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Agency Costs and Strategic Speculation in the U.S. Stock Market

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Abstract

This study shows theoretically and empirically that a firm's agency problems may affect its stock liquidity. We postulate that less uncertainty about suboptimal managerial effort may enhance liquidity provision — by lowering dealers' perceived adverse selection risk from trading with better-informed speculators. Consistent with our theory, we find that the staggered adoption of antitakeover provisions across U.S. states in the 1980s and 1990s — a plausibly exogenous shock reducing perceived effort uncertainty by unambiguously facilitating managerial agency — *improves* the stock liquidity of affected firms relative to peer firms. This evidence suggests that firm-level agency considerations play a nontrivial role for the process of price formation in financial markets.

JEL classification: D22; G14; G34

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1 Introduction

The separation of ownership and control is one of the main features of the modern corporation. The relationship between principals (e.g., investors) and agents (e.g., managers) is plagued by frictions allowing agents not to always act in the best interest of their principals. In the presence of ineffective corporate governance, these conflicts may produce severe agency costs from managerial decisions that, while privately optimal, destroy firm value. A vibrant literature has long been modeling and investigating the empirical relevance of these conflicts for a firm's financing and investment policies (e.g., Jensen and Meckling, 1976; Tirole, 2006). This study introduces and provides evidence for the notion that agency problems may also affect a firm's stock *liquidity*.

Understanding the frictions that affect the quality of price formation in capital markets is among the most important endeavors in financial economics.[1] We contribute to this understanding by showing that corporate governance may have significant, previously ignored externalities on those frictions and financial market liquidity. In doing so we bridge two areas of research, corporate finance and market microstructure, that have seldom interacted.[2]

We illustrate this notion in a parsimonious one-period model of strategic trading based on Kyle (1985). This otherwise standard economy is populated not only by a better-informed speculator, noise traders, and competitive dealership, but also by a manager exerting privately optimal, costly effort (or investment) that affects her firm's fundamental value (i.e., the liquidation value of the traded asset) by a technology of random, privately known productivity. In choosing her effort, the manager faces a trade-off between firm value and private benefit maximization, whose relative importance depends on exogenous managerial preferences and corporate governance considerations. The speculator receives a private, noisy signal of firm value, yet does not observe either managerial effort or its unit productivity and private benefit to the manager. Risk-neutral dealers clear the aggregate order flow made of speculative and noise trades, and in so doing face adverse selection risk.

[1]Comprehensive surveys of this vast body of literature include O'Hara (1995), Madhavan (2000), Hasbrouck (2007), Vives (2008), and Foucault et al. (2013).

[2]E.g., see Chen et al. (2007), Bharath et al. (2009), Bond et al. (2012), and references therein.

In this setting, we show that second-best managerial effort *lowers* the equilibrium liquidity of the traded asset (i.e., its market depth) relative to the first-best scenario. An intuitive explanation for this result is that the manager's socially suboptimal effort makes firm value sensitive to an additional source of risk (her private benefits) besides technology shocks. This renders speculation's private information of firm value more valuable and her trading activity more cautious, thus worsening dealers' adverse selection risk and their liquidity provision. As importantly, we also show that second-best equilibrium liquidity is *decreasing* in both the *extent of* and *uncertainty about* firm-level managerial agency problems — since an increase in the former amplifies, while a decrease in the latter mitigates dealers' perceived severity of adverse selection problems when clearing the market.

We test our model's implications in the U.S. stock market — where agency and adverse selection problems have been *separately* found to be important by much governance and microstructure research (e.g., see Hasbrouck, 2007; Atanasov and Black, 2015). Performing such a test is, however, challenging. Market liquidity is by its nature elusive, multifaceted (e.g., featuring tightness, immediacy, breadth, depth, and resiliency), and difficult to quantify, and especially so are its determinants (which include not only information asymmetry but also inventory considerations, transaction costs, and order-processing fees, among others). Accordingly, we construct a composite, annual, firm-level measure of stock market illiquidity as the equal-weighted average of up to ten different (standardized) proxies in the literature — some with broad interpretation and sample coverage, some closer to the concept of market depth (or price impact) in Kyle (1985), and some more scarcely available but explicitly extracting its portion due to adverse selection risk.[3] The aggregation is meant to capture, both transparently and parsimoniously, adverse selection commonality across all of these proxies (as in Bharath et al., 2009) for as many firms as possible while minimizing idiosyncratic shocks and measurement noise.

[3] These proxies, detailed in Section 3.1, are: the quoted proportional bid-ask spread; the effective bid-ask spread of Roll (1984); the effective cost of trading of Hasbrouck (2009); the price impact measure of Amihud (2002); (the negative of) the liquidity ratio (or market depth measure) of Cooper et al. (1985) and Amihud et al. (1997); (the negative of) the reversal coefficient of Pastor and Stambaugh (2003); the fractions of quoted and Roll's (1984) effective bid-ask spreads due to adverse selection (as in George et al., 1991); the return-volume coefficient of Llorente et al. (2002); and the probability of informed trading of Easley et al. (1996).

It is equally difficult to assess the severity of agency problems within a firm, as the effectiveness of various observable forms of firm or country-level corporate governance is controversial and the ensuing agency costs are often unobservable (e.g., see Shleifer and Vishny, 1997). The literature proposes numerous proxies for firms' external shareholder governance — e.g., voting rights, restrictions to shareholder rights and investor activism, institutional ownership, board structure, managerial power, and executive compensation (Bhagat et al., 2008; Gillan et al., 2011). Two widely used indices of the relative weakness of firm-level corporate governance based on many of these provisions — the g-index of Gompers et al. (2003) and (especially) the e-index of Bebchuk et al. (2009) — are weakly *positively* correlated with (especially the market depth and adverse selection components of) our measure of firm-level stock illiquidity. While marginally consistent with our model, these cross-sectional relations cannot be interpreted as causal since they may be clouded by measurement error, offsetting effects (discussed next; see also Ferreira and Laux, 2007), or the endogeneity of corporate governance and stock market liquidity. Omitted variable bias could arise if firms differ on observable and unobservable characteristics (e.g., related to their riskiness) influencing both agency costs (Tirole, 2006) and liquidity provision (Vives, 2008; Foucault et al., 2013). Simultaneity bias could arise if both corporate governance and liquidity are jointly determined (e.g., as liquidity may facilitate either block formation or block disposition; see Kyle and Vila, 1991; Maug, 1998; Edmans, 2009; Back et al., 2015; Collin-Dufresne and Fos, 2015).

We address these concerns by investigating the impact of the staggered adoption of *business combination* (BC) laws in U.S. states in the 1980s and 1990s on firm-level stock illiquidity. Numerous studies (surveyed in Atanasov and Black, 2015) interpret the passage of BC laws in a state as a plausibly exogenous event unambiguously weakening the external shareholder governance of firms there incorporated (i.e., treated firms) by mitigating the threat of hostile takeover (and replacement) that may otherwise limit their managers' ability to exert value-destroying effort (e.g., Jensen and Meckling, 1976). However, anecdotal and empirical evidence suggests that the enactment of these antitakeover statutes may have not only exogenously increased the severity of treated firms' agency problems but also exogenously resolved prior uncertainty among stock market participants about whether treated firm management may exert suboptimal effort.[4] According to our model, the former effect would *worsen*, while the latter would *improve*, treated firms' stock market liquidity. To determine the relative importance of these effects, our difference-in-differences (DiD) identification strategy compares changes in the illiquidity of treated firms around the adoption of BC laws to changes in the illiquidity of otherwise similar control firms (e.g., operating in the same state as the treated ones) but incorporated in different states. We use average-effects DiD regressions (as in Bertrand and Mullainathan, 2003) and high-dimensional fixed-effects DiD regressions (as in Gormley and Matsa, 2014, 2016) to control for a variety of unobserved differences (across time, states, and industries) that may bias our inference by coinciding with the passage of BC laws or the treatment and control groups.

We find that the liquidity of firms' stocks *improves* following the state adoption of antitakeover provisions. This result is statistically and economically significant, as well as robust to a variety of alternative liquidity, sample, and regression specifications. For instance, our measure of stock illiquidity of firms incorporated in a state adopting BC laws declines by an average of 10% of its sample variation after their enactment relative to firms located (i.e., headquartered) in the *same* state and operating in the *same* industry but incorporated in *different* states where BC laws have not (or not yet) been passed. The estimated improvement in liquidity is consistent across different aggregations of its proxies and cannot be explained by differences in ex ante characteristics of treated and control firms (including past illiquidity), pre-event trends in illiquidity, policy anticipation and transience, unobserved local economic or political shocks, endogenous lobbying by treated firms, Delaware incorporation, or firms being treated in their state of location.

This result may be only indirectly suggestive of the joint effect of agency costs and strategic speculation on stock liquidity that our theory advocates, since both the severity of and uncer-

[4]For instance, BC laws were extensively covered by the media and litigated in courts (Bertrand and Mullainathan, 2003; Karpoff and Wittry, 2015), while the stock prices of firms affected by their adoption promptly and significantly declined when their adoption was announced (e.g., Pound, 1987; Karpoff and Malatesta, 1989; Szewczyk and Tsetsekos, 1992). We discuss this issue further in Section 3.2.

tainty about firm-level agency costs (and the impact of BC laws on either) are unobservable.[5] Further, more direct support for our theory comes from testing its additional, unique predictions. In particular, our model conjectures the slope of the relation between firm-level corporate governance and stock liquidity to be *decreasing* in the ex ante unit cost of managerial effort. Intuitively, firm managers exert more effort (including possibly value-destroying one) if it is less costly; ceteris paribus, this makes not only dealers' liquidity provision more sensitive to managerial agency problems, but also firm value and speculation's private information about it more volatile. Firm-level unit effort cost is also not directly observable. Accordingly, we use the latter set of model predictions to measure low (high) such cost with standard proxies for high (low) private signal volatility — high (low) analyst earnings-per-share (EPS) forecast dispersion and uncertainty (e.g., O'Brien, 1988; Bradshaw et al., 2012) — and high (low) price variance — high (low) stock return volatility. Matching DiD estimates of the heterogeneous response of firms' stock illiquidity to BC laws based on ex ante (i.e., prior-year) realizations of these proxies are consistent with our model. For instance, we find that following the adoption of a BC law, the liquidity of treated firms with above-median forecast dispersion, forecast uncertainty, or return volatility in the previous year improves (relative to similar control firms in the same state and industry) by 40% to 80% *more* than when comparing similarly treated and control firms with previous below-median such characteristics.

These findings indicate that the passage of BC provisions may have not only impaired corporate governance for the affected firms but also enhanced their stock market liquidity by resolving prior uncertainty about the severity of their agency costs. More generally, our analysis suggests that managerial agency problems may play a nontrivial role for the process of price formation in financial markets. We believe this to be an important, original insight into the economics of

[5]For example, alternative explanations include *i)* the negative effects of BC laws on dealers' inventory management risk — e.g., due to lower managerial effort (Bertrand and Mullainathan, 2003) or risk-taking (Gormley and Matsa, 2016) reducing fundamental (and price) risk for the treated firms — although our illiquidity proxy is designed to capture the portion of firm-level liquidity driven by adverse selection risk alone; as well as *ii)* the ambiguous effects of the adoption of antitakeover provisions on that risk from either discouraging the entry of potential blockholders or motivating the exit of existing ones (e.g., Bacidore and Sofianos, 2002; Brockman and Chung, 2003; Bhagat et al., 2008; Back et al., 2015).

capital market quality.[6]

We proceed as follows. In Section 2, we construct a model of strategic trading in the presence of potentially suboptimal managerial effort yielding agency costs. In Section 3, we describe the data and present the empirical results. We conclude in Section 4.

2 Theory

We are interested in the effects of firm-level agency costs on stock market liquidity. To that purpose, we develop a noisy rational expectations equilibrium (REE) model of strategic, informed, one-shot trading — based on Kyle (1985) — in which the liquidation value of the traded asset depends on managerial effort. This is the simplest setting in which to represent the more general notion here advocated that socially suboptimal managerial behavior may affect liquidity provision in the presence of adverse selection risk from trading. We then derive the model's equilibrium in closed-form and consider its implications for the asset's liquidity. All proofs are in the Appendix.

2.1 The Basic Economy

The model is a two-date ($t = 0, 1$), one-period economy in which a single risky asset is traded. Trading occurs only at date $t = 1$, after which the asset's payoff v is revealed. The economy

[6] Related work includes studies arguing that better investor protection (measured by differences in various firm-level corporate governance indices or in the legal and regulatory environments of firms' listing markets) may improve stock market liquidity and price informativeness by fostering transparency and information production and curbing insider trading (e.g., Bacidore and Sofianos, 2002; Brockman and Chung, 2003; Ferreira and Laux, 2007; Fernandes and Ferreira, 2008; Chung et al., 2010; Lang et al., 2012). This inference may, however, be plagued by the endogeneity of agency problems and stock illiquidity. Numerous studies consider the reverse-causation arguments that a firm's stock market liquidity may either weaken its corporate governance (by facilitating the "exit" of blockholders who may otherwise monitor the firm; e.g., see Bhide, 1993; Admati et al., 1994; Bolton and Von Thadden, 1998; Back et al., 2015) or strengthen it (by facilitating the emergence of those blockholders; e.g., see Kyle and Vila, 1991; Maug, 1998; Edmans, 2009; Fang et al., 2009; Bharath et al., 2013; Edmans et al., 2013). Dumitrescu (2015) develops a model of both blockholder governance by "voice" and trading in which a strategic firm manager is, however, also the only speculator. Our theory highlights the impact of suboptimal managerial behavior on strategic speculation. Other related studies investigate the relation between firms' stock market liquidity and such corporate outcomes as their investment and leverage decisions (e.g., Chen et al., 2007; Bharath et al., 2009).

is populated by four types of agents: an informed trader (labeled *speculator*) representing a strategic "speculative sector;" uninformed liquidity traders; perfectly competitive *market-makers* (or *dealers*); and an informed *firm manager.* All agents know the structure of the economy and the decision process leading to payoffs, order flow, and prices.

2.2 The Firm Manager

A vast corporate finance literature links firm value to costly managerial effort and investigates the corporate governance issues leading to "second-best" decision-making (e.g., Jensen and Meckling, 1976; Tirole, 2006). In particular, managers (or *insiders*) may either have private information about the firm (adverse selection) or may exert effort that is unobservable to firm *outsiders* (moral hazard); in the presence of either form of information asymmetry, insiders may exert effort (or make investment) that, while beneficial to them, is detrimental to outsiders and overall firm value.

We capture these agency costs parsimoniously by assuming that: *i)* at date $t = 0$, the firm manager exerts a privately observed, privately optimal effort y affecting the traded asset's liquidation value v according to the following quadratic function $v\left(y\right)$:

$$v\left(y\right) = uy - \frac{c}{2}y^2, \tag{1}$$

where u is a normally distributed random variable (with mean zero and variance σ_u^2) — known exclusively to the manager — representing the firm's technology or environment affecting the productivity of y, while $c > 0$ is a fixed, unit cost of implementing y; and *ii)* the manager's optimal effort (or investment) is the one maximizing the following separable value function $U_M\left(y\right)$:

$$U_M\left(y\right) = \left(1-\gamma\right)v\left(y\right) + \gamma e y, \tag{2}$$

where $\gamma \in (0,1)$ and e is a normally distributed random variable (with mean zero and variance σ_e^2) — independent from u but also known exclusively to the manager — representing the manager's private benefits from her effort that are unrelated to firm value.

The first term in Eq. (2) motivates the manager to maximize firm value in the presence of decreasing returns to effort (in line with outsiders' best interests), i.e., to maximize $v(y)$. The second term in Eq. (2) motivates the manager to exert suboptimal effort (or to make suboptimal investment, in conflict with outsiders' best interests), i.e., to deviate from "first-best" ($\gamma = 0$) effort y_{FB}:

$$y_{FB} \equiv \arg\max v(y) = \frac{1}{c}u, \tag{3}$$

yielding firm value $v_{FB} \equiv v(y_{FB}) = \frac{1}{2c}u^2$, a gamma distributed random variable with mean $\overline{v}_{FB} = \frac{1}{2c}\sigma_u^2$ and variance $\sigma^2_{v_{FB}} = \frac{1}{2c^2}\sigma_u^4$.[7] Accordingly, when $\gamma > 0$, the manager's second-best effort (or investment) y_{SB} is given by

$$y_{SB} \equiv \arg\max U_M(y) = \frac{1}{c}(u + de), \tag{4}$$

where $d = \frac{\gamma}{1-\gamma}$ measures the relative ineffectiveness of exogenous corporate governance at mitigating firm-level agency conflicts — i.e., at reining in privately beneficial-only managerial effort in y_{SB} — yielding firm value $v_{SB} \equiv v(y_{SB}) = \frac{1}{2c}(u^2 - d^2e^2)$, a gamma distributed random variable with mean $\overline{v} = \frac{1}{2c}(\sigma_u^2 - d^2\sigma_e^2) < \overline{v}_{FB}$ and variance $\sigma_v^2 = \frac{1}{2c^2}(\sigma_u^4 + d^4\sigma_e^4) > \sigma^2_{v_{FB}}$.[8]

This setting can accommodate a variety of suboptimal managerial actions in the literature. For instance, Figure 1 plots firm value v of Eq. (1) (solid line) as a function of the manager's effort y in the above economy when $\sigma_u^2 = 1$, $\sigma_e^2 = 1$, $u = 1$, $c = 0.62$, and $\gamma = 0.5$. Ceteris paribus, when $\gamma > 0$, a nonzero realization of the private benefit e leads the firm manager to undertake value-destroying actions ($v_{SB} < v_{FB}$): excessive effort (over-investment or "extravagant investment")

[7] The second order condition for the maximization of the manager's value function $U_M(y)$ of Eq. (2) is satisfied for either $\gamma = 0$ or $\gamma \in (0, 1)$, since $c > 0$.

[8] Much theoretical literature on the microeconomics of corporate finance, also surveyed in Tirole (2006), studies the design of contracts or securities to mitigate the conflicts between (and better align the interests of) insiders and outsiders. Recent studies also consider the feedback effects between financial markets and product markets when the former reveal information to firm managers about the latter either in the absence of agency problems (e.g., Subrahmanyam and Titman, 2001; Goldstein and Guembel, 2008; Goldstein et al., 2013; Edmans et al., 2015) or in the presence of suboptimal managerial behavior and blockholders exerting governance by exit (e.g., Admati and Pfleiderer, 2009; Edmans, 2009). In the current study, we abstract from these issues to concentrate on the implications of a given intensity of agency costs for strategic speculation and price formation.

$y_{SB} > y_{FB}$ if $e > 0$ (the dashed and dotted lines in Figure 1, respectively, for $e = 0.5$) — consistent with the notion of "inefficient empire building" (e.g., Jensen, 1988) — or "insufficient effort" (under-investment) $y_{SB} < y_{FB}$ if $e < 0$ — consistent with the notion of "enjoying the quiet life" (e.g., Bertrand and Mullainathan, 2003). Hence, the more important are private benefits to the manager (higher γ) — i.e., the less effective is corporate governance at preventing wasteful managerial actions — and/or the less costly is her effort (lower c), the larger are the agency costs of those actions (e.g., greater expected loss of firm value and firm risk).

2.3 Information and Trading

As in Kyle (1985), speculation and competitive dealership are risk-neutral. Sometime between $t = 0$ and $t = 1$, the speculator receives private information about the risky asset's payoff in the form of a noisy signal $S = v_{SB} + \varepsilon$, where ε is normally distributed with mean zero, variance σ_ε^2, and $cov(\varepsilon, u) = cov(\varepsilon, e) = 0$. Eqs. (1) to (4) then imply that S is a mixture of gamma and normally distributed random variables with mean $\overline{S} = \overline{v}$ and variance $\sigma^2_{S_{SB}} = \sigma^2_{v_{SB}} + \sigma^2_\varepsilon$. Thus, the speculator neither precisely observes the extent to which v_{SB} depends on investment productivity (u) or managerial effort (y_{SB}) at date $t = 0$, nor can precisely assess the extent to which that effort is influenced by private benefits (e). We define $\phi \equiv \frac{\sigma^2_{v_{SB}}}{\sigma^2_{S_{SB}}} = \frac{\sigma_u^4 + d^4\sigma_e^4}{\sigma_u^4 + d^4\sigma_e^4 + 2c^2\sigma_\varepsilon^2}$ as the precision of the speculator's private information. Ceteris paribus, the more severe are agency problems (higher γ) and/or the more uncertainty surrounds their severity (higher σ_e^2), the more asset fundamentals v depend on the manager's private benefits — an additional source of risk — and the more precise (and *valuable*) is the speculator's private signal of v (higher ϕ).[9] The relation between agency considerations and speculation is an important feature of our model, since it allows for changes in corporate governance to affect not only γ and σ_e^2 but also the process of price formation for the traded asset. We return to this issue below.

At date $t = 1$, the speculator and liquidity traders simultaneously submit their market orders to the dealers before the equilibrium price p has been set. We define the market order

[9] Specifically, $\frac{\partial \phi}{\partial \gamma} = \frac{8c^2 d^3 \sigma_e^4 \sigma_\varepsilon^2}{[(1-\gamma)(\sigma_u^4 + d^4\sigma_e^4 + 2c^2\sigma_\varepsilon^2)]^2} > 0$ and $\frac{\partial \phi}{\partial \sigma_e^2} = \frac{4c^2 d^4 \sigma_e^4 \sigma_\varepsilon^2}{(\sigma_u^4 + d^4\sigma_e^4 + 2c^2\sigma_\varepsilon^2)^2} > 0$.

of the speculator to be x, such that her trading profits are $\pi(x,p) = (v-p)x$. Liquidity traders generate a random, normally distributed demand z, with mean zero and variance σ_z^2; for simplicity, we further impose that z is independent of all other random variables. Dealers do not receive any information, but observe the aggregate order flow $\omega = x + z$ from all market participants and set the market-clearing price $p = p(\omega)$.

2.4 Equilibrium

Given the optimal managerial effort y_{SB} of Section 2.2 at date $t = 0$, a Bayesian Nash equilibrium of the game of Section 2.3 at date $t = 1$ is made of two functions $x(\cdot)$ and $p(\cdot)$ satisfying the following conditions:

1. *Speculator's utility maximization*: $x(S) = \arg\max E(\pi|S)$;

2. *Semi-strong market efficiency*: $p = E(v|\omega)$.[10]

Unfortunately, y_{SB} of Eq. (4) makes v a nonlinear function of the normally distributed technology (u) and private benefit shocks (e), thus both the speculator's and the dealers' inference problems analytically intractable. The literature proposes several approaches to approximate nonlinear REE models (e.g., Sims, 2000; Lombardo and Sutherland, 2007; Pasquariello, 2014). In this paper, as in Pasquariello (2014), we express both conditional first moments $E[v|S]$ and $E[v|\omega]$ as linear regressions of v on S and ω, respectively:

$$E(v|S) \approx E(v) + \frac{cov(v,S)}{var(S)}[S - E(S)], \tag{5}$$

$$E(v|\omega) \approx E(v) + \frac{cov(v,\omega)}{var(\omega)}[\omega - E(\omega)], \tag{6}$$

whose coefficients depend on moments of v, S, and ω that can be computed in closed form (e.g., Greene, 1997). The intuition of this approach is that rational speculation and dealership

[10]Condition 2 is also commonly interpreted as the outcome of competition among dealers forcing expected profits from liquidity provision to zero (Kyle, 1985).

use their knowledge of the economy to form conditional expectations about asset fundamentals from linear least squares estimates of the relation between those fundamentals and their private information — as they would do, if constrained by computational ability, from first simulating a large number of realizations of the economy and then estimating a relation between v and either S or ω via ordinary least squares (e.g., Hayashi, 2000).[11] Proposition 1 describes the unique linear REE that obtains from Eqs. (5) and (6).

Proposition 1 *There exists a unique linear equilibrium of the model of Sections 2.2 and 2.3 given by the price function*

$$p = \overline{v} + \lambda\omega, \tag{7}$$

where

$$\lambda = \frac{\sigma_u^4 + d^4\sigma_e^4}{2c\sigma_z\sqrt{2\left(\sigma_u^4 + d^4\sigma_e^4 + 2c^2\sigma_\varepsilon^2\right)}}; \tag{8}$$

and by the speculator's order

$$x = \beta\left(S - \overline{v}\right), \tag{9}$$

where

$$\beta = \frac{c\sigma_z\sqrt{2}}{\sqrt{\sigma_u^4 + d^4\sigma_e^4 + 2c^2\sigma_\varepsilon^2}}. \tag{10}$$

2.5 Market Liquidity

Some of the basic properties of the equilibrium of Proposition 1 are standard in this class of models based on Kyle (1985); yet, there are also some noteworthy differences. These properties are best illustrated by considering the limiting first-best scenario ($\gamma = 0$) in which $y = y_{FB}$ of Eq. (3) such that

$$\lambda_{FB} = \frac{\sigma_u^4}{2c\sigma_z\sqrt{2\left(\sigma_u^4 + 2c^2\sigma_\varepsilon^2\right)}} \tag{11}$$

[11] Using numerical analysis, Pasquariello (2014) finds this approach to be accurate and the ensuing inference to be unaffected by using higher-order polynomials in Eqs. (5) and (6).

and

$$\beta_{FB} = \frac{c\sigma_z\sqrt{2}}{\sqrt{\sigma_u^4 + 2c^2\sigma_\varepsilon^2}}. \tag{12}$$

In the above equilibrium, both the speculator's trading *aggressiveness* (β_{FB}) and the *depth* of the market ($\frac{1}{\lambda_{FB}}$) depend on the precision of her private signal of v_{FB} ($\phi_{FB} \equiv \frac{\sigma^2_{v_{FB}}}{\sigma^2_{S_{FB}}}$, where $\sigma^2_{S_{FB}} = \sigma^2_{v_{FB}} + \sigma^2_\varepsilon$): $\beta_{FB} = \frac{\sigma_z}{\sigma_{v_{FB}}}\sqrt{\phi_{FB}}$ and $\lambda_{FB} = \frac{\sigma_{v_{FB}}}{2\sigma_z}\sqrt{\phi_{FB}}$, respectively. Intuitively, the speculator is aware of the potential impact of her trades on prices. Thus, despite being risk-neutral, she trades on her private information about v_{FB} *cautiously* ($|x_{FB}| < \infty$, by camouflaging her market order with noise trading z in the order flow) to dissipate less of it — the more so (lower β_{FB}) the more valuable (higher σ_u^2) or noisier (higher σ_ε^2) is her private signal S_{FB}. The market-makers use the order flow's positive price impact λ_{FB} to offset expected losses from trading with better-informed speculation with expected profits from noise trading.

Accordingly, as in Kyle (1985), liquidity deteriorates (higher λ_{FB}) the less intense is noise trading (lower σ_z^2) and the more vulnerable are market-makers to adverse selection — i.e., the more uncertain is the traded asset's payoff v_{FB} (higher σ_u^2) and the less noisy is S_{FB} (lower σ_ε^2), making the speculator's private information more valuable. However, differently from Kyle (1985), market-makers' adverse selection risk depends not only on the economy's fundamental (or the speculator's information) technology σ_u^2 (σ_ε^2) but also on the effort exerted (or investment made) by the firm manager (y_{FB} of Eq. (3)). As discussed in Section 2.2, managerial effort is greater the lower is its unit cost c. Ceteris paribus, greater such effort not only increases firm value v (higher $\overline{v}_{FB}$ and $\sigma^2_{v_{FB}}$) but also makes the speculator's private information about it more valuable (higher ϕ_{FB}, as $\sigma^2_{S_{FB}}$ depends less on signal noise σ_ε^2) and her trading activity more cautious (lower β_{FB}), ultimately exacerbating dealers' adverse selection concerns and decreasing equilibrium market liquidity (higher λ_{FB}).[12]

Importantly, in the presence of agency problems ($\gamma > 0$), this relation between managerial

[12]More generally, it can be shown from Proposition 1 that $\frac{\partial\phi}{\partial c} = -\frac{4c\sigma_\varepsilon^2\left(\sigma_u^4+d^4\sigma_e^4\right)}{(\sigma_u^4+d^4\sigma_e^4+2c^2\sigma_\varepsilon^2)^2} < 0$, $\frac{\partial\beta}{\partial c} = \frac{\sqrt{2}\sigma_z\left(\sigma_u^4+d^4\sigma_e^4\right)}{(\sigma_u^4+d^4\sigma_e^4+2c^2\sigma_\varepsilon^2)^{\frac{3}{2}}} > 0$, and $\frac{\partial\lambda}{\partial c} = -\frac{4c\sigma_\varepsilon^2\left(\sigma_u^4+d^4\sigma_e^4\right)}{(\sigma_u^4+d^4\sigma_e^4+2c^2\sigma_\varepsilon^2)^2} < 0$ in correspondence with both first-best ($\gamma = 0$ and $y = y_{FB}$ of Eq. (3)) and second-best managerial effort ($\gamma > 0$ and $y = y_{SB}$ of Eq. (4)).

effort and speculation makes the traded asset's liquidity sensitive to firm-level agency costs. In particular, Proposition 1 implies that: *i)* agency problems *worsen* equilibrium market depth ($\lambda - \lambda_{FB} > 0$); and *ii)* equilibrium market depth is *lower* (λ is higher) the more important are private benefits e in the firm manager's value function $U_M(y)$ of Eq.(2) and in her second-best effort y_{SB} of Eq. (4) (higher γ), and the greater is the uncertainty surrounding those private benefits among market participants (higher σ_e^2). We illustrate the intuition behind these results in Figures 2 and 3, where we plot first-best (solid line) and second-best (dashed line) private signal precision (ϕ_{FB} and ϕ) and equilibrium trading aggressiveness (β_{FB} and β) and price impact (λ_{FB} and λ) as a function of γ and σ_e^2 in the economy of Figure 1.

Ceteris paribus, more severe agency problems (higher γ and d; e.g., because of less effective corporate governance) allow the manager to increase her private benefits from running the firm (i.e., to put greater weight on e in y_{SB}), hence to exert more suboptimal effort or investment (e.g., greater $E(|y_{SB} - y_{FB}|) = \frac{1}{c} d\sigma_e^2 \sqrt{\frac{2}{pi}} > 0$). This behavior makes firm value v_{SB} more sensitive to an additional source of risk (e) unrelated to the firm's fundamental technology (u), hence the speculator's private signal of v_{SB} (S) more valuable (higher ϕ in Figure 2a) and her trading on it less aggressive (lower β in Figure 2c). In response to both, the dealers perceive the threat of adverse selection as more serious and decrease market depth (higher λ in Figure 3a). Along those lines, however, less uncertainty (or more transparency) among market participants about the firm's agency problems (lower σ_e^2) alleviates those adverse selection concerns for the dealers, not only because private signal precision deteriorates (lower ϕ in Figure 2b) but also because that deterioration induces less cautious speculation (higher β in Figure 2d), ultimately improving market liquidity (lower λ in Figure 3b).

Corollary 1 *In the equilibrium of Proposition 1, second-best market liquidity is lower than in the first-best scenario, as well as decreasing both in the severity of agency problems plaguing managerial effort and in the uncertainty surrounding those problems.*

Further insight about our model comes from examining the effect of shocks to the unit cost of managerial effort or investment (c) on the relation between agency considerations and market liquidity. To that purpose, Figure 3 plots the second-best equilibrium price impact λ of Eq. (8) in the economy of Figure 1 as a function of γ (Figure 3c) and σ_e^2 (Figure 3d) for either low ($c_L = 0.25$, solid line) or high ($c_H = 0.75$, dashed line) such cost. Ceteris paribus, higher c induces firm management to exert lesser effort (or invest less) — whether it be motivated by the outsiders' or her own best interest (e.g., $\frac{\partial E(|y_{SB}-y_{FB}|)}{\partial c} = -\frac{1}{c^2} d\sigma_e^2 \sqrt{\frac{2}{pi}} < 0$) — so making agency problems less important for firm value (e.g., $\frac{\partial(\overline{v}-\overline{v}_{FB})}{\partial c} = \frac{1}{2c^2} d^2\sigma_e^2 > 0$) and speculation's private information about it less valuable ($\frac{\partial \phi}{\partial c} < 0$). Accordingly, not only does market-makers' adverse selection risk decline and market liquidity improve (as noted earlier; e.g., $\lambda(c_H) < \lambda(c_L)$ in Figure 3), but also such liquidity provision becomes less dependent upon agency considerations (e.g., a flatter slope for $\lambda(c_H)$ in Figure 3).

Remark 1 *In the equilibrium of Proposition 1, the positive sensitivity of equilibrium price impact to the severity of, and uncertainty about, firm-level agency problems is decreasing in the cost of managerial effort.*

3 Empirical Analysis

Our model postulates that firm-level agency problems may affect the liquidity of its securities when traded in financial markets plagued by information asymmetry problems. In this section, we assess the empirical relevance of this notion within the U.S. stock market.

Such an investigation poses numerous challenges. First, measuring the liquidity of a firm's stock — namely, the ability to trade it promptly, cheaply, and with small price impact — is both difficult and controversial, as its intrinsically elusive and multifaceted nature prevents a precise yet general characterization (e.g., Amihud, 2002; Hasbrouck, 2007; Bharath et al., 2009).[13] Second, measuring the ex ante severity of firm-level corporate governance issues is also complex, as suboptimal managerial effort (or investment) may arise from multiple, often unobservable sources of agency conflicts (e.g., Jensen and Meckling, 1976; Gompers et al., 2003; Bebchuk et

[13] For instance, Amihud (2002, p. 35) notes that "[i]t is doubtful that there is one single measure [of liquidity] that captures all its aspects."

al., 2009). Third, while the literature has proposed several proxies for either concept, the causal interpretation of any statistical (cross-sectional or within-firm) relation among them is clouded by the endogeneity of corporate governance provisions (e.g., Bertrand and Mullainathan, 2003; Gormley and Matsa, 2016). Firms may differ on observable factors (e.g., size, fundamental risk, investment opportunity set) and unobservable dimensions affecting both their agency problems and their stock market liquidity — a potential source of omitted variable bias. Corporate governance and liquidity may also be jointly determined (e.g., if a firm's stock market liquidity is linked to its attractiveness to activist investors) — a potential source of simultaneity bias.

We tackle these challenges as follows. First, we develop a firm-level measure of stock market liquidity that aggregates up to ten different proxies in the market microstructure literature (including those directly related to adverse selection, as in Bharath et al., 2009). Second, we estimate the cross-sectional correlation of our liquidity measure with widely used indices of corporate governance. Third, we examine the differential response of our liquidity measure to the staggered adoption of antitakeover laws (also known as business combination [BC] laws) in U.S. states during the 1980s and 1990s — events deemed to have exogenously affected the external shareholder governance of treated firms according to the corporate finance literature (since Bertrand and Mullainathan, 2003). We find that both the extent of and uncertainty about managerial agency problems influence firm-level stock market liquidity as predicated by our model.

3.1 Measuring Stock Market Liquidity

A vast market microstructure literature argues that the liquidity of a firm's stock depends on such frictions as inventory considerations, transaction costs, order-processing fees, and adverse selection risk, among others (e.g., O'Hara, 1995; Huang and Stoll, 1997; Hasbrouck, 2007; Foucault et al., 2013). This literature has proposed many *broad* measures of firm-level stock market liquidity. Most of these measures — while often only weakly correlated with each other (Chordia et al., 2000; Korajczyk and Sadka, 2008; Bharath et al., 2009; Hasbrouck, 2009) — can be easily computed from available data, at relatively low frequencies, and over long sample periods, for virtually all stocks traded in major U.S. exchanges. However, the model of Section 2 proposes a linkage between a firm's managerial agency costs and the depth of its traded securities in the presence of strategic, better-informed speculation — i.e., the portion of dealers' liquidity provision that is affected *exclusively* by their perceived adverse selection risk. Measuring such a portion is a more difficult task — one generally requiring higher-quality, higher-frequency data that is typically available only for fewer stocks over shorter, more recent periods of time.

In light of these issues, we construct a firm-level (i) *composite annual* (t) measure from *both* sets of illiquidity proxies, $ILLIQ_{i,t}$. We begin by estimating up to ten such proxies. The first set of proxies provides us with the longest simultaneous coverage of as many stocks as possible in the universe of U.S. firms. It includes six liquidity variables based on observed trading costs, the serial covariance properties of stock returns, the interaction between stock returns and trading volume (in the spirit of Kyle, 1985), or the estimation of structural models of stock price formation: the quoted proportional bid-ask spread, $PBA_{i,t}$; the effective bid-ask spread of Roll (1984), $ROLL_{i,t}$; the effective cost of trading of Hasbrouck (2009), $EC_{i,t}$; the price impact measure of Amihud (2002), $AMIHUD_{i,t}$; (the negative of) the liquidity ratio (or market depth measure) of Cooper et al. (1985) and Amihud et al. (1997), $AMIVEST_{i,t}$; and (the negative of) the reversal coefficient of Pastor and Stambaugh (2003), $PS_{i,t}$. The second set of proxies provides us with a more direct assessment of the extent to which better-informed trading affects stock price formation. It includes four variables of more involved construction and with often more limited coverage: the adverse selection portions of the quoted and Roll's (1984) effective bid-ask spread (as in George et al., 1991), $ASYPBA_{i,t}$, and $ASYROLL_{i,t}$; the return-volume coefficient of Llorente et al. (2002), $C2_{i,t}$; and the probability of informed trading of Easley et al. (1996), $PIN_{i,t}$. More detailed definitions and intuition are in Table 1 (see also Bharath et al., 2009; Hasbrouck, 2009).

By construction, the higher is each proxy the worse is a firm's stock market liquidity, i.e., the greater is the illiquidity of its stock. Yet, also by construction, each proxy has a different scale, and is only an imprecise estimate of a specific facet of that illiquidity — one that may be plagued by noise and idiosyncratic shocks. Several recent studies propose aggregating some of these proxies to produce a more precise assessment of firm-level or marketwide commonality in liquidity (Chordia et al., 2000; Amihud, 2002; Pastor and Stambaugh, 2003; Acharya and Pedersen, 2005; Korajczyk and Sadka, 2008; Bharath et al., 2009). Aggregation across both sets of proxies may further isolate the portion of this commonality due to firm-level adverse selection risk (Bharath et al., 2009).[14] Accordingly, we compute firm i's stock market illiquidity in year t, $ILLIQ_{i,t}$, as the equal-weighted average of all available, standardized illiquidity proxies for that firm in that year.[15] In unreported analysis, averaging exclusively those four proxies more closely related to adverse selection risk yet with lower sample coverage ($ASYPBA_{i,t}$, $ASYROLL_{i,t}$, $C2_{i,t}$, and $PIN_{i,t}$) yields a noisier measure of firm-level illiquidity but qualitatively similar insight.[16]

3.2 BC Laws and Stock Market Liquidity

Firm management routinely resists a hostile takeover, as it often leads to its replacement and so threatens its ability to continue to pursue actions that may not be in the firm's best interest. Accordingly, the corporate finance literature considers the severity of hostile takeover threats

[14] Aggregating both sets of proxies may also mitigate the downward bias in measures of adverse selection risk resulting from the tendency of such possibly better-informed speculators as activist investors to trade when markets are broadly more liquid, as argued by Collin-Dufresne and Fos (2015).

[15] Principal component analysis (PCA) is also used to aggregate (and extract the common information in) multiple time series of variables of interest (e.g., Baker and Wurgler, 2006; Korajczyk and Sadka, 2008; Bharath et al., 2009). Using PCA for this purpose in our setting is however less than ideal since *i)* it requires all firm-year observations, thus potentially introducing a look-ahead bias in our analysis; and *ii)* as noted earlier, the ten illiquidity proxies listed above do not provide uniform coverage across firms and over time, while their samplewide pairwise correlations (in column (4) of Table 3) are relatively low. Accordingly, when replacing each missing standardized illiquidity proxy-firm-year observation with the equal weighted average of the other contemporaneously available proxies (e.g., Connor and Korajczyk, 1987), we find that: *i)* only the first three principal components have eigenvalues above the conventional threshold of one (3.7, 1.4, and 1.1, respectively); *ii)* the first principal component (loading evenly on broad-based, price impact, and adverse selection-based proxies) accounts for 37% of their variance, while the next two (with more uneven loadings) account for an additional 24%; *iii)* the correlation between an equal-weighted (or variance explained-weighted) average of these three principal components and $ILLIQ_{i,t}$ is 0.93 (0.98); and *iv)* replacing $ILLIQ_{i,t}$ with either average in the analysis that follows leads to the same inference.

[16] Our analysis is similarly unaffected by the further inclusion of such broad, yet conceptually more ambiguous measures of firm-level stock market liquidity as the (log) inverse turnover ratio (i.e., the natural logarithm of the inverse of the ratio of annual trading volume to end-of-year market capitalization) and the proportion of zero returns (i.e., the fraction of days with zero returns but positive trading volume in a year; Lesmond et al., 1999) in $ILLIQ_{i,t}$.

an important form of corporate governance — hence an important determinant of managerial agency problems (Jensen and Meckling, 1976; Tirole, 2006).

Between 1985 and 1997, 33 U.S. states (listed in Table 2) adopted BC laws preventing a variety of corporate transactions between a target firm and a raider (e.g., mergers, sale of assets, or business relationships) and so ultimately restricting hostile takeovers of firms incorporated (i.e., legally organized) in those states. Bertrand and Mullainathan (2003) and numerous subsequent studies (surveyed in Atanasov and Black, 2015) interpret these events as a well-suited source of *exogenous* variation in managerial agency costs for the affected firms, since BC statutes *i)* effectively *weakened* the corporate governance of those firms; *ii)* were unlikely to stem from organized lobbying efforts by those firms (see also Romano, 1987); and *iii)* were enacted in a staggered fashion across states and over time, allowing for multiple treatment events.[17] Thus, these events allow us to assess whether changes in corporate governance (and managerial agency costs) do in fact affect firm-level stock market liquidity, as conjectured by our model.

Notwithstanding this observation, antitakeover laws may have an ambiguous effect on stock illiquidity within our model. The enactment of BC provisions in a state may represent an exogenous increase in the weight (γ) placed by the manager of an affected firm to her private benefits (e) when setting her privately optimal effort (y_{SB}) — i.e., an exogenous *increase* in the *level* of agency costs within that firm. Ceteris paribus, Corollary 1 postulates that such an increase (higher γ) may *worsen* that firm's stock market liquidity (higher λ). However, anecdotal and empirical evidence suggests that the adoption of BC statutes may have also resolved much prior uncertainty about the extent to which managers of affected firms might engage in suboptimal effort. Bertrand and Mullainathan (2003) and Karpoff and Wittry (2015) note that these laws were extensively covered by both specialized and popular press, as well as extensively litigated by both raiders and target companies. Several studies find significantly negative effects of BC laws on the stock prices of affected firms, especially on the first press

[17] In a recent study, Karpoff and Wittry (2015) argue that more than two dozen firms (listed in their Table 3) actively lobbied for the adoption of BC laws. The removal of these firms (about 200 firm-year observations) from the analysis that follows has no effect on our inference.

announcement date (e.g., among others, Pound, 1987; Karpoff and Malatesta, 1989; Szewczyk and Tsetsekos, 1992). This evidence suggests that not only were BC laws perceived to hurt shareholder value but also that their adoption left less ambiguity among stock market participants about whether affected firm management might engage in value-destroying actions. Ceteris paribus, Corollary 1 then predicts that such an exogenous *decrease* in the *uncertainty* about firm-level agency problems (lower σ_e^2) may *improve* the treated firm's stock market liquidity (lower λ).

Because both the extent of and uncertainty about managerial agency costs are not directly observable, it is a difficult empirical question to ascertain which (if any) of these effects may have prevailed upon the enactment of BC laws. In this study, we attempt to answer this question using a difference-in-differences (DiD) methodology based on Bertrand and Mullainathan (2003) and Gormley and Matsa (2014, 2016). This methodology compares changes in stock illiquidity among (*treated*) firms incorporated in states where BC laws had been passed to changes in stock illiquidity among otherwise *similar* (*control*, or *untreated*) firms (e.g., located in the same states) but incorporated in *different* states where BC laws have not (or not yet) been passed. The main identification assumption behind this approach is that stock illiquidity of both sets of firms follows parallel trends over time — namely that, if not for being incorporated in states passing a BC law, stock illiquidity for both sets of firms would have experienced similar changes.

We consider two basic DiD specifications for this setting. In the first one, based on Bertrand and Mullainathan (2003), we estimate the following *average-effects* regression:

$$ILLIQ_{i,j,l,s,t} = \alpha_t + \alpha_i + \delta BC_{s,t} + \beta X_{i,j,l,s,t} + \rho\overline{ILLIQ}_{l,t} + \eta\overline{ILLIQ}_{j,t} + \varepsilon_{i,j,l,s,t}, \qquad (13)$$

where $ILLIQ_{i,j,l,s,t}$ is our measure of stock illiquidity of firm i, in industry j, located in state l, incorporated in state s, on year t; α_t are year fixed effects controlling for aggregate liquidity fluctuations over time; α_i are firm fixed effects controlling for time-invariant differences in stock illiquidity between treated and control firms; and $BC_{s,t}$ is a dummy variable equal to one if a BC law has been passed in state s by year t. Thus, estimates of the coefficient δ capture the differential response to the passage of BC laws of the stock illiquidity of firms incorporated in different states, only some of which have passed those laws. These estimates may be biased if failing to control for other observable factors thought to affect stock illiquidity of treated and control firms, as well as if failing to control for unobserved heterogeneity between treated and control firms — for example, local shocks (e.g., local business cycles) affecting the stock illiquidity of firms located and incorporated in the same state ($l = s$) at the same time when state-level antitakeover provisions were there adopted; current and future local shocks influencing (e.g., via political economy channels; see Karpoff and Wittry, 2015) the adoption itself of those provisions; or any potential differential trends in stock illiquidity between the industries of treated and control firms over time. To account for these possibilities, Eq. (13) includes both a vector of time-varying controls ($X_{i,j,l,s,t}$) related to stock illiquidity as well as state-year ($\overline{ILLIQ}_{l,t}$) and (four-digit SIC) industry-year ($\overline{ILLIQ}_{j,t}$) averages of $ILLIQ_{i,j,l,s,t}$.

In two recent studies, Gormley and Matsa (2014, 2016) argue that the above approach, albeit common in the literature, is biased and inconsistent — because time-varying controls may themselves be affected by the passage of BC laws (e.g., Angrist and Pischke, 2009) while averages of the dependent variable are plagued by measurement error (Gormley and Matsa, 2014) — and can distort inference (e.g., by even yielding estimates of δ of the opposite sign of the true coefficient). To address these issues, Gormley and Matsa (2014, 2016) propose the estimation of the following *high-dimensional fixed-effects* regression:

$$ILLIQ_{i,j,l,s,t} = \alpha_i + \alpha_{l,t} + \alpha_{j,t} + \delta BC_{s,t} + \varepsilon_{i,j,l,s,t}, \tag{14}$$

where $\alpha_{l,t}$ are state of location-by-year fixed effects controlling for unobserved, time-varying differences in stock illiquidity across states; and $\alpha_{j,t}$ are (four-digit SIC) industry-by-year fixed effects controlling for unobserved, time-varying differences in stock illiquidity across industries. Eq. (14) relaxes the parallel trends assumption behind Eq. (13) as estimates of δ are identified from *within*-state-year and *within*-industry-year variation — insofar as (like in our sample, whose construction we discuss next) a sufficiently large fraction of firms i (nearly 67%) is located and incorporated in different states ($l \neq s$). Thus, δ from Eq. (14) captures the differential response to the passage of BC laws in year t of the stock illiquidity of firms in the same industry j, located in the same state l, but incorporated in different states s on that year. This approach accounts for many types of unobservable heterogeneity by allowing for both unobserved, time-varying state-level factors affecting stock illiquidity and differential trends in stock illiquidity across industries over time.[18]

3.3 Data

We study all firms in the COMPUSTAT database between 1976 and 2006 for which our measure of stock market illiquidity $ILLIQ^z_{i,t}$ can be computed and information about state of incorporation and state of location can be obtained. Our sample is constructed following standard practices in the relevant literatures (e.g., Bertrand and Mullainathan, 2003; Bharath et al., 2009; Hasbrouck, 2009; Gormley and Matsa, 2016). We concentrate on a sample period allowing for no less than ten years of data before and after the adoption of a BC law. We exclude regulated utilities (SIC codes 4900-4999), as well as firms incorporated or located outside of the U.S. or in U.S. territories, firms with only one observation, and firms with negative or missing assets or sales.[19] We use the legacy version of COMPUSTAT to fill missing firm-level corporate domicile information in its most recent version.[20] We estimate (or obtain) the ten illiquidity proxies entering $ILLIQ_{i,t}$

[18]Bertrand and Mullainathan (2003, p. 1057) also advocate the use of high-dimensional fixed effects but argue that "computational difficulties make [their estimation] infeasible." We estimate Eq. (14) using a Stata code developed by Gormley and Matsa (2014) and available on Matsa's website at http://www.kellogg.northwestern.edu/faculty/matsa/htm/fe.htm.

[19]In unreported analysis, we find our inference to be unaffected by further excluding financial firms (SIC codes 6000-6999; about $25,000$ firm-year observations) from the sample.

[20]While common in the aforementioned literature, this practice may lead to incorrect treatment assignment (and possible endogeneity) for firms that changed their state of incorporation or location (e.g., in response to the adoption of BC laws) over our sample period, since COMPUSTAT updates this information to current status (Cohen, 2011). However, some studies suggest that any ensuing measurement error and endogeneity bias are likely to be small. For instance, when augmenting a sample that is similar to ours with additional historical incorporation and location information (unavailable to us) and then removing firms that reincorporated either away from or into a state with a BC law over 1976-2006, Gormley and Matsa (2016) find that: *i)* only a small fraction of firms reincorporate (see also Dodd and Leftwich, 1980; Romano, 1993; Daines, 2000); *ii)* only about 6% of firm-year observations are affected; *iii)* treatment changes for only 2% of firm-year observations; and *iv)* the augmented database does not significantly affect their estimates of the effect of BC laws on corporate risk taking. See also the discussion in Bertrand and Mullainathan (2003).

from standard approaches and data sources in the literature (see Table 1; e.g., CRSP and TAQ). We winsorize each of these proxies and all other firm-level variables used in the analysis at the 1% and 99% levels. The final sample includes about $134,000$ firm-year observations.

Summary statistics for our measure of illiquidity $ILLIQ_{i,t}$ and each of its components are in Table 3, together with their pairwise Pearson correlation matrix. Consistent with the aforementioned literature, most liquidity proxies are only weakly correlated with each other. The means for the four of them more closely related to the notion of better-informed trading ($ASYPBA_{i,t}$, $ASYROLL_{i,t}$, $C2_{i,t}$, and $PIN_{i,t}$; in column (1)) are all positive, large (e.g., about 37% of the effective bid-ask spread $ROLL_{i,t}$), and statistically significant — suggesting that adverse selection risk is an important determinant of firm-level stock market liquidity over our sample period. The composite index $ILLIQ_{i,t}$ loads positively on all of them (in column (4)), and especially so not only on broad (and often available) estimates of transaction costs and price impact but also on more precise estimates (when available) of the probability and intensity of informed trading.

Table 4 compares average characteristics (defined in Table 1) of (treated) firms in the year before a BC law is adopted in their state of incorporation to those of (control) firms incorporated in a state where a BC law has not (or not yet) been adopted in that year. Treated and control firms do not exhibit any meaningful prior difference in size, stock price, financial ratios (e.g., return on assets [ROA], debt on assets, cash flow on assets), riskiness (annualized stock return volatility), and illiquidity: nearly all p-values from t-tests of their differences in means (using standard errors clustered at the state-of-incorporation level; in column (3)) are large. Overall, our sample's main features are similar to those of related studies in the literature.

3.4 Results

3.4.1 Corporate Governance Indices

The model of Section 2 postulates the perceived severity of a firm's agency costs to be *positively* correlated with its stock illiquidity. For instance, Figure 2a shows that second-best equilibrium price impact λ is both greater than its first-best λ_{FB} as well as increasing in the extent γ to which the firm manager values private benefits in setting her optimal effort. As noted earlier, firm-level agency problems are commonly inferred from the relative weakness of firm-level corporate governance, as measured by two popular indices: the g-index of Gompers et al. (2003) and the e-index of Bebchuk et al. (2009). Both indices rate the weakness of firms' external shareholder governance with (relatively stable and infrequently updated) ordinal scores increasing (from 1 to 18 for the g-index; from 0 to 6 for the e-index) in the number and nature of various provisions in firms' corporate documents and states' takeover statutes either restricting shareholder rights (by their inclusion) or failing to constraint managerial power (by their omission).

Table 5 reports the slope coefficient of *grouped-data* (and group size-weighted) regressions (with robust standard errors) of governance score-level averages of our measure of firm-level illiquidity $ILLIQ_{i,t}$ on those scores. Either index is available for only a fraction of (firms and years in) our sample, yielding between $9,000$ and $11,000$ firm-year observations over 1990-2006. In some regressions, we exclude score groups with less than 50 observations and/or include, as (potentially endogenous) controls, score-level averages of firm-level characteristics (e.g., stock price, size, or riskiness) known to be related to both a firm's governance and its stock market liquidity (e.g., Shleifer and Vishny, 1997; Hasbrouck, 2009; Foucault et al., 2013).[21]

According to Table 5, stock illiquidity is generally correlated with (but not always *increasing* in) either index in the cross-section of firms in our sample. When positive, the estimated slopes are significant (but only for the coarser e-index). For example, a one standard deviation weaker corporate governance (i.e., higher e-index [g-index]) is accompanied by as large as a 6.1% (2.0%) decrease in stock market liquidity relative to its sample standard deviation, with a t-statistic of 3.1 in column (5) (0.2 in column (2)). Yet, all estimates become insignificant (and most change sign) when including score-level controls. In further (unreported) analysis, we find these slopes to be positive mostly (and also significant only) for those components of $ILLIQ_{i,t}$ that either capture more closely the notion of market depth in our model ($AMIHUD_{i,t}$ and $AMIVEST_{i,t}$) or,

[21] (Observation-weighted) grouped-data regressions (with robust standard errors) account for heteroskedasticity within and across groups (when their sizes differ; see Angrist and Pischke, 2009). Standard (equal-weighted) such regressions (with robust standard errors), firm-year panel regressions (with standard errors adjusted for clustering at the firm level), and missing data replacement with latest past scores (within three years) yield similar inference.

while less often available, measure more directly the portion of illiquidity from adverse selection risk behind its predictions ($ASYPBA_{i,t}$, $ASYROLL_{i,t}$, and $C2_{i,t}$ [but not $PIN_{i,t}$]).

Overall, this evidence, while weakly consistent with our theory, is nonetheless far from conclusive. Governance indices may only imperfectly capture the true extent of corporate managerial power (e.g., Bhagat et al., 2008; Gillan et al., 2011) and so induce measurement error (e.g., Hausman, 2001). Alternative proxies include institutional ownership, executive compensation, voting rights, and board size and composition, among others. However, as previously discussed, the possible endogeneity of firm-level agency costs and stock illiquidity precludes a causal interpretation of their cross-sectional correlations. Lastly, our model suggests that those correlations may be weakened (or even reversed, as for the less coarse g-index in columns (1) and (3); see also Ferreira and Laux, 2007) if the adoption of governance provisions not only altered managerial power but also affected uncertainty about that power among stock market participants.

3.4.2 BC Laws

These challenges motivate us to study the effect of the staggered adoption of BC laws in U.S. states — a plausibly exogenous *positive* shock to the perceived severity of, and *negative* shock to marketwide uncertainty about, agency problems in the treated firms — on firm-level stock illiquidity. Our theory predicts a positive shock to the level of agency costs ($\Delta\gamma > 0$) to *worsen*, but a negative shock to the uncertainty about agency costs ($\Delta\sigma_e^2 < 0$) to *improve*, stock market liquidity for the affected firms.

We start by estimating the two DiD specifications of Eqs. (13) and (14). In both regressions, the coefficient δ captures the differential response of our proxy for stock illiquidity $ILLIQ_{i,t}$ of treated and untreated firms incorporated in different states to the enactment of BC provisions in treated firms' state of incorporation. Eq. (13) controls for unobserved heterogeneity (e.g., from differences in the state of location or industry across treated and untreated firms) with annual firm-level characteristics and state-of-location and (four-digit SIC) industry-level illiquidity averages; in Eq. (14), that response is identified from within-state and within-industry variation (i.e., by comparing treated and untreated firms in the same state of location and [four-digit SIC] industry).[22] We report estimates of δ in Table 6, together with standard errors adjusted for clustering at the state-of-incorporation level (as in Gormley and Matsa, 2016) to control for the potential covariation of stock illiquidity among firms incorporated in the same state.[23]

We find that firm-level stock market liquidity *improves* after the adoption of BC laws. Our estimates of this effect are both statistically and economically significant. For instance, estimation of the high-dimensional fixed-effects regression of Eq. (14) in column (4) indicates that the stock illiquidity of firms incorporated in states passing BC provisions drops on average by 9.6% of its sample standard deviation (in column (3) of Table 3; with a t-statistic of 3.0) after their enactment relative to firms located in the *same* states and operating in the *same* industries but incorporated in states where those provision have not (or not yet) been passed.[24] As noted earlier, ignoring unobserved heterogeneity may lead to overestimate the liquidity effect of BC laws (as in column (1)). However, improperly accounting for such heterogeneity and/or including potentially endogenous controls (as in the average-effects regression of Eq. (13)) may either underestimate or imprecisely estimate that effect (as in columns (2) and (3)).[25]

We also verify that there are no pre-existing trends in firm-level stock illiquidity before BC provisions are passed. We do so by first amending Eqs. (13) and (14) to allow for the coefficient

[22] Using three-digit SIC industry average and fixed effects in Eqs. (13) and (14) has no material impact on our inference.

[23] Many U.S. firms are incorporated in a single state, Delaware, where a BC law was passed in 1988 (see Table 2; Daines, 2001). Excluding the roughly 50% of firm-year observations in our sample made of firms incorporated in Delaware from the analysis that follows yields qualitatively similar inference (and often more statistically and economically significant [unreported] estimates of δ in Eqs. (13) and (14)).

[24] Within-state comparison in Eq. (14) alleviates the concern that the estimated impact of BC laws on stock illiquidity may be driven by unobservable local economic shocks affecting both stock price formation and the passage of antitakeover provisions, but leaves open the possibility of policy endogeneity from local politicians being more responsive to shocks affecting firms located in their state of incorporation than to shocks affecting locally incorporated firms operating elsewhere (e.g., see the discussion in Gormley and Matsa, 2016). However, in unreported analysis (based on Gormley and Matsa, 2016), we find that the estimated differential response δ to the adoption of BC laws of the stock illiquidity of firms incorporated *and* located in the *same* state is qualitatively similar to, but smaller and noisier than both the estimated δ for firms incorporated and located in *different* states and the overall estimated δ in Table 6.

[25] As in the analysis of Section 3.4.1 (and Table 5), control variables in Eq. (13) include widely used firm-level characteristics (defined in Table 1) that are commonly associated not only with a firm's stock illiquidity (or its adverse selection component; e.g., Hasbrouck, 2007; Bharath et al., 2009) but also with its corporate governance (e.g., Bhagat et al., 2008): Stock price, market capitalization, stock return volatility, and overall financial health and riskiness (debt on assets, ROA, cash flow on assets, and Altman z-score).

δ to change by event-year, and then plotting its annual point estimates in Figures 4a and 4b, respectively (solid line) — together with 90% confidence intervals (adjusted for clustering at the state-of-incorporation level; dashed lines). While noisier than in Table 6 (but with significant F-tests), these estimates show that the stock liquidity of treated firms improves relative to control firms only following the adoption of BC laws. We further find the (unreported) separate estimation of Eqs. (13) and (14) for each of the ten illiquidity proxies entering the composite measure $ILLIQ_{i,t}$ to yield noisier yet both similar and largely consistent inference.

3.4.3 BC Laws and Strategic Trading

According to Corollary 1, the negative estimates of δ in Table 6 and Figure 4 suggest that the possibly negative effect of the widely publicized passage of BC laws on the uncertainty about firm-level agency problems among stock market participants — hence mitigating dealers' adverse selection risk — may have prevailed upon the positive effect of the adoption of anti-takeover provisions on the extent of agency problems — hence making strategic speculation's firm-level information more valuable and their stock trading more cautious — ultimately facilitating liquidity provision for the stocks of treated firms relative to untreated ones.

Alternative interpretations are nonetheless possible. For instance, Gormley and Matsa (2016) find that the stock return volatility of firms treated by the adoption of BC laws declines relative to untreated firms in the same state and industry. In unreported analysis, we replicate this result in our sample. According to Gormley and Matsa (2016), this and other evidence on ROA, cash holdings, and diversifying acquisitions is consistent with the notion that management insulated by antitakeover provisions may "play it safe" by taking value-destroying actions that reduce overall firm-level risk. Relatedly, Bertrand and Mullainathan (2003) report evidence that managers of firms treated by BC laws may prefer to "enjoy the quiet life" (for themselves and their firms) by exerting less effort. Previous microstructure research (surveyed in O'Hara, 1995; Foucault et al., 2013) suggests that liquidity provision for those stocks may then improve because lower firm-level (fundamental and price) risk facilitates dealers' inventory management.

By construction, inventory considerations play no role in our model; yet, our model also predicts lower equilibrium fundamental and price volatility following the passage of BC provisions if, as we argued earlier, those events attenuated marketwide uncertainty about agency problems ($\Delta\sigma_e^2 < 0$) more than they worsened their severity ($\Delta\gamma > 0$).[26] In addition, our measure $ILLIQ_{i,t}$ is designed to capture (albeit imperfectly) the portion of firm-level stock illiquidity that is driven primarily by adverse selection considerations. The adoption of antitakeover provisions may have also either discouraged informed trading activity by potential blockholders or motivated the exit of existing ones (e.g., Bacidore and Sofianos, 2002; Brockman and Chung, 2003; Bhagat et al., 2008; Back et al., 2015), with potentially ambiguous effects on dealers' adverse selection risk and liquidity provision.

More generally, since both parameters γ and σ_e^2 (and the impact of BC laws on either) are unobservable, the evidence in Table 6 is only indirectly suggestive of the joint effect of agency costs and strategic speculation on stock liquidity, as postulated by the model of Section 2 (in Corollary 1). Our theory attributes this effect to the impact of agency problems on informed trading and, ultimately, on price formation in the stock market. To assess more *directly* this notion, we assess some of its unique, additional predictions for firm-level illiquidity by analyzing the heterogeneity in its response to the passage of BC provisions. According to Remark 1, such a response should be *more pronounced* (and the absolute magnitude of estimates of δ be larger) for firms where the cost of managerial effort (or investment; c) is lower (e.g., see the slope of equilibrium price impact λ in Figures 3c and 3d) — i.e., where agency problems more severely affect firm value and speculation's private information about it is more valuable.

This analysis raises additional challenges. To begin with, firm-level cost of managerial effort c is itself not directly observable. Our model nonetheless yields sharp *ex ante* predictions about

[26] We noted in Section 2.2 that $\sigma_v^2 = \frac{1}{2c^2}\left(\sigma_u^4 + d^4\sigma_e^4\right)$, while it can be shown from Proposition 1 that $var\left(p\right) = \frac{\left(\sigma_u^4+d^4\sigma_e^4\right)^2}{4c^2(\sigma_u^4+d^4\sigma_e^4+2c^2\sigma_\varepsilon^2)}$, such that $\frac{\partial\sigma_v^2}{\partial\gamma} = \frac{2d^3\sigma_e^4}{c^2(1-\gamma)^2} > 0$, $\frac{\partial\sigma_v^2}{\partial\sigma_e^2} = \frac{d^4\sigma_e^2}{c^2} > 0$, $\frac{\partial var(p)}{\partial\gamma} = \frac{d^3\sigma_e^4\left(\sigma_u^4+d^4\sigma_e^4\right)\left(\sigma_u^4+d^4\sigma_e^4+4c^2\sigma_\varepsilon^2\right)}{c^2(1-\gamma)^2(\sigma_u^4+d^4\sigma_e^4+2c^2\sigma_\varepsilon^2)^2} > 0$, and $\frac{\partial var(p)}{\partial\sigma_e^2} = \frac{d^4\sigma_e^2\left(\sigma_u^4+d^4\sigma_e^4\right)\left(\sigma_u^4+d^4\sigma_e^4+4c^2\sigma_\varepsilon^2\right)}{2c^2(\sigma_u^4+d^4\sigma_e^4+2c^2\sigma_\varepsilon^2)^2} > 0$. Accordingly, our theory's predictions on the relation between a firm's agency problems and its stock market liquidity generalize to any form of second-best managerial behavior affecting the firm's fundamental uncertainty in our setting — hence dealers' perceived adverse selection risk when facing better-informed trading in its stocks. See also the discussion in Section 2.

the effect of high (c_H) or low (c_L) unit effort cost on possibly measurable firm-level equilibrium outcomes. Specifically, ceteris paribus for perceived firm-level agency problems (γ and σ_e^2), both the equilibrium volatility of speculation's private signal of firm value (σ_S^2) and equilibrium price volatility ($var(p)$) are *decreasing* in c:

$$\sigma_S^2(c_H) < \sigma_S^2(c_L), \tag{15}$$

$$var(p)(c_H) < var(p)(c_L). \tag{16}$$

Intuitively, firm managers exert less effort y (including value-destroying one [$\gamma > 0$]) if it is more costly; this makes both firm value ($v(y)$) and private fundamental information ($S = v(y) + \varepsilon$) less sensitive to managerial decisions (including suboptimal ones) and so less volatile (lower σ_v^2 and σ_S^2), ultimately dampening price fluctuations (lower $var(p)$).[27] We measure the latter by firm-level stock return volatility (defined in Table 1); idiosyncratic such volatility yields similar results. The literature proposes numerous proxies for the variance of the private information of sophisticated stock market participants that are based on professional analyst forecasts of firms' earnings per share (EPS; e.g., O'Brien, 1988; Bradshaw et al., 2012; Pasquariello and Vega, 2015). Accordingly, we use the I/B/E/S database to construct two such proxies for a firm's private information volatility (also defined in Table 1): firm-level EPS forecast *dispersion* (i.e., standard deviation of available forecasts) and *uncertainty* (i.e., mean square forecast errors).

Thus, Remark 1 and the comparative statics in Eqs. (15) and (16) suggest the absolute magnitude of the estimated relative impact of BC laws on firm-level illiquidity to be greater for firms displaying lower *prior* unit effort cost ($|\delta(c_L)| > |\delta(c_H)|$) — as captured by higher (e.g., *above-median*) prior private signal dispersion, higher (above-median) prior private signal uncertainty, and higher (above-median) prior stock return volatility. Conditioning our analysis on ex ante such firm-level characteristics (e.g., measured in the year prior to the passage of BC laws) is important to overcome endogeneity concerns, since all of them are equilibrium outcomes

[27] It can be shown from Section 2.3 and Proposition 1 that $\frac{\partial \sigma_v^2}{\partial c} = \frac{\partial \sigma_S^2}{\partial c} = -\frac{\sigma_u^4 + d^4\sigma_e^4}{c^3} < 0$ and $\frac{\partial var(p)}{\partial c} = -\frac{\left(\sigma_u^4 + d^4\sigma_e^4\right)^2}{2c^3\left(\sigma_u^4 + d^4\sigma_e^4 + 2c^2\sigma_\varepsilon^2\right)} < 0$.

of the model (rather than exogenous firm-level characteristics) and all of them may also be affected by those laws.[28] To that purpose, one may estimate Eqs. (13) and (14) separately for firms with above or below-median characteristic in the year before a BC law event. However, Gormley and Matsa (2011, 2016) argue that, because these events are staggered over time, this approach would compare the average response of treated and control firms sorted on firm-level characteristics at *different* points in time.

To address this problem, Gormley and Matsa (2011, 2016) propose an alternative, *matching* difference-in-differences (MDiD) methodology that: *i)* in each year when new BC laws are passed (e.g., 1991), compares newly treated firms to untreated firms; *ii)* estimates the impact of that event on illiquidity (δ) exclusively within this specific BC law *cohort* (g) of firm-years (e.g., $g = 1991$), separately for those cohort-g firms with above and below-median previous-year characteristic, exclusively over a window of up to fifteen years before and after the events g occurred (e.g., between 1977 and 2006), while neither requiring a firm to be available for the full (i.e., up to thirty-year) estimation window nor preventing a firm from entering multiple cohorts; and *iii)* reports the average of all DiD coefficients δ across BC law cohorts (eight of them; see Table 2).[29]

This methodology allows us to assess the heterogeneous responses of firm-level illiquidity

[28] Also importantly for this comparison, Table 4 shows that such past-year realizations of these firm-level characteristics are, on average, similar for treated and control firms.

[29] Shorter cohort-level windows yield noisier but qualitatively similar results. According to the literature, staggered policy changes in which the studied policy variable is binary (as for the adoption of BC laws, i.e., the dummy variable $BC_{s,t}$) may lead to an attenuation bias in estimates of treatment responses to policy assignment (e.g., since firms may have either anticipated state-level changes in antitakeover provisions or assumed those changes to be temporary); see, for instance, Angrist and Pischke (2009), Atanasov and Black (2015), and Hennessy and Strebulaev (2015). However, Hennessy and Strebulaev (2015) also argue that, in those circumstances, the estimated treatment response may approach the true causal effect if the binary policy change variable has nonzero mean (as for $BC_{s,t}$) and the policy assignment is near-permanent (as for state antitakeover provisions, since reincorporations are rare [see Section 3.3] and BC statutes were upheld by the Supreme Court in 1987 [Bertrand and Mullainathan, 2003]). Accordingly, in unreported analysis we find that: *i)* the evidence in Table 6 is robust to (and only slightly more significant when) excluding the latest BC law cohort ($g = 1997$, in Iowa and Texas; about $1,300$ firm-year observations), i.e., the one occurring the *longest* (six years) *after* the previous cohort of events ($g = 1991$; see Table 2); and *ii)* the *separate* estimation of Eqs. (13) and (14) for each of the eight BC law cohorts g in Table 2 over the same full-sample window (i.e., between 1976 and 2006) yields DiD coefficients δ that (while generally noisy in less populated cohorts of events and most statistically and economically significant in the most populated one [$g = 1988$]) are broadly (but not uniformly) consistent both across event-years and with the samplewide estimates of δ in Table 6.

to BC laws separately for each cohort, i.e., by comparing the response of newly-treated and untreated firms not only exposed to the same cohort of events (e.g., $g = 1991$) but also sorted on firm-level characteristics in the same prior year (e.g., above and below-median return volatility in 1990). We implement it by first pooling all cohort-level, firm-year data (to obtain average cohort-level effects directly) and then estimating the following amended versions of Eq. (13):

$$ILLIQ_{g,i,j,l,s,t} = \alpha_{g,t} + \alpha_{g,i} + \delta BC_{s,t} + \beta X_{g,i,j,l,s,t} + \rho \overline{ILLIQ}_{g,l,t} + \eta \overline{ILLIQ}_{g,j,t} + \varepsilon_{g,i,j,l,s,t}, \quad (17)$$

where $\alpha_{g,t}$ are year-by-cohort fixed effects controlling for aggregate liquidity fluctuations over time within each cohort g; $\alpha_{g,i}$ are firm-by-cohort fixed effects controlling for cohort-level, time-invariant differences in stock illiquidity between treated and control firms; and $\overline{ILLIQ}_{g,l,t}$ and $\overline{ILLIQ}_{g,j,t}$ are cohort-level, state-year and industry-year averages of firm-level illiquidity $ILLIQ_{g,i,j,l,s,t}$; and of Eq. (14):

$$ILLIQ_{g,i,j,l,s,t} = \alpha_{g,i} + \alpha_{g,l,t} + \alpha_{g,j,t} + \delta BC_{s,t} + \varepsilon_{g,i,j,l,s,t}, \quad (18)$$

where $\alpha_{g,l,t}$ are state of location-by-year-by-cohort fixed effects controlling for cohort-level, unobserved, time-varying differences in stock illiquidity across states; and $\alpha_{g,j,t}$ are industry-by-year-by-cohort fixed effects controlling for cohort-level, unobserved, time-varying differences in stock illiquidity across industries.

We report pairs of estimates of δ from Eqs. (17) and (18) for each past-year, below and above-median sort (proxying for high [c_H] and low [c_L] past-year unit cost of effort, respectively): low and high past-year EPS forecast uncertainty in Table 7, EPS forecast dispersion in Table 8, and return volatility in Table 9 (in columns (1) and (2), and (5) and (6), respectively). For each firm-level characteristic, a pair of average-effects estimates of δ in Eq. (17) captures the average heterogeneous, differential response of the stock illiquidity of treated and control firms within each cohort of BC laws to the passage of these laws. A pair of high-dimensional fixed-effects estimates δ in Eq. (18) is instead identified from *within*-state-year-cohort and *within*-industry-year-cohort variation — hence, it captures the average heterogeneous, differential response to the passage of BC laws within each cohort g of the stock illiquidity of firms in the same industry j, located in the same state l, but incorporated in different states s on the year when those BC laws were passed. Tables 7 to 9 also report pairs of coefficients δ from the separate estimation of Eqs. (13) and (14) for each sort, i.e., when ignoring BC law cohort-level effects (in columns (3) and (4), and (7) and (8)). As in Table 6, all standard errors are adjusted for clustering at the state-of-incorporation level.

The evidence in Tables 7 to 9 provides additional support for our model. Point matching estimates of the negative impact of the passage of BC laws on firm-level stock illiquidity (while similar to the base estimates in Table 6) are always *larger*, and most often more statistically significant, among firms conjectured to be characterized by *low* ex ante cost of managerial effort — whether it be measured by *high* previous-year dispersion, uncertainty, or return volatility. The resulting positive differences between those estimated coefficients ($|\delta(c_L)| - |\delta(c_H)| > 0$) are also economically significant. For instance, the matching high-dimensional fixed-effects regression of Eq. (18) (in columns (5) and (6)) implies that after a BC law is adopted, the stock liquidity of treated firms with prior above-median EPS forecast dispersion (prior high σ_S^2 [low c]; Table 7), EPS forecast uncertainty (prior high σ_S^2 [so low c]; Table 8), or return volatility (prior high $var(p)$ [low c]; Table 9) improves (relative to similarly sorted control firms) on average by 145%, 102%, and 35% more than among similarly treated and untreated firms with prior below-median such characteristics. These differences amount to 66%, 51%, and 19%, respectively, of the samplewide average base liquidity improvement among all treated firms relative to all control firms (δ of Eq. (14), in column (4) of Table 6). Observed relative effects are similarly large when either ignoring cohort effects or estimating the matching average effects regression of Eq. (17).

In short, the above analysis shows that firms incorporated in states passing antitakeover provisions in the 1980s and 1990s experienced a considerable improvement in the liquidity of their traded stocks relative to both similar control firms unaffected by those law changes as well as similarly treated firms whose prior unit cost of managerial effort was likely higher. These findings are consistent with the notion that the adoption of those provisions may have not only worsened agency problems for the affected firms but also resolved prior uncertainty about their severity, the latter ultimately ameliorating stock price formation, as postulated by our model.

4 Conclusions

This study aims to contribute to the theoretical and empirical understanding of the frictions affecting the quality of firms' capital markets. Despite a substantial body of evidence on the impact of corporate governance on firms' behavior, much extant literature has either ignored the role of agency conflicts within the firm for security price formation or argued that some features of the firm's security trading may themselves affect its external and internal corporate governance. We propose and test the notion that firm-level agency costs may have nontrivial effects on firm-level stock liquidity.

To characterize this notion, we develop a parsimonious model of strategic, speculative trading (based on Kyle, 1985) in which a firm manager exerts unobservable, privately-optimal (i.e., possibly value-destroying) effort. In this setting, positive shocks to the severity of and perceived uncertainty about the firm's agency costs worsen the adverse selection risk faced by competitive dealers, thus impeding their liquidity provision (especially when the cost of managerial effort is low). An empirical analysis of this channel presents many difficulties. Measuring the (adverse selection portion of) liquidity of a firm's stock and the ex ante severity of firm-level agency problems — both intrinsically elusive notions — is challenging and controversial. As importantly, the endogeneity of corporate governance precludes the causal interpretation of any (often weakly positive) correlation between measures of firm-level agency costs (e.g., the g-index of Gompers et al. 2003; the e-index of Bebchuk et al., 2009) and stock market illiquidity as prima facie supportive of our model.

We tackle these issues by first *i)* constructing a composite measure of the (adverse selection) commonality in ten firm-level illiquidity proxies in the literature — some broad in scope and widely available; some capturing the notion of price impact in Kyle (1985); and some less often available but designed to depend on information asymmetry among stock market participants; and then *ii)* considering the impact on this measure of the staggered adoption of antitakeover (business combination [BC]) provisions in U.S. states during the 1980s and 1990s, a plausibly exogenous *positive* shock to the perceived severity of, and *negative* shock to marketwide uncertainty about, treated firms' agency costs. According to our theory, the former would worsen stock market liquidity by facilitating better-informed speculation, while the latter might improve it by mitigating dealers' perceived adverse selection risk when clearing speculative trades.

Consistent with the model's latter prediction, we find that: *i)* the stock market liquidity of firms incorporated in states enacting BC laws *improves* after their adoption relative to otherwise similar firms (e.g., located in the same state and operating in the same industry) but incorporated in states where BC laws have not (or not yet) been passed; and *ii)* the improvement in liquidity is most pronounced among treated firms with prior characteristics (such as high analyst EPS forecast uncertainty and dispersion, or high stock return volatility) that (our model suggests) may be associated with a *low* prior cost of (possibly suboptimal) managerial effort.

Our novel investigation indicates that firms' agency problems may play an important role for the price formation of their securities. We hope that this insight may stimulate future work on the externalities of various forms of suboptimal corporate behavior for financial market quality.

5 Appendix

Proof of Proposition 1. As standard in this class of models, we restrict our attention to linear REEs of the game between competitive dealership and strategic speculation (e.g., see Kyle, 1985; Pasquariello and Vega, 2007), given the firm manager's privately optimal effort y_{SB} of Eq. (4). Thus, the proof is by construction, in three steps. In the first step, we conjecture general linear functions for pricing and speculation. In the second step, we solve for the parameters of these functions satisfying conditions 1 and 2 in Section 2.4. In the third step, we verify that these parameters and functions represent a REE. We begin by assuming that, in equilibrium, $p = A_0 + A_1\omega$ and $x = B_0 + B_1 S$, where $A_1 > 0$. These assumptions, the approximately linear conditional first moment $E(v|S)$ of Eq. (5):

$$E(v|S) \approx \overline{v} + \phi(S - \overline{v}), \tag{A-1}$$

and the definition of ω imply that

$$E[p|S] = A_0 + A_1 x. \tag{A-2}$$

Using Eq. (A-2), the first order condition for the maximization of the speculator's expected profit $E(\pi|S)$ is given by

$$\phi S + (1-\phi)\overline{v} - A_0 - 2A_1B_0 - 2A_1B_1S = 0. \tag{A-3}$$

The second order condition is satisfied, since $2A_1 > 0$. For Eq. (A-3) to be true, it must be that

$$\begin{aligned} (1-\phi)\overline{v} - A_0 &= 2A_1B_0, && \text{(A-4)} \\ \phi &= 2A_1B_1. && \text{(A-5)} \end{aligned}$$

The distributional assumptions of Sections 2.1 to 2.3 imply that $E(\omega) = B_0 + B_1\overline{v}$, $var(\omega) = \sigma_z^2 + B_1^2\sigma_{S_{SB}}^2$, and $cov(v,\omega) = B_1\sigma_{v_{SB}}^2$, such that the approximately linear conditional first moment $E(v|\omega)$ of Eq. (6) becomes

$$E(v|\omega) \approx \overline{v} + \frac{B_1\sigma_{v_{SB}}^2}{\sigma_z^2 + B_1^2\sigma_{S_{SB}}^2}(\omega - B_0 - B_1\overline{v}). \tag{A-6}$$

According to condition 2 in Section 2.4 (semi-strong market efficiency), $p = E(v|\omega)$. Therefore, our prior conjecture for p is correct if and only if:

$$A_0 = \overline{v} - A_1 B_0 - A_1 B_1 \overline{v}, \tag{A-7}$$
$$A_1 = \frac{B_1\sigma_{v_{SB}}^2}{\sigma_z^2 + B_1^2\sigma_{S_{SB}}^2}. \tag{A-8}$$

The expressions for A_0, A_1, B_0, and B_1 in Proposition 1 must solve the system made of Eqs. (A-4), (A-5), (A-7), and (A-8) to represent a linear equilibrium. Rewriting Eq. (A-4) with respect to A_1B_0 and plugging the resulting expression $A_1B_0 = \frac{1}{2}[(1-\phi)\overline{v} - A_0]$ into Eq. (A-7) leads to $A_0 = \overline{v}$. Rewriting Eq. (A-5) with respect to A_1 and equating the resulting expression $A_1 = \frac{\phi}{2B_1}$ to Eq. (A-8) yields

$$2B_1^2\sigma_{v_{SB}}^2 = \phi\left(\sigma_z^2 + B_1^2\sigma_{S_{SB}}^2\right). \tag{A-9}$$

Since $\phi \equiv \frac{\sigma_{v_{SB}}^2}{\sigma_{S_{SB}}^2}$ (see Section 2.3), Eq. (A-9) implies that $B_1^2 = \frac{\sigma_z^2}{\sigma_{S_{SB}}^2}$, such that $B_1 = \frac{\sigma_z}{\sigma_{S_{SB}}} = \beta$ of Eq. (10) as $\sigma_{S_{SB}}^2 = \frac{1}{2c^2}(\sigma_u^4 + d^4\sigma_e^4 + 2c^2\sigma_\varepsilon^2)$. Substituting this expression for B_1 back into Eq. (A-5) and solving for A_1, we obtain $A_1 = \frac{\sigma_{v_{SB}}^2}{2\sigma_{S_{SB}}\sigma_z} = \lambda$ of Eq. (8) and p of Eq. (7). Lastly, replacing A_0 with $\overline{v}$ and A_1 with λ in Eq. (A-4) yields $B_0 = -\beta\overline{v}$ and x of Eq. (9). ■

Proof of Corollary 1. The first part of the statement ensues from Eqs. (8) and (11) implying that

$$\lambda - \lambda_{FB} = \frac{1}{2c\sigma_z}\left(\frac{\sigma_u^4 + d^4\sigma_e^4}{\sqrt{2(\sigma_u^4 + d^4\sigma_e^4 + 2c^2\sigma_\varepsilon^2)}} - \frac{\sigma_u^4}{\sqrt{2(\sigma_u^4 + 2c^2\sigma_\varepsilon^2)}}\right) > 0, \tag{A-10}$$

since if $f(x) = \frac{x}{\sqrt{x}}$, then $\frac{\partial f(x)}{\partial x} = \frac{1}{2\sqrt{x}} > 0$. The second part of the statement follows from noting that

$$\frac{\partial \lambda}{\partial \gamma} = \frac{d^3 \sigma_e^4 \sqrt{2} \left(\sigma_u^4 + d^4 \sigma_e^4 + 4c^2 \sigma_\varepsilon^2\right)}{2c\sigma_z \left(1-\gamma\right)^2 \left(\sigma_u^4 + d^4 \sigma_e^4 + 2c^2 \sigma_\varepsilon^2\right)^{\frac{3}{2}}} > 0, \tag{A-11}$$

$$\frac{\partial \lambda}{\partial \sigma_e^2} = \frac{d^4 \sigma_e^2 \sqrt{2} \left(\sigma_u^4 + d^4 \sigma_e^4 + 4c^2 \sigma_\varepsilon^2\right)}{4c\sigma_z \left(\sigma_u^4 + d^4 \sigma_e^4 + 2c^2 \sigma_\varepsilon^2\right)^{\frac{3}{2}}} > 0. \tag{A-12}$$

■

Proof of Remark 1. Given Corollary 1, the statement ensues from Eqs. (A-11) and (A-12) implying that

$$\frac{\partial^2 \lambda}{\partial \gamma \partial c} = -\frac{d^3 \sigma_e^4 \sqrt{2} \left[\sigma_u^8 + d^4 \sigma_e^4 \left(2\sigma_u^4 + d^4 \sigma_e^4\right) + 4c^2 \sigma_\varepsilon^2 \left(\sigma_u^4 + d^4 \sigma_e^4 + 4c^2 \sigma_\varepsilon^2\right)\right]}{2c^2 \sigma_z \left(1-\gamma\right)^2 \left(\sigma_u^4 + d^4 \sigma_e^4 + 2c^2 \sigma_\varepsilon^2\right)^{\frac{5}{2}}} < 0, \tag{A-13}$$

$$\frac{\partial^2 \lambda}{\partial \sigma_e^2 \partial c} = -\frac{d^4 \sigma_e^2 \sqrt{2} \left[\sigma_u^8 + d^4 \sigma_e^4 \left(2\sigma_u^4 + d^4 \sigma_e^4\right) + 4c^2 \sigma_\varepsilon^2 \left(\sigma_u^4 + d^4 \sigma_e^4 + 4c^2 \sigma_\varepsilon^2\right)\right]}{4c^2 \sigma_z \left(\sigma_u^4 + d^4 \sigma_e^4 + 2c^2 \sigma_\varepsilon^2\right)^{\frac{5}{2}}} < 0. \tag{A-14}$$

■

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Table 1. Variable Definition

Variable	Definition
PBA	Computed from CRSP as the annual average of the daily ratio between a firm's bid-ask spread (*bas*) and its absolute stock price, abs(*prc*), when at least 60 observations are available in a year.
ROLL	Based on Roll's (1984) random-walk model of prices in which one-half the posted bid-ask spread is noninformational; computed from CRSP as (200 times) either the square root of (the negative of) the first-order daily return autocovariance cov[*ret*,*ret*(-1)] over a year if cov[*ret*,*ret*(-1)] $<$ 0 or (the negative of) the square root of cov[*ret*,*ret*(-1)] over a year if cov[*ret*,*ret*(-1)] $>$ 0, when at least 60 observations are available in a year.
EC	Computed by Hasbrouck (2009) from CRSP as (100 times) the Gibbs estimate of one-half the posted bid-ask spread for a firm in a year using daily *ret* (at http://people.stern.nyu.edu/jhasbrou/Research/GibbsEstimates2006/Liquidity%20estimates%202006.htm), when at least 60 observations are available in a year.
AMIHUD	Computed from CRSP as the annual average of (10^6 times) the daily ratio between a firm's absolute return (abs(*ret*)) and the product of its abs(*prc*) and trading volume (*vol*), the dollar volume (*dollarvol*), when at least 60 observations are available in a year.
AMIVEST	Computed from CRSP as the annual average of the daily ratio between a firm's *dollarvol* (divided by 10^8) and its abs(*ret*), when at least 60 observations are available in a year.
PS	Based on the notion in Pastor and Stambaugh (2003) that the greater is a stock return's expected reversal for a given dollar volume, the lower is that stock's liquidity; computed from CRSP as (10^9 times the negative of) the coefficient of an annual regression of daily stock returns in excess of the CRSP value-weighted market return (*eret*) on the product of their sign (sign(*eret*)) and *dollarvol*, after controlling for *ret*(-1), when at least 60 observations are available in a year.
ASYPBA	Based on the notion in George et al. (1991) that liquidity trading (better-informed speculation) induces a temporary (permanent) revision in stock prices, hence generating negatively (positively) autocorrelated returns; computed from CRSP as (100 times) one minus the coefficient of an annual regression of the average PBA over a 60-day rolling window on the average ROLL over that same window, when at least 60 observations are available in a year.
ASYROLL	Based on the aforementioned decomposition in George et al. (1991); estimated from CRSP as (100 times) one minus the square of the coefficient of an annual regression of the average *filtered* ROLL (i.e., computed on the residuals of a regression of *ret* on expected returns from a market model estimated over the previous year) over a 60-day rolling window on the average ROLL over that same window, when at least 60 observations are available in a year.

Table 1. (*Continued*)

Variable	Definition
C2	Based on the notion in Llorente et al. (2002) that the cross-sectional variation in stocks' volume-return dynamics is related to the relative importance of better-informed speculation in stock price formation; computed from CRSP as (100 times) the coefficient of an annual regression of *ret* on the product of daily (log) turnover (*logturn*, the natural logarithm of the ratio between daily *vol* and total shares outstanding *shout* times 10^3) and *ret*(-1) after controlling for *ret*(-1), when at least 60 observations are available in a year.
PIN	Based on Easley et al.'s (1996) sequential model of trading in which dealers' perceived probability of the arrival of better-informed speculation is driven by the frequency and magnitude of buy-sell imbalances; computed as an equal weighted average of (100 times) estimates of annual PIN from two sources, when available: Easley et al.'s (2010) basic PIN measure of Easley et al. (1996; at https://sites.google.com/site/hvidkjaer/data) from ISSM and TAQ intraday data, and the amended PIN measure of Venter and deJongh (2006) and Brown and Hillegeist (2007), accounting for the strong positive correlation between buy and sell orders in that dataset (at http://scholar.rhsmith.umd.edu/sbrown/pin-data), when at least 60 observations are available in a year.
Market Cap	Calculated from CRSP as the product of a stock's year-end *shrout* and abs(*prc*) (divided by 10^3).
Return Volatility	Calculated from CRSP as (100 times) the annualized (i.e., multiplied by the square root of 252) standard deviation of a stock's daily *ret* over a year, when at least 60 observations are available in that year.
ROA	Calculated from COMPUSTAT as (100 times) *ni* / *at*.
Cash Flow on Assets	Calculated from COMPUSTAT as (100 times) (*oiadp* - *accruals*) / *at*, where *accruals* = [*act* - *act*(-1)] - [*che* - *che*(-1)] + [*lct* - *lct*(-1)] + [*dlc* - *dlc*(-1)] - *dp*.
Debt on Assets	Calculated from COMPUSTAT as (100 times) (*dltt* + *dlc*) / *at*.
Altman z-score	Calculated from COMPUSTAT as [(3.3 x *oiadp* +0.999 x *sale* + 1.4 x *re* + 1.2 x *wcap*) / *at*] + + [(0.6 x *csho* x *prcc_f*) / *lt*].
Dispersion	Calculated from I/B/E/S as (100 times) the standard deviation of the analyst forecasts of the quarterly EPS of a firm (*value*) in the year when their corresponding *actual* values are announced divided by its CRSP's end-of-year abs(*prc*).
Uncertainty	Calculated from I/B/E/S as (100 times) the average of the square of (the negative of) the difference between each available analyst forecast of a firm's quarterly EPS (*value*) in a year and the corresponding actual EPS (*actual*) announced in that year (*anndats*) divided by CRSP's end-of-year abs(*prc*).

Table 2. States Adopting a Business Combination Law

This table reports all 33 U.S. states adopting a business combination (BC) law as well as the year of adoption (in chronological order), as listed in Bertrand and Mullainathan (2003) and Gormley and Matsa (2015).

U.S. State	Year of BC Law Adoption	U.S. State	Year of BC Law Adoption
New York	1985	Connecticut	1989
Indiana	1986	Illinois	1989
Missouri	1986	Kansas	1989
New Jersey	1986	Maryland	1989
Arizona	1987	Massachusetts	1989
Kentucky	1987	Michigan	1989
Minnesota	1987	Pennsylvania	1989
Washington	1987	Wyoming	1989
Wisconsin	1987	Ohio	1990
Delaware	1988	Rhode Island	1990
Georgia	1988	South Dakota	1990
Idaho	1988	Nevada	1991
Maine	1988	Oklahoma	1991
Nebraska	1988	Oregon	1991
South Carolina	1988	Iowa	1997
Tennessee	1988	Texas	1997
Virginia	1988		

Table 3. Illiquidity: Summary Statistics

This table reports summary statistics (in columns (1) to (3)) for the firm-level illiquidity measure ILLIQ and each of its components (PBA, ROLL, EC, PS, AMIHUD, AMIVEST, ASYPBA, ASYROLL, C2. and PIN), as defined in Section 3.1 and Table 1, as well as the corresponding pairwise Pearson correlation matrix (in column (4)). Specifically, PBA is the quoted proportional bid-ask spread; ROLL is the effective bid-ask spread of Roll (1994); EC is the effective cost of trading of Hasbrouck (2009); AMIHUD is the price impact measure of Amihud (2002); AMIVEST is (the negative of) the liquidity ratio of Cooper et al. (1985) and Amihud et al. (1997); PS is (the negative of) the reversal coefficient of Pastor and Stambaugh (2003); ASYPBA and ASYROLL are the adverse selection portions of the quoted and Roll's (1984) effective bid-ask spread (as in George et al., 1991), respectively; C2 is the return-volume coefficient of Llorente et al. (2002); and PIN is the probability of informed trading of Easley et al. (1996). More detailed definitions are in Table 1. Firm-level illiquidity ILLIQ is then computed as the equal-weighted average of all available, standardized illiquidity proxies. N is the number of available firm-year observations in our sample for each variable over 1976-2006.

	(1)	(2)	(3)	(4)										
	Summary Statistics			Pairwise Pearson Correlation Matrix										
	N	Mean	Stdev	ILLIQ	PBA	ROLL	EC	AMIHUD	AMIVEST	PS	ASYPBA	ASYROLL	C2	PIN
ILLIQ	134,393	-0.03	0.49	1										
PBA	65,102	4.56	4.79	0.83	1									
ROLL	134,307	1.25	3.45	0.70	0.77	1								
EC	115,130	1.31	1.48	0.81	0.95	0.85	1							
AMIHUD	124,352	5.02	15.94	0.62	0.78	0.50	0.74	1						
AMIVEST	121,125	-7.99	31.81	0.41	0.17	0.10	0.17	0.08	1					
PS	126,299	-27.13	204.54	0.13	-0.23	-0.15	-0.31	-0.33	-0.03	1				
ASYPBA	61,650	92.08	15.82	0.21	-0.05	-0.05	-0.06	-0.03	0.00	0.00	1			
ASYROLL	125,371	37.47	27.26	0.13	-0.16	-0.09	-0.17	-0.11	-0.17	0.06	0.05	1		
C2	118,889	1.57	8.79	0.27	-0.09	0.07	0.08	-0.02	0.04	-0.08	-0.01	-0.06	1	
PIN	84,558	23.18	10.73	0.59	0.38	0.33	0.36	0.27	0.33	-0.12	0.07	-0.27	0.09	1

Table 4. BC Laws: Ex Ante Firm-Level Characteristics

This table reports means and standard deviations (in parentheses) of various firm-level characteristics (defined in Table 1) in the year before a new BC law is adopted for treated firms (i.e., incorporated in states adopting a BC law in the following year; column (1)) and control firms (i.e., incorporated in states not adopting a BC law in the following year; column (2)), as well the p-value from a t-test of the difference between means of treated and control firms based on standard errors adjusted for clustering at the state-of-incorporation level (column (3)). The stock price is in U.S. dollars; the market cap is in millions of U.S. dollars. N is the number of available treated and control firm-event year observations in our sample for each variable over 1976-2006.

	(1)		(2)		(3)
	Treated Firms		Control Firms		
	Mean (Stdev)	N	Mean (Stdev)	N	p-value of Difference
Market Cap	439.4	3,760	510.7	26,422	0.195
	(1,602.4)		(1,896.9)		
Stock Price	13.14	3,760	14.48	26,422	0.297
	(14.55)		(15.53)		
Return Volatility	60.50	3,765	54.93	26,507	0.223
	(31.71)		(33.44)		
ROA	-1.90	3,766	-2.67	26,529	0.196
	(22.08)		(23.04)		
Cash Flow on Assets	5.54	3,207	5.40	22,255	0.891
	(25.87)		(25.63)		
Debt on Assets	25.36	3,751	24.37	26,407	0.011
	(21.72)		(21.63)		
Altman z-score	4.96	3,167	5.21	22,045	0.074
	(7.49)		(7.87)		
ILLIQ	-0.004	3,767	-0.008	26,531	0.814
	(0.437)		(0.464)		
Dispersion	4.42	1,539	3.99	11,032	0.372
	(13.68)		(13.57)		
Uncertainty	18.58	1,661	16.65	11,709	0.318
	(111.6)		(110.5)		

Table 5. Illiquidity and Corporate Governance Indices

This table reports the slope coefficient of *grouped-data* regressions of average illiquidity (ILLIQ of Section 3.1) within each governance index's ordinal score (from 1 to 18 in the *g*-index of Gompers et al., 2003, in columns (1) to (4)); from 0 to 6 in the *e*-index of Bebchuk et al., 2009, in columns (5) to (8)) on those scores — weighted by the number of observations in each score group. Potentially endogenous controls for the *e*-index include governance score-level averages of a firm's stock price, size (measured by its market capitalization), and stock return volatility; potentially endogenous controls for the *g*-index further include score-level averages of such financial ratios as debt on assets, ROA, cash flow on assets, and Altman *z*-score. Score restriction involves removing averages computed with less than 50 observations (scores 1, 2, 16, 17, and 18 for the *g*-index; score 6 for the *e*-index). N_a is the number of governance score-level averages; N is the underlying number of available firm-year observations in our sample over 1990-2006; R^2 is the coefficient of determination; robust standard errors (in parentheses) are heteroskedasticity-consistent. A *, **, or *** indicates statistical significance at the 10%, 5%, or 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Variable =	*g*-Index-Level Averages of ILLIQ				*e*-Index-Level Averages of ILLIQ			
g-Index	-0.0068***	0.0012	-0.0074***	-0.0012				
	(0.0018)	(0.0068)	(0.0018)	(0.0136)				
e-Index					0.0104**	-0.0061	0.0098**	-0.0004
					(0.0033)	(0.0279)	(0.0034)	(0.0343)
Endogenous Controls	NO	YES	NO	YES	NO	YES	NO	YES
Restricted Scores	NO	NO	YES	YES	NO	NO	YES	YES
N_a	18	18	13	13	7	7	6	6
N	10,682	8,617	10,599	8,564	9,295	9,233	9,250	9,188
R^2	0.44	0.83	0.54	0.87	0.71	0.90	0.72	0.94

Table 6. Illiquidity and BC Laws

This table reports estimates for the coefficient (δ) of firm-year panel regressions (*average effects* (AE), Eq. (13), in columns (1) to (3); *high-dimensional fixed effects* (FE), Eq. (14), in column (4)) of stock illiquidity (ILLIQ of Section 3.1) on a dummy variable (BC) equal to one if a firm is incorporated in a state that has adopted a BC law and equal to zero otherwise. Potentially endogenous controls include a firm's stock price, size (measured by its market capitalization), stock return volatility, debt on assets, ROA, cash flow on assets, and Altman z-score. State-year and industry-year AE are computed as state of location-year and four-digit SIC industry-year averages of ILLIQ; industry-year FE are at the four-digit SIC level. N is the number of available firm-year observations in our sample over 1976-2006; R^2 is the coefficient of determination; standard errors (in parentheses) are adjusted for clustering at the state-of-incorporation level. A *, **, or *** indicates statistical significance at the 10%, 5%, or 1% level, respectively.

	(1)	(2)	(3)	(4)
	Average Effects			High-Dimensional Fixed Effects
BC Law Dummy	-0.0667**	-0.0370**	-0.0183*	-0.0465***
	(0.0278)	(0.0180)	(0.0106)	(0.0156)
Year FE	YES	YES	YES	NO
Firm FE	YES	YES	YES	YES
State-Year FE	NO	NO	NO	YES
Industry-Year FE	NO	NO	NO	YES
Endogenous Controls	NO	YES	YES	NO
State-Year AE	NO	NO	YES	NO
Industry-Year AE	NO	NO	YES	NO
N	134,393	104,496	104,496	134,393
R^2	0.42	0.54	0.63	0.58

Table 7. Illiquidity, BC Laws, and Forecast Dispersion

This table reports estimates for the coefficient (δ) of firm-year panel regressions (*average effects* (AE) with *matching* [Eq. (17), in columns (1) and (2)] and without matching [Eq. (13), in columns (3) and (4)]; *high-dimensional fixed effects* (FE) with matching [Eq. (18), in columns (5) and (6)] and without matching [Eq. (14), in columns (7) and (8)]) of stock illiquidity (ILLIQ of Section 3.1) on a dummy variable (BC) equal to one if a firm is incorporated in a state that has adopted a BC law and equal to zero otherwise, separately for firms with below-median (*low*) and above-median (*high*) analyst EPS forecast *dispersion*. Potentially endogenous controls include a firm's stock price, size (measured by its market capitalization), stock return volatility, debt on assets, ROA, cash flow on assets, and Altman z-score. A cohort is made of firm-year observations within up to fifteen years before and after each BC adoption year; N is the number of available firm-year observations in our sample over 1976-2006; R^2 is the coefficient of determination; standard errors (in parentheses) are adjusted for clustering at the state-of-incorporation level. A *, **, or *** indicates statistical significance at the 10%, 5%, or 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Matching Average Effects		Average Effects		Matching High-Dimensional Fixed Effects		High-Dimensional Fixed Effects	
Sorting Variable = Dispersion	Low	High	Low	High	Low	High	Low	High
BC Law Dummy	-0.0193**	-0.0288***	-0.0242**	-0.0341***	-0.0212	-0.0520***	-0.0303***	-0.0627***
	(0.0084)	(0.0108)	(0.0091)	(0.0123)	(0.0131)	(0.0173)	(0.0109)	(0.0201)
Year FE	NO	NO	YES	YES	NO	NO	NO	NO
Firm FE	NO	NO	YES	YES	NO	NO	YES	YES
State-Year FE	NO	NO	NO	NO	NO	NO	YES	YES
Industry-Year FE	NO	NO	NO	NO	NO	NO	YES	YES
Cohort-Year FE	YES	YES	NO	NO	NO	NO	NO	NO
Cohort-Firm FE	YES	YES	NO	NO	YES	YES	NO	NO
Cohort-State-Year FE	NO	NO	NO	NO	YES	YES	NO	NO
Cohort-Industry-Year FE	NO	NO	NO	NO	YES	YES	NO	NO
Endogenous Controls	YES	YES	YES	YES	NO	NO	NO	NO
State-Year AE	NO	NO	YES	YES	NO	NO	NO	NO
Industry-Year AE	NO	NO	YES	YES	NO	NO	NO	NO
Cohort-State-Year AE	YES	YES	NO	NO	NO	NO	NO	NO
Cohort-Industry-Year AE	YES	YES	NO	NO	NO	NO	NO	NO
N	37,764	39,926	37,764	39,926	47,380	47,836	47,380	47,836
R^2	0.71	0.71	0.59	0.61	0.76	0.72	0.66	0.64

Table 8. Illiquidity, BC Laws, and Forecast Uncertainty

This table reports estimates for the coefficient (δ) of firm-year panel regressions (*average effects* (AE) with *matching* [Eq. (17), in columns (1) and (2)] and without matching [Eq. (13), in columns (3) and (4)]; *high-dimensional fixed effects* (FE) with matching [Eq. (18), in columns (5) and (6)] and without matching [Eq. (14), in columns (7) and (8)]) of stock illiquidity (ILLIQ of Section 3.1) on a dummy variable (BC) equal to one if a firm is incorporated in a state that has adopted a BC law and equal to zero otherwise, separately for firms with below-median (*low*) and above-median (*high*) analyst EPS forecast *uncertainty*. Potentially endogenous controls include a firm's stock price, size (measured by its market capitalization), stock return volatility, debt on assets, ROA, cash flow on assets, and Altman z-score. A cohort is made of firm-year observations within up to fifteen years before and after each BC adoption year; N is the number of available firm-year observations in our sample over 1976-2006; R^2 is the coefficient of determination; standard errors (in parentheses) are adjusted for clustering at the state-of-incorporation level. A *, **, or *** indicates statistical significance at the 10%, 5%, or 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Matching Average Effects		Average Effects		Matching High-Dimensional Fixed Effects		High-Dimensional Fixed Effects	
Sorting Variable = Uncertainty	Low	High	Low	High	Low	High	Low	High
BC Law Dummy	-0.0140	-0.0264**	-0.0170**	-0.0349**	-0.0233*	-0.0471**	-0.0329**	-0.0561**
	(0.0093)	(0.0103)	(0.0074)	(0.0131)	(0.0135)	(0.0204)	(0.0159)	(0.0247)
Year FE	NO	NO	YES	YES	NO	NO	NO	NO
Firm FE	NO	NO	YES	YES	NO	NO	YES	YES
State-Year FE	NO	NO	NO	NO	NO	NO	YES	YES
Industry-Year FE	NO	NO	NO	NO	NO	NO	YES	YES
Cohort-Year FE	YES	YES	NO	NO	NO	NO	NO	NO
Cohort-Firm FE	YES	YES	NO	NO	YES	YES	NO	NO
Cohort-State-Year FE	NO	NO	NO	NO	YES	YES	NO	NO
Cohort-Industry-Year FE	NO	NO	NO	NO	YES	YES	NO	NO
Endogenous Controls	YES	YES	YES	YES	NO	NO	NO	NO
State-Year AE	NO	NO	YES	YES	NO	NO	NO	NO
Industry-Year AE	NO	NO	YES	YES	NO	NO	NO	NO
Cohort-State-Year AE	YES	YES	NO	NO	NO	NO	NO	NO
Cohort-Industry-Year AE	YES	YES	NO	NO	NO	NO	NO	NO
N	39,885	41,788	39,885	41,788	50,036	50,079	50,036	50,079
R^2	0.71	0.70	0.59	0.61	0.75	0.71	0.65	0.64

Table 9. Illiquidity, BC Laws, and Return Volatility

This table reports estimates for the coefficient (δ) of firm-year panel regressions (*average effects* (AE) with *matching* [Eq. (17), in columns (1) and (2)] and without matching [Eq. (13), in columns (3) and (4)]; *high-dimensional fixed effects* (FE) with *matching* [Eq. (18), in columns (5) and (6)] and without matching [Eq. (14), in columns (7) and (8)]) of stock illiquidity (ILLIQ of Section 3.1) on a dummy variable (BC) equal to one if a firm is incorporated in a state that has adopted a BC law and equal to zero otherwise, separately for firms with below-median (*low*) and above-median (*high*) stock *return volatility.* Potentially endogenous controls include a firm's stock price, size (measured by its market capitalization), stock return volatility, debt on assets, ROA, cash flow on assets, and Altman z-score. A cohort is made of firm-year observations within up to fifteen years before and after each BC adoption year; N is the number of available firm-year observations in our sample over 1976-2006; R^2 is the coefficient of determination; standard errors (in parentheses) are adjusted for clustering at the state-of-incorporation level. A *, **, or *** indicates statistical significance at the 10%, 5%, or 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Matching Average Effects		Average Effects		Matching High-Dimensional Fixed Effects		High-Dimensional Fixed Effects	
Sorting Variable = Return Volatility	Low	High	Low	High	Low	High	Low	High
BC Law Dummy	-0.0074	-0.0086	-0.0184**	-0.0160	-0.0255	-0.0345*	-0.0396**	-0.0528***
	(0.0091)	(0.0096)	(0.0085)	(0.0108)	(0.0177)	(0.0177)	(0.0159)	(0.0187)
Year FE	NO	NO	YES	YES	NO	NO	NO	NO
Firm FE	NO	NO	YES	YES	NO	NO	YES	YES
State-Year FE	NO	NO	NO	NO	NO	NO	YES	YES
Industry-Year FE	NO	NO	NO	NO	NO	NO	YES	YES
Cohort-Year FE	YES	YES	NO	NO	NO	NO	NO	NO
Cohort-Firm FE	YES	YES	NO	NO	YES	YES	NO	NO
Cohort-State-Year FE	NO	NO	NO	NO	YES	YES	NO	NO
Cohort-Industry-Year FE	NO	NO	NO	NO	YES	YES	NO	NO
Endogenous Controls	YES	YES	YES	YES	NO	NO	NO	NO
State-Year AE	NO	NO	YES	YES	NO	NO	NO	NO
Industry-Year AE	NO	NO	YES	YES	NO	NO	NO	NO
Cohort-State-Year AE	YES	YES	NO	NO	NO	NO	NO	NO
Cohort-Industry-Year AE	YES	YES	NO	NO	NO	NO	NO	NO
N	64,983	68,174	64,983	68,174	86,302	79,163	86,302	79,163
R^2	0.69	0.70	0.60	0.62	0.68	0.67	0.59	0.59

Figure 1. Managerial Effort and Firm Value

This figure plots firm value v of Eq. (1) (solid line) as a function of managerial effort y in the economy of Section 2 when $\sigma_u^2 = 1$, $\sigma_e^2 = 1$, $u = 1$, $c = 0.62$, and $\gamma = 0.5$, as well as both the corresponding first-best (y_{FB} of Eq. (3); dashed line) and second-best effort (y_{SB} of Eq. (4); dotted line) when $e = 0.5$.

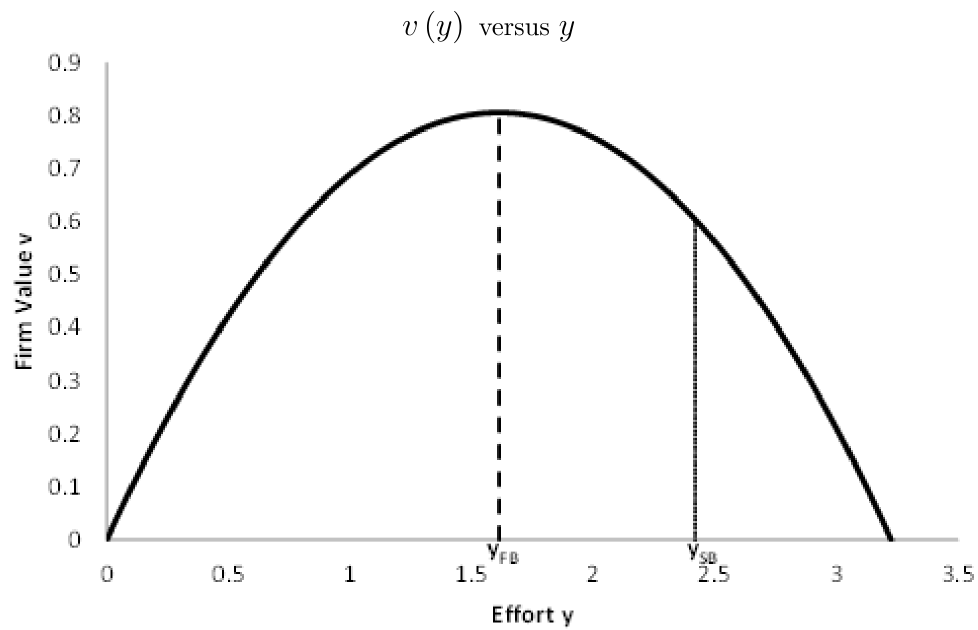
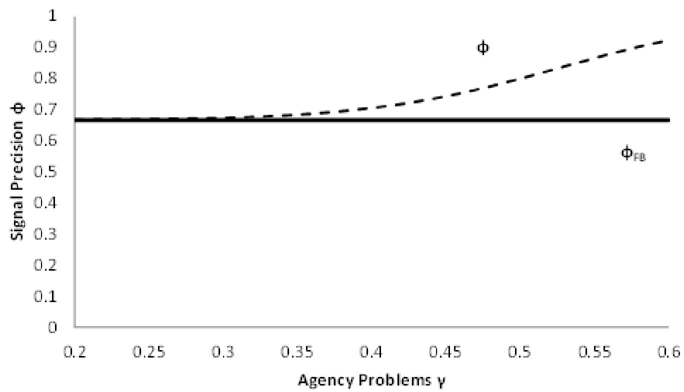


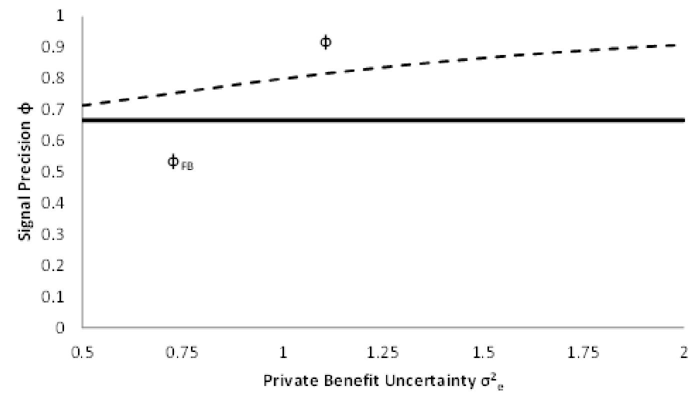
Figure 2. Agency Considerations and Speculation

This figure plots first-best (solid line) and second-best (dashed line) precision of the speculator's private signal ($\phi_{FB} = \frac{\sigma_u^4}{\sigma_u^4+2c^2\sigma_\varepsilon^2}$ and $\phi = \frac{\sigma_u^4+d^4\sigma_e^4}{\sigma_u^4+d^4\sigma_e^4+2c^2\sigma_\varepsilon^2}$) and her trading aggressiveness (β_{FB} of Eq. (12) and β of Eq. (10)) in the economy of Section 2 (when $\sigma_u^2 = 1$, $u = 1$, and $c = 0.62$) as a function of the severity of agency problems affecting managerial effort (γ, in Figures 2a, 2c, and 2e, respectively, when $\sigma_e^2 = 1$) and of marketwide uncertainty about the firm manager's private benefits (σ_e^2, in Figures 2b, 2d, and 2f, when $\gamma = 0.5$).

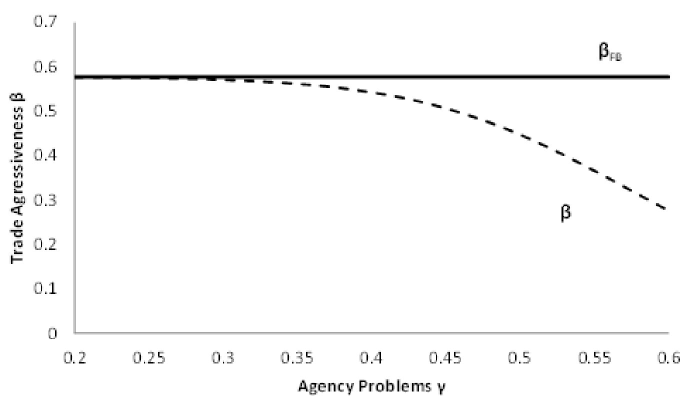
a) ϕ_{FB}, ϕ versus γ



b) ϕ_{FB}, ϕ versus σ_e^2



c) β_{FB}, β versus γ



d) β_{FB}, β versus σ_e^2

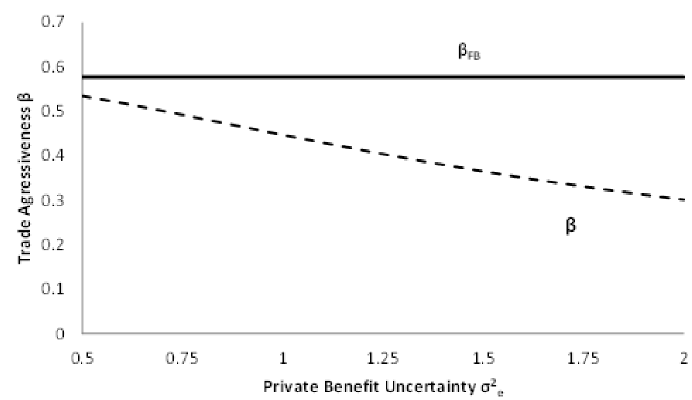


Figure 3. Agency Considerations and Market Liquidity

This figure plots first-best (solid line) and second-best (dashed line) equilibrium price impact (λ_{FB} of Eq. (11) and λ of Eq. (8)) in the economy of Section 2 (when $\sigma_u^2 = 1$, $u = 1$, and $c = 0.62$), as well as second-best equilibrium price impact when the unit cost of managerial effort (or investment) is either low ($c_L = 0.25$; solid line) or high ($c_H = 0.75$; dashed line), as a function of the severity of agency problems affecting managerial effort (γ, in Figure 3a and 3c, respectively, when $\sigma_e^2 = 1$) and of marketwide uncertainty about the firm manager's private benefits (σ_e^2, in Figure 3b and 3d, when $\gamma = 0.5$).

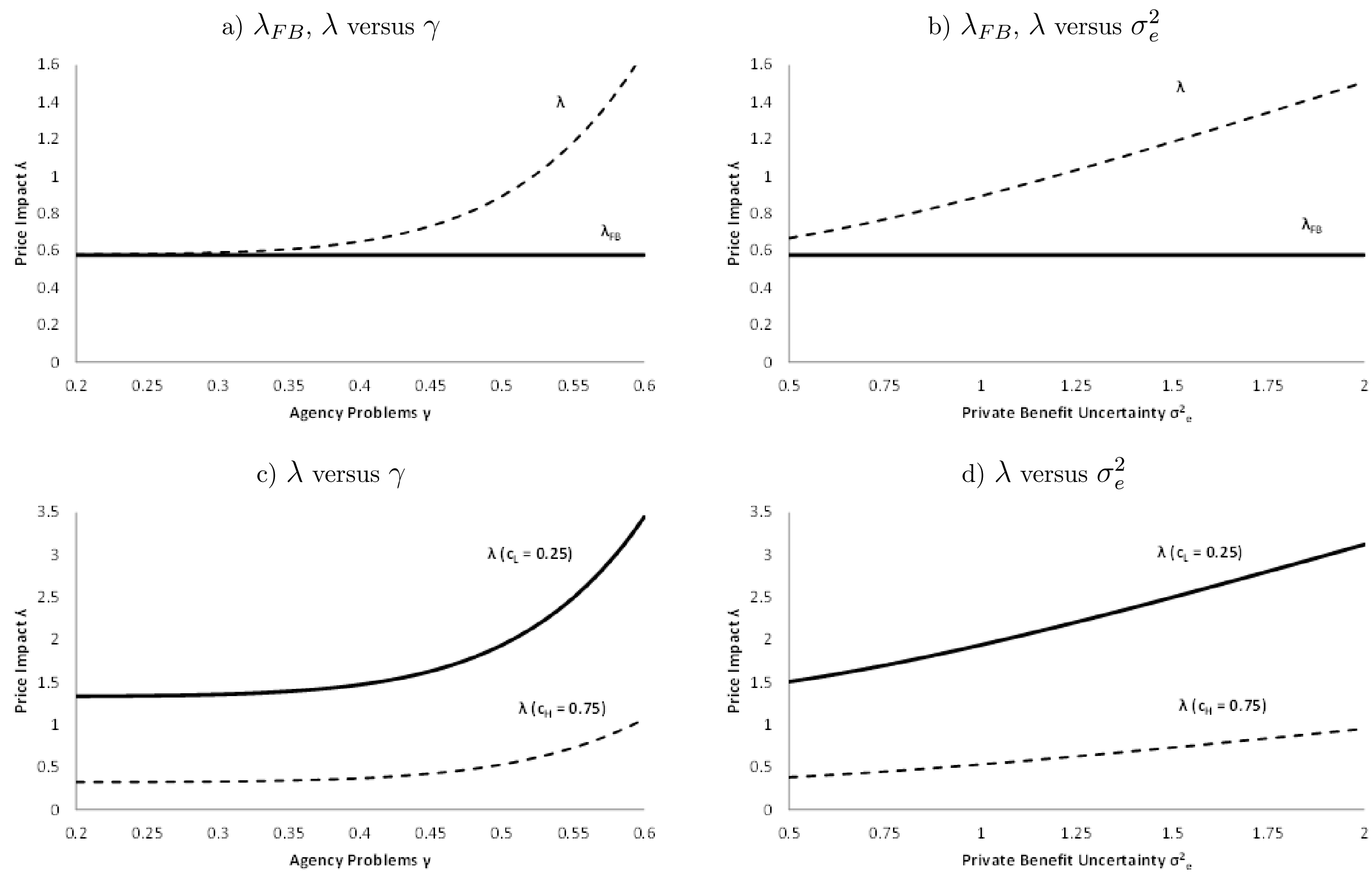
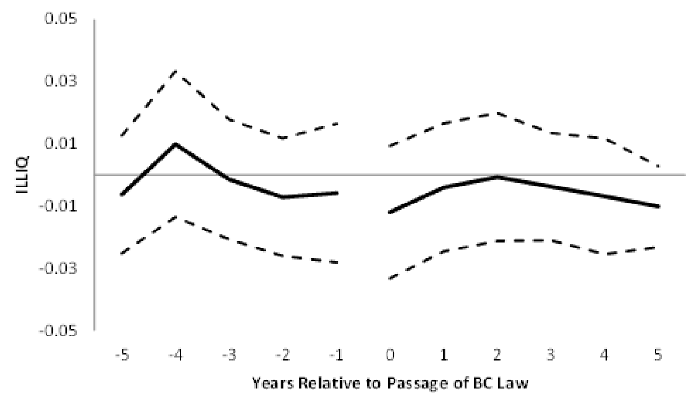


Figure 4. Illiquidity and BC Laws in Event Time

This figure plots estimates for the coefficient (δ, solid line) of firm-year regressions (*average effects*, Eq. (13) as in column (3) of Table 6, in Figure 4a; *high-dimensional fixed effects*, Eq. (14) as in column (4) of Table 6, in Figure 4b) of stock illiquidity (ILLIQ of Section 3.1) on a dummy variable (BC) equal to one if a firm is incorporated in a state that has adopted a BC law and equal to zero otherwise — when allowing those estimates to change by year in event time — as well as their 90% confidence intervals (dashed lines), adjusted for clustering at the state-of-incorporation level.

a) δ from Average Effects



b) δ from High-Dimensional Fixed Effects