma)\gamma(1-\mu^*)\Delta V}{2[2-2\gamma+\gamma-2r(1-\gamma)(1-\mu^*)]^2}>0.$$

Observe that μ^* is a function of γ and is independent of r. So holding γ constant, then as the proportion of career-concerned speculators increases, so does the upper bound on investment. Therefore, in response to an increasing proportion of career-concerned speculators, firms' cost of capital decreases. ■

7.4 Imperfect Signals

Lemma 15 *For $I \leq \hat{\mathcal{I}}_{\mathrm{pm}}$, $c \leq \hat{\mathcal{C}}_{\mathrm{pm}}$, and $\delta < \frac{1+2\rho-\gamma}{2(2-\gamma)}$, there exists a perfect Bayesian equilibrium in which the unskilled speculator does not trade, the skilled speculator acquires information and follows his signal, and the firm chooses to issue equity.*

Proof. The proof is similar to that of Lemma 2 in Appendix 7.1.1. Here I present only the points of departure from that proof.

Prices: Secondary market prices are

$$
\begin{aligned}
p_1^{-2} &= p_1^{-1} = p_1^0 = 0, \\
p_1^1 &= \frac{(\gamma\rho + 1 - \gamma)V_{\mathrm{G}} + [\gamma(1-\rho) + 1 - \gamma]V_{\mathrm{B}}}{2-\gamma} - I, \\
p_1^2 &= \rho V_{\mathrm{G}} + (1-\rho)V_{\mathrm{B}} - I,
\end{aligned}
$$

as long as fund raising succeeds, or $p_1^1 \geq 0$, which re-writes as

$$
I \leq \frac{(\gamma\rho + 1 - \gamma)V_{\mathrm{G}} + [\gamma(1-\rho) + 1 - \gamma]V_{\mathrm{B}}}{2-\gamma} =: \hat{\mathcal{I}}_{\mathrm{pm}}.
$$

Unskilled speculator: The unskilled speculator upon observing a negative signal is indifferent between selling and not trading because after a sale, investment fails and he earns no profits. What condition ensures that he prefers not to trade rather than to buy upon observing a negative signal? This is guaranteed by

$$
\begin{aligned}
\Pi(a^{\mathrm{U}} = +1, \phi = \phi_{\mathrm{G}}) =& \frac{1}{3}\left[\delta V_{\mathrm{G}} + (1-\delta)V_{\mathrm{B}} - I - p_1^1\right] + \frac{1}{3}\left[\delta V_{\mathrm{G}} + (1-\delta)V_{\mathrm{B}} - I - p_1^2\right] \leq \\
& 0 = \Pi(a^{\mathrm{U}} = 0, \phi = \phi_{\mathrm{G}}),
\end{aligned}
$$

which can be re-written as

$$
-\frac{[1 - 4\delta - \gamma(1-2\delta) + 2\rho]\,\Delta V}{3(2-\gamma)} < 0.
$$

This is satisfied for $\delta < \frac{1+2\rho-\gamma}{2(2-\gamma)}$.

Skilled negatively informed speculator: A skilled negatively informed speculator is indifferent between selling and not trading: selling triggers a firm's investment failure. He prefers to sell than to buy a bad firm if

$$\begin{aligned}
&\Pi(a^{\mathrm{S}} = -1, \sigma = \sigma_{\mathrm{B}}) = 0 \geq \\
&\quad \frac{1}{3}\left[(1-\rho)V_{\mathrm{G}} + \rho V_{\mathrm{B}} - I - p_1^2\right] + \frac{1}{3}\left[(1-\rho)V_{\mathrm{G}} + \rho V_{\mathrm{B}} - I - p_1^1\right] = \Pi(a^{\mathrm{S}} = +1, \sigma = \sigma_{\mathrm{B}}),
\end{aligned}$$

which is satisfied since $p_1^y > (1-\rho)V_{\mathrm{G}} + \rho V_{\mathrm{B}} - I$ for $y \in \{1, 2\}$.

Skilled positively informed speculator: The skilled positively informed speculator prefers to buy rather than to sell or not trade since

$$\begin{aligned}
\Pi(a^{\mathrm{S}} = +1, \sigma = \sigma_{\mathrm{G}}) = \frac{1}{3}\left[\rho V_{\mathrm{G}} + (1-\rho)V_{\mathrm{B}} - I - p_1^2\right] + \frac{1}{3}\left[\rho V_{\mathrm{G}} + (1-\rho)V_{\mathrm{B}} - I - p_1^1\right] \geq \\
0 = \Pi(a^{\mathrm{S}} = -1, \sigma = \sigma_{\mathrm{G}}) = \Pi(a^{\mathrm{S}} = 0, \sigma = \sigma_{\mathrm{G}}),
\end{aligned}$$

which is satisfied since $p_1^y \leq \rho V_{\mathrm{G}} + (1-\rho)V_{\mathrm{B}} - I$ for $y \in \{1, 2\}$.

Information acquisition: If this speculator does not acquire information, it is optimal for him to behave like the unskilled speculator and not trade. He therefore acquires information and follows his signal only if his payoff from doing so is positive, or

$$c < \frac{(1-\gamma)(2\rho-1)\Delta V}{6(2-\gamma)} =: \hat{\mathcal{C}}_{\mathrm{pm}}.$$

■

Lemma 16 *For $I \leq \hat{\mathcal{I}}_{\mathrm{cc}}$ and $c \leq \hat{\mathcal{C}}_{\mathrm{cc}}$, there exists a perfect Bayesian equilibrium in which the skilled speculator acquires and follows his signal, the unskilled speculator sells if he receives a negative signal and buys with probability $\bar{\mu} \in (0, 1)$ if he receives a positive signal, and the firm chooses to issue equity.*

Proof. The proof is similar to that of Lemma 4. Here I present only the points of departure from such proof.

Beliefs: The client's posteriors are as follows:

$$\mathbb{P}(\mathrm{S}\,|\,\Theta\iota, a, y)\begin{cases} = \dfrac{\gamma(1-\rho)}{\gamma(1-\rho)+(1-\gamma)(1-\delta)\bar{\mu}} & \text{if } \Theta\iota = \mathrm{B} \text{ and } a=+1 \\ = \dfrac{\gamma}{\gamma+(1-\gamma)\bar{\mu}} & \text{if } \Theta\iota = 0 \text{ and } a=+1, \\ = \dfrac{\gamma\rho}{\gamma\rho+(1-\gamma)\delta\bar{\mu}} & \text{if } \Theta\iota = \mathrm{G} \text{ and } a=+1, \\ = \dfrac{\gamma}{1+(1-\gamma)(1-\bar{\mu})} & \text{if } \Theta\iota = 0 \text{ and } a=-1, \\ \in [0,1] & \text{if } a=0. \end{cases}$$

Action $a=0$ is off the equilibrium path. I set $\mathbb{P}(\mathrm{S}\,|\,a=0)=0$.

Prices: Secondary market prices are

$$\begin{aligned} &p_1^{-2} = p_1^{-1} = p_1^0 = 0, \\ &p_1^1 = p_1^2 = \frac{[\gamma\rho+(1-\gamma)\delta\bar{\mu}]\,V_{\mathrm{G}} + [\gamma(1-\rho)+(1-\gamma)(1-\delta)\bar{\mu}]\,V_{\mathrm{B}}}{\gamma+(1-\gamma)\bar{\mu}} - I, \end{aligned}$$

as long as $p_1^1 \geq 0$, or

$$I \leq \frac{[\gamma\rho+(1-\gamma)\delta\bar{\mu}]\,V_{\mathrm{G}} + [\gamma(1-\rho)+(1-\gamma)(1-\delta)\bar{\mu}]\,V_{\mathrm{B}}}{\gamma+(1-\gamma)\bar{\mu}} =: \hat{\mathcal{I}}_{\mathrm{cc}}.$$

Unskilled speculator: An unskilled speculator who does not trade obtains no payoff owing to the out-of-equilibrium beliefs. Conditional on observing a positive signal he mixes with probability $\bar{\mu}$ if he is indifferent between selling and buying (and if he prefers that to not trading). He mixes if

$$\begin{aligned} f(\bar{\mu}) := \Phi(a^{\mathrm{U}}=+1, \phi=\phi_G) - \Phi(a^{\mathrm{U}}=-1, \phi=\phi_G) = \frac{2}{3}\delta\frac{\gamma\rho}{\gamma\rho+(1-\gamma)\delta\bar{\mu}} + \\ + \frac{2}{3}(1-\delta)\frac{\gamma(1-\rho)}{\gamma(1-\rho)+(1-\gamma)(1-\delta)\bar{\mu}} + \frac{\gamma}{3[\gamma+(1-\gamma)\bar{\mu}]} - \frac{\gamma}{1+(1-\gamma)(1-\mu)} = 0. \end{aligned}$$

In equilibrium, $\bar{\mu}(\gamma) \in (0,1)$. In fact, $\bar{\mu}(\gamma) \in (0,1)$ by the intermediate value theorem when one considers that $\gamma \in (0,1)$ and f is continuous in μ, as well as $f(\bar{\mu}=0) > 0$ and $f(\bar{\mu}=1) < 0$.

Conditional on observing a negative signal, the unskilled speculator's payoff from selling is

$$\Phi(a^{\mathrm{U}}=-1, \phi=\phi_B) = \frac{\gamma}{1+(1-\gamma)(1-\bar{\mu})} > 0 = \Phi(a^{\mathrm{U}}=0, \phi=\phi_B).$$

He would deviate and buy if

$$g(\bar{\mu}) := \Phi(a^{\mathrm{U}} = +1, \phi = \phi_B) - \Phi(a^{\mathrm{U}} = -1, \phi = \phi_B) = \frac{2}{3}(1-\delta)\frac{\gamma\rho}{\gamma\rho + (1-\gamma)\delta\bar{\mu}} + $$
$$+ \frac{2}{3}\delta\frac{\gamma(1-\rho)}{\gamma(1-\rho) + (1-\gamma)(1-\delta)\bar{\mu}} + \frac{\gamma}{3[\gamma + (1-\gamma)\bar{\mu}]} - \frac{\gamma}{1 + (1-\gamma)(1-\bar{\mu})} > 0.$$

But this cannot be the case: since $\rho > \delta > 1/2$, then $f > g$ and since $\bar{\mu}$ is such that $f(\bar{\mu}) = 0$, it follows that $g(\bar{\mu}) < 0$.

Skilled speculator: I show that (i) that the skilled speculator has no profitable deviation from following his signal after acquiring information, and (ii) he prefers to acquire. A skilled speculator who acquires and obtains a positive signal prefers buying to selling or not trading. In fact, since he obtains zero from not trading, it remains to show that

$$h(\bar{\mu}) := \Phi\left(a^{\mathrm{S}} = 1,\, \sigma = \sigma_{\mathrm{G}},\, \eta^* = 1\right) - \Phi\left(a^{\mathrm{S}} = -1,\, \sigma = \sigma_{\mathrm{G}},\, \eta^* = 1\right) > 0,$$

where

$$h(\bar{\mu}) = \frac{1}{3}\left[\frac{2\gamma\rho^2}{\gamma\rho + (1-\gamma)\delta\bar{\mu}} + \frac{2\gamma(1-\rho)^2}{\gamma(1-\rho) + (1-\gamma)(1-\delta)\bar{\mu}} + \frac{\gamma}{\gamma + (1-\gamma)\bar{\mu}} - \frac{\gamma}{1 + (1-\gamma)(1-\bar{\mu})}\right].$$

Comparing h and f, since $\rho > \delta$, it follows that $h > f$, proving that the skilled speculator prefers to buy upon observing a positive signal.

Upon observing a bad signal, the skilled speculator must prefer to sell rather than to buy or not trade. Again, since he gets zero from not trading, it remains to show that

$$\bar{g}(\bar{\mu}) := \Phi(a^{\mathrm{S}} = -1,\, \sigma = \sigma_{\mathrm{B}},\, \eta^* = 1) - \Phi(a^{\mathrm{S}} = +1,\, \sigma = \sigma_{\mathrm{B}},\, \eta^* = 1) > 0.$$

Define $\bar{g}^*(\bar{\mu}) = -\bar{g}(\bar{\mu})$ and note that $\bar{g}^*(\bar{\mu}) < 0$ since

$$\frac{2(1-\rho)\gamma\rho}{3[\gamma\rho + (1-\gamma)\delta\bar{\mu}]} + \frac{2\rho\gamma(1-\rho)}{3[\gamma(1-\rho) + (1-\gamma)(1-\delta)\bar{\mu}]} + \frac{\gamma}{3[\gamma + (1-\gamma)\bar{\mu}]} - \frac{\gamma}{1 + (1-\gamma)(1-\bar{\mu})} < 0.$$

Since $\rho > \delta$, we have that $\bar{g}^*(\bar{\mu}) < g(\bar{\mu}) < 0$. Therefore, $\bar{g}(\bar{\mu}) > 0$ and the skilled negatively informed speculator has no incentive to deviate.

Having proved that the skilled speculator prefers to follow his signal, I must now show that he prefers to acquire information. His payoff from acquiring information and following his signal is

$$\Phi(s^{\mathrm{S}}(\sigma),\, \eta^* = 1) - c = \frac{\gamma\rho^2}{3[\gamma\rho + (1-\gamma)\delta\bar{\mu}]} + \\ + \frac{\gamma(1-\rho)^2}{3[\gamma(1-\rho) + (1-\gamma)(1-\delta)\bar{\mu}]} + \frac{\gamma}{6[\gamma + (1-\gamma)\bar{\mu}]} + \frac{\gamma}{2[1 + (1-\gamma)(1-\bar{\mu})]} - c.$$

If the speculator does not acquire information, then his optimal deviation is to behave as the unskilled speculator. I must therefore show that

$$\Phi(s^{\mathrm{S}}(\sigma),\, \eta^* = 1) - c > \Phi(s^{\mathrm{U}}(s),\, \eta^* = 1). \tag{40}$$

Substituting, the skilled speculator prefers to acquire if

$$c < \frac{1}{3}(\rho - \delta\bar{\mu})\frac{\gamma\rho}{\gamma\rho + (1-\gamma)\delta\bar{\mu}} + \frac{1}{3}(1 - \rho - (1-\delta)\bar{\mu})\frac{\gamma(1-\rho)}{\gamma(1-\rho) + (1-\gamma)(1-\delta)\bar{\mu}} + \\ + \frac{1}{6}(1-\mu)\frac{\gamma}{\gamma + (1-\gamma)\bar{\mu}} - \frac{1}{2}(1-\mu)\frac{\gamma}{1 + (1-\gamma)(1-\bar{\mu})} := \hat{\mathcal{C}}_{\mathrm{cc}}.$$

■

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