Mandatory Disclosure of Innovation Failure and VC Investment

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Abstract

The current innovation system centers on the mandatory and voluntary disclosure of inventors' successful outcomes. The innovation process remains a "black box" for external investors, leading to substantial frictions in innovation financing. This study leverages a unique regulation shock, which opens the "black box" by mandating disclosure of failed attempts in the process, and explores whether disclosure of innovation failure is value-relevant for venture capitalists, a key source for innovation funding. Drawing on ambiguity aversion theory and using the clinical trial setting, I hypothesize that after firms' disclosure of failed clinical trials, VC investment will increase for their peer firms, which innovate in the same market but pursue different technologies. I find consistent evidence, and the results are more significant when the disclosure is more material and impactful: when the market is more opaque, when the market is more concentrated, and when the firm has more knowledge stock. Further analyses show that the increase in VC investment is driven by venture capitalists with technology expertise instead of those with market expertise. In contrast to the disclosure of successful innovation outcomes, which hurts technology novelty in the same market, the disclosure of innovation failures enhances social welfare by encouraging technology novelty. It also improves venture capitalists' deal quality, proxied with increases in both the likelihood and the return of successful exits. Overall, my findings reveal how mandatory disclosure of innovation failure changes the landscape of innovation financing and improves the welfare of various stakeholders.

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"I have not failed 10,000 times—I've successfully found 10,000 ways that will not work."

— Thomas Edison, as quoted by B.C. Forbes in Harper's Monthly Magazine, September 1931

1. Introduction

Innovation is the key engine of growth (e.g., Solow, 1956; Romer, 1990). To foster it, the patent system grants inventors partial excludability for their claimed innovation in exchange for public disclosure of their successful works (Glaeser and Lang, 2024). Market competition dynamics also incentivize inventors to voluntarily disclose their successful works (Glaeser et al., 2020; Glaeser, 2021; He and Lee, 2023; Zhang, 2024). However, even with both mandatory and voluntary disclosure of successful innovation outcomes, market frictions in innovation financing remain substantial, especially for innovations that generate large societal value relative to the private returns captured by the inventors (Hall and Lerner, 2010; Kerr and Nanda, 2015; Lo and Thakor, 2022). One underlying reason is that such disclosures focus on successful innovation outcomes and overlook the process of innovation, especially the numerous failures that are inherently part of the process. With the innovation process being a "black box", external investors face high uncertainty and therefore do not participate sufficiently. If that "black box" were to be opened, for instance, by mandating disclosure of failed innovation attempts in the exploratory process, it would raise an empirically important and interesting question: can increased transparency reduce frictions in innovation financing, and if so, how?

I exploit a unique setting in which failures in the innovation process are subject to mandatory public disclosure and investigate whether such disclosure influences the investment decisions of venture capitalists, an important source of innovation financing. The pharmaceutical industry is highly innovation-intensive, and its innovation process is largely reflected in the clinical

trial pipeline. Clinical development typically proceeds through three main phases: Phase I assesses safety, Phase II evaluates effectiveness, and Phase III confirms efficacy and compares the candidate drug to existing treatments. After successful completion of these phases, new drug candidates are reviewed by the Food and Drug Administration (FDA) for approval consideration. Beginning in 2007, Section 801 of the Food and Drug Administration Amendments Act (FDAAA 801) mandated that sponsor firms register their clinical trials on the publicly accessible platform ClinicalTrials.gov. However, disclosure of trial results remained largely voluntary due to ambiguity in application scope and a lack of enforcement (Capkun et al., 2023). In practice, only trials for approved products were required to disclose their results (Ropes and Gray, 2020), resulting in limited disclosure of phased outcomes and a strong bias toward successful results. In September 2016, the Department of Health and Human Services (HHS) issued the Final Rule for Clinical Trials Registration and Results Information Submission (hereafter, "the Final Rule"), which broadened the result reporting requirements to trials of unapproved products. Since the rule's implementation in January 2017, the number of clinical trials with failed result submission has increased sharply and even outnumbered that of clinical trials with successful result submission. Leveraging this exogenous regulatory change, I investigate whether firms' disclosure of innovation failure provides value-relevant information for venture capitalists to invest in their peer firms who innovate in the same market (therapeutic condition) but pursue different technologies (mechanisms of action).

Firms' disclosure of innovation failure can increase VC investment for their peer firms that innovate in the same market but pursue different technologies. Innovation process is inherently of high uncertainty. Fundamentally different from risk, which features known probabilities of different outcomes, uncertainty (used interchangeably with ambiguity in this study) means the

probabilities are unknown (Knight, 1921). Ellsberg (1961) demonstrates individuals' tendency to avoid outcomes with unknown probabilities compared with those with known probabilities and formalizes it as ambiguity aversion. Finance literature widely documents that ambiguity aversion is a significant factor contributing to nonparticipation in stock markets (Dow and Werlang, 1994; Cao et al., 2005; Epstein and Schneider, 2010; Dimmock et al., 2016), and that learning can mitigate this aversion both by narrowing the set of subjective probability distributions, thereby reducing perceived ambiguity, and by fostering greater tolerance toward ambiguity itself (Epstein and Schneider, 2007; Baillon et al., 2018; Peijnenburg, 2018). Investment in innovative start-ups also faces high ambiguity and is insufficient, especially for drug development (Lo and Thakor, 2022). Mandatory disclosure of innovation failure provides opportunities for investors to learn about the scientific landscape and therefore, reduce their ambiguity aversion. In the context of clinical trials, it eliminates ineffective mechanisms from the set of possibilities and provides valuable information to understand the targeted therapeutic conditions.[1] Thus, investors can better assess the potential of the remaining drug candidates, thereby reducing perceived ambiguity. Moreover, exposure to past observations will change investors' attitudes towards ambiguity, making them less averse and more tolerant. Therefore, the investment in the remaining drug candidates, which pursue different mechanisms from the failed ones, will increase. In contrast, disclosure of innovation success does not necessarily encourage investment in its competing candidates who innovate in the same market but pursue different technologies. Although it also discloses useful information about the targeted therapeutic conditions, its leading position creates

[1] The failure of one therapeutic approach can lead to new insights, prompt a paradigm shift in understanding disease mechanisms, and guide the development of alternative therapies. This case is widely observed across the drug development process. Anecdotal evidence supporting this argument is presented in Appendix B.

a competitive barrier, limiting the market space available to other drug candidates.[2] If the decline in market shares outweighs the reduction in ambiguity, investors will not provide financial support for the remaining drug candidates in the same market. This hypothesis is not without tension. If the disclosure of failed clinical trials dampens the prospects of the whole market, then the investment in the market will decrease accordingly.

I first construct a panel sample of start-up clinical trial sponsor firms. Compared with innovation in a general context, the setting of clinical trials establishes clear definitions for markets and technologies. Following prior literature (Krieger 2021, Cunningham et al., 2021, Li et al., 2021, Zhang, 2024), I use the intended therapeutic conditions to define markets and use the mechanisms of action (MOAs) to define technologies. To capture the effects of one firm's disclosure of failed clinical trials on VC investment for its peer firms that innovate in the same market but pursue different technologies, I use an identification strategy that directly compares the VC investment for firms using *different* technologies from the failed trial but in the *same* market as the failed trial with those using *different* technologies and in *different* markets from the failed trial. This research design constructs a clean control group and mitigates the concern that my findings are driven by the decline in VC investment for firms with the same technologies as the failed clinical trials.

I first conduct a benchmark analysis to examine whether a firm's disclosure of successful clinical trials affects VC investment for its peer firms that innovate in the same market but pursue different technologies. I find that disclosure of phased success does not encourage VC investment for peer firms. These results suggest that disclosure on success does not reduce the friction of

[2] The competing relationship of drug candidates aiming for the same therapeutic condition but with different MOAs is widely documented in prior literature (Krieger, 2021; Li et al., 2023; Zhang, 2024) and supported by anecdotal evidence. For example, in November 2022, after Roche announced the failure of its Phase III trials for the Alzheimer's drug, Eli Lilly's stock rose over 7% in the following two days, who conducts clinical trials also for Alzheimer's drug but with a different MOA.

innovation financing and I use them as a benchmark to compare with the effects of disclosure on failure.

I begin my main analysis with a staggered difference-in-differences (DiD) research design, examining the changes in firms' VC investment before and after competing firms' disclosure of failed clinical trial results. I find that following a firm's disclosure of failed clinical trials, its peer firms that innovate in the same market but pursue different technologies are more likely to get VC investment and obtain larger funding amount from a greater number of VC funds, compared with non-peer firms that innovate in different markets and pursue different technologies. Economically, peer firms (same market but different technologies) exhibit a 0.031 incremental increase in the likelihood of getting VC investment relative to non-peer firms (different markets and different technologies), which represents a 45.59% increase relative to the sample mean. Moreover, I test for and find evidence of parallel trends in VC investment for peer and non-peer firms in the pre-disclosure period, providing greater confidence that the results can be interpreted causally.

Having established a robust relation between firms' disclosure of failed clinical trials and their peer firms' VC investment, I next conduct three cross-sectional tests to explore the nature of the changes in VC investment. First, if the market is more opaque, investors have less information to assess the success rate of drug candidates in the market and hence, face higher uncertainty. If a failed clinical trial is disclosed, it serves as a credible signal that helps reduce ambiguity about the remaining drug candidates in the market, therefore encouraging more investment. Accordingly, I find that firms with higher opacity benefit more from competing firms' disclosure of failed clinical trials, as shown by the increase in the likelihood and the amount of VC investment. Second, if the market is more concentrated, the failure of one clinical trial has greater implications for the remaining drug candidates' competitive positions and market shares. With fewer competitors, a

failed clinical trial sends a clearer and more impactful signal to investors, encouraging greater VC investment toward surviving firms with different technologies. Consistent with this expectation, I find that firms with higher market concentration experience more of an increase in the likelihood and amount of VC investment. Third, firms with more knowledge stock accumulate more experience and intellectual assets, signaling higher potential for success. Therefore, competing firms' disclosure of failed clinical trials provides them with greater opportunities to capitalize on market gaps. In support of this argument, I find that firms with more knowledge stock are more likely to get VC investment and get a larger funding amount from a greater number of VC funds. These findings are consistent with my hypothesis that disclosure of failed clinical trials provides value-relevant information for venture capitalists and that the effects are stronger when the information is more material and impactful.

Next, I examine whether the increase in VC investment reflects a reallocation of resources within the market or an influx of external capital seeking markets for new technologies. Specifically, the increase may stem from venture capitalists who previously invested in failed drug candidates and are now redirecting their capital toward more promising opportunities. Alternatively, it could be driven by venture capitalists who are familiar with technologies and seek innovative solutions for the targeted condition. I define market expertise as having invested in the same market as the current deal during the past three years, and technology expertise as having invested in firms using the same technology as the current deal during the past three years. The results show that the observed increase in VC investment is primarily driven by venture capitalists with technology expertise.

Then, I conduct social welfare analyses focusing on technology novelty. The lack of novelty in drug development, especially the prevalence of low-novelty "me-too" drugs, has long

been a concern for social welfare, as these drugs typically offer only modest improvements over existing treatments and divert resources away from genuine innovation (Angell, 2010). Drug novelty largely depends on mechanisms of action (MOAs), a key criterion in the FDA's evaluation of "first-in-class" status (Osipenko et al., 2024). However, the high risk associated with radical innovation deters sponsor firms, especially financially constrained private firms, from pursuing novel drug development (Krieger et al., 2022). Venture capitalists play a critical role in sharing risk and supporting start-ups with the potential for generating high returns through acquisition or IPO. Mandatory disclosure of failed clinical trial results helps venture capitalists reduce ambiguity and evaluate the remaining candidates with more confidence, therefore promoting innovation of high novelty. In contrast, disclosure of successful innovation outcomes tends to encourage incremental follow-on innovations and increase technological similarity (Kim and Valentine, 2021; Hegde et al., 2022; Dyer et al., 2023). In the clinical trial setting, such disclosures may discourage exploration of novel MOAs by narrowing the perceived market and raising approval standards. I find consistent evidence that disclosure of successful clinical trials significantly deters the registration of new clinical trials with novel MOAs that have never been used for the therapeutic condition before. In contrast, disclosure of failed clinical trials significantly encourages the registration of new clinical trials with novel MOAs never been used for the condition before. And the encouraging effects are mainly driven by VC-supported markets.

I next conduct welfare analyses for venture capitalists. If the information in the failed clinical trial disclosure is useful for venture capitalists to find promising investment targets, venture capitalists will be more likely to successfully exit and generate higher returns from the deals made following such disclosure. Investee firms' going public and being acquired are two main exit strategies for venture capitalists. I examine both the likelihoods and venture capitalists'

returns of investee firms' IPO and acquisition transactions. The results show that investee firms in the deals following competing firms' disclosure of failed clinical trials are more likely to go public and venture capitalists obtain higher returns both on the IPO day and after the lock-up period. The results also show that investee firms in the deals following competing firms' disclosure of failed clinical trials are more likely to be acquired and the deal value is more likely to be larger than the total funding amount invested in the firm. In sum, these results provide evidence that the mandatory disclosure of failed clinical trials helps venture capitalists improve deal quality by finding promising investment targets.

I then analyze how pharmaceutical firms' voluntary disclosure policies change in response to the regulation of mandating result submission for failed clinical trials. I find that public firms disclose significantly more failures of their clinical trials in SEC filings and press release following the Final Rule. These results suggest that mandatory disclosure requirement also improves firms' transparency in voluntary disclosure and alleviate the concern that firms may have already disclosed their clinical trial failures through other channels rather than via ClinicalTrials.gov prior to the regulation change.

Next, I conduct a falsification test to assure the validity of my findings. A potential concern is that venture capitalists, particularly those specializing in the pharmaceutical industry, may rely on private information networks rather than public disclosures to learn from clinical trial outcomes. If true, the observed effects may reflect investment responses to private rather than public information.[3] To empirically address this concern, I use zombie clinical trials (trials without reported outcomes or follow-up activities) before the Final Rule as a proxy for not publicly disclosed failures. If venture capitalists' private information network is efficient enough, their

[3] Nonetheless, this would still reflect value-relevance of failed trial information for peer sponsor firms.

investment should change following the completion of these zombie trials. I find no significant increases in VC investment for peer firms innovating in the same market but pursuing different technologies following zombie trials' completion. These results lend support to the material impact of mandatory and public disclosure of failed clinical trials.

Finally, I conduct several tests to assess the robustness of my findings. I (i) estimate a stacked DiD specification, (ii) adopt alternative definitions of markets, (iii) use longer and short sample periods, and (iv) match each peer firm (treatment firm) with a "twin" firm from the non-peer firm pool (a "twin" firm uses the same technology but innovate in different markets from the treatment firm) and use "twin" firms as the control group. In all cases, I find that my main inferences are unchanged.

This study's findings contribute to the extant literature in three primary ways. First, prior literature highlights the role of disclosure in the innovation system and focuses on disclosures of successful outcomes, both mandatory and voluntary (e.g., Kim and Valentine, 2021; Hegde et al., 2022; Beyhaghi et al., 2023; Dyer et al., 2023; Glaeser and Lang, 2024). However, the underlying process of innovation, which is inherently accompanied by numerous failures, remains largely unobservable. As the innovation process remains a "black box" to external investors, the successful-outcome-oriented disclosures fail to reduce the friction of innovation financing. Leveraging a unique regulation shock that opens the "black box" by mandating disclosure of failed attempts in the innovation process, I study whether investment for innovation and the characteristics (novelty) of innovation will change following the increased transparency. I focus on start-up pharmaceutical firms and VC investment, both of which are crucial in drug development by advancing high-risk and high-reward therapies (DiMasi et al., 2010). I find that after a firm discloses the results of its failed clinical trials, VC investment increases for its peer

firms innovating in the same market but pursuing different technologies. Moreover, technology novelty will also increase in markets with such disclosures. Such effects can not be achieved with the disclosure of successful clinical trials. These results suggest that disclosure of innovation failure decreases ambiguity for venture capitalists, alleviates the friction of innovation financing, and encourages radical exploration instead of follow-on innovations.

Second, my research contributes to the literature on ambiguity aversion theory. Since its introduction by Knight (1921) and formalization by Ellsberg (1961), a substantial body of theoretical models and empirical studies has established ambiguity aversion as a critical determinant of investment decisions, widely cited as a key reason for limited participation in stock markets (Dow and Werlang, 1994; Cao et al., 2005; Easley and O'Hara, 2009; Epstein and Schneider, 2010; Dimmock et al., 2016). A strand of literature highlights learning (from past observations) as a remedy and supports this argument with both model analysis and experimental evidence (Juand Miao, 2002; Epstein and Schneider, 2007; Peijnenburg, 2018; Baillon et al., 2018). My study contributes to the literature by providing empirical evidence of how learning encourages participation in the innovation financing markets. Moreover, my study further differentiates the varied effects of past observations with varied characteristics (failure vs. success).

Third, my research contributes to the emerging literature on target screening of venture capitalists. Finding high-quality investment opportunities is an important determinant of success in VC investment (Sørensen, 2007). However, venture capitalists face significant searching frictions (e.g., Gompers et al., 2020) and sometimes even use a "spray and pray" strategy (Ewens et al., 2018). Signals, such as public financial statements, affiliation with universities, and government subsidies, play an important role in this process (Higgins et al., 2011; Kim et al., 2018;

Howell, 2017; Baik et al., 2025). This study contributes to the literature by documenting the signaling spillover effect arising from competing firms' innovation failure.

2. Background and Hypothesis Development

2.1 Background on clinical trials and their result disclosure

Drug development features an innovation process, lasting 12 years and costing $ 2.6 billion capitalized R&D from initial discovery through regulatory approval on average (DiMasi et al., 2016). The FDA supervises the innovation process and divides it into two stages: preclinical research and clinical trials. In the preclinical research stage, researchers screen promising compounds, synthesize new chemical entities, and test drug candidates in vitro and in vivo for efficacy and toxicity. The clinical trial stage represents three phases of increasing rigor, scale, and cost. Phase I assesses safety and dosage in a small group of healthy volunteers; Phase II evaluates efficacy and side effects in several hundred patients; and Phase III tests treatment effects at scale, often involving thousands of participants. Trial costs escalate significantly, from thousands of dollars in Phase I to hundreds of millions in Phase III (Manhattan Institute, 2012). About 70 percent of drug candidates advance from Phase I to Phase II, roughly one-third proceed from Phase II to Phase III, about 25 to 30 percent move beyond Phase III, and then the FDA will review the accumulated evidence to decide on approval (Capkun et al., 2023).

The disclosure requirement for clinical trials' results has evolved through a series of regulatory milestones aimed at increasing transparency. Prior to the Food and Drug Administration Modernization Act of 1997, there was no centralized repository for clinical trial data. This legislation established ClinicalTrials.gov, which mandates public registration of Phase II and later trials. Subsequently, Section 801 of the FDA Amendments Act of 2007 (FDAAA 801) required

sponsors to not only register clinical trials but also submit summary results, including key efficacy outcomes and adverse events. Despite the requirement of the FDAAA 801, many clinical trial sponsors do not report the results of their trials on ClinicalTrials.gov due to two primary reasons. First, ambiguity in application scope impedes the enforcement of mandatory disclosure. The HHS interpreted the FDAAA 801 as requiring result submission only for trials of drugs that have been *approved*, *licensed*, or *cleared* by the FDA, effectively excluding failed or discarded drug candidates from disclosure obligations.[4] Second, the FDA has rarely enforced compliance through penalties, further weakening sponsor firms' incentives to submit results for their clinical trials (Department of Health and Human Services, 2014; The Economist, 2015). In sum, result disclosure of clinical trials in this period is voluntary (Capkun et al., 2023) and dominated by successful trials.[5]

In September 2016, the HHS issued a Final Rule for Clinical Trials Registration and Results Information Submission (42 CFR Part 11), which expands the FDAAA 801 result submission requirement to *all* trials, including trials for unapproved drug candidates.[6] The regulation became effective on January 18, 2017, and trial sponsors are expected to be in compliance as of April 18, 2017. Noncompliant sponsors are subject to legal consequences, including civil or criminal judicial actions and civil monetary penalties, up to $10,000 per day. After passage of the Final Rule, the FDA has issued noncompliance notices to public and private firms (e.g., Acceleron Pharma, Inc. and Dr. Andrey Petrikovets) for failure to submit their trial results.

[4] In the lawsuit Seife v. HHS, the HHS reveals its interpretation of FDAAA's reporting requirements as sponsors need not report the results for their clinical trials of pre-approval drugs.
[5] Subsection 3.4 provides empirical evidence for this argument.
[6] In § 11.42 of 42 CFR Part 11, it is clarified that clinical trials for which the studied product is not approved, licensed, or cleared by FDA with primary completion dates on or after January 18, 2017 must submit their results unless a waiver is granted.

Clinical trial result reports systematically document the procedure and outcomes, providing critical information for both scientific progress and strategic decision-making. Result reports must include detailed information on participant flow, baseline characteristics, outcome measures with statistical analyses, and adverse events. It provides a transparent and comprehensive disclosure of who participated, how the trial was conducted, and what was observed regarding efficacy and safety. Result reports offer valuable learning opportunities for peer firms to identify the limitations of specific mechanisms, adjust trial designs, refine patient targeting strategies, and avoid repeating ineffective approaches.

2.2 Hypothesis development

Innovation is of significant importance to economic growth (e.g., Solow, 1956; Romer, 1990). However, financing for innovation faces high market frictions, especially for innovations that generate large societal value relative to the private returns captured by the inventors (Hall and Lerner, 2010; Kerr and Nanda, 2015; Lo and Thakor, 2022). The current system (e.g., the patent system) tries to encourage innovation by mandating the disclosure of inventors' successful works. Market competition dynamics also motivate inventors to voluntarily disclose their successful works (Glaeser, 2021; Zhang et al., 2024). However, such disclosure, which emphasizes successful outcomes, does not prove to be a cure for innovation financing frictions. One underlying reason is that the innovation process, characterized by exploration and high uncertainty, remains a "black box" for external investors, and their uncertainty aversion impedes their engagement.

As originally differentiated by Knight (1921), risk refers to situations where the probabilities of outcomes are known and uncertainty (used interchangeably with ambiguity in this study) refers to situations where these probabilities are unknown. As shown in the well-known

example Ellsberg paradox,[7] individuals exhibit aversion toward outcomes with unknown probabilities, and such tendency is formalized as ambiguity aversion (Ellsberg, 1961). Following Ellsberg's findings, researchers develop different theoretical models to characterize and analyze ambiguity-averse preferences (Gilboa and Schmeidler, 1989; Hansen and Sargent, 2001; Klibanoff et al., 2005; Maccheroni et al., 2006). When applied in finance research, ambiguity aversion has been widely documented, both theoretically and empirically, as a key factor contributing to nonparticipation in stock markets (Dow and Werlang, 1994; Cao et al., 2005; Epstein and Schneider, 2010; Dimmock et al., 2016).[8] Among discussions on how to alleviate ambiguity aversion and encourage participation (e.g., Easley and O'Hara, 2009), learning has emerged as a remedy, supported by both theoretical models (Epstein and Schneider, 2007) and experimental evidence (Baillon et al., 2018). Unlike the standard Bayesian learning framework, where past observations influence decision-making only through updating beliefs about a known probability distribution, the ambiguity aversion framework assigns greater importance to information and learning. This is because, under ambiguity, decision makers evaluate outcomes based on a set of plausible probability distributions rather than one known distribution. Information from past observations can reduce perceived ambiguity by narrowing the set of priors and mitigate the decision maker's sensitivity to ambiguity. Consequently, as learning progresses, individuals' choices tend to converge toward those predicted by traditional expected utility models under risk. This process has been formalized in theoretical and experimental studies (Epstein and Schneider,

[7] An urn known to contain 30 red balls and 60 black and yellow balls, the latter in unknown proportion. Bet I is $100 on a red ball and Bet II is $100 on a black ball. Bet III is $100 on a red or yellow ball and Bet IV is $100 on a black or yellow ball. Decision makers prefer I to II while IV to III.

[8] Based on Federal Reserve's Survey of Consumer Finances (2023), about 42% families do not participate in stock markets either in an individual stock, a stock market fund, or in a self-directed 401(k) or IRA as of 2022.

2007; Ju and Miao, 2012; Baillon et al., 2018; Peijnenburg, 2018), which show that learning reduces ambiguity aversion and promotes greater participation.

The innovation process is fundamentally characterized by high levels of ambiguity. Unlike traditional investments, where probabilities of outcomes are well-defined, innovation, particularly in science-based industries like pharmaceuticals, often ventures into unknown technological, scientific, and market territories (Nelson 1959; Manso, 2011). Venture capitalists, though more risk-tolerant than other investors, still exhibit aversion when evaluating innovation projects with ambiguous prospects, especially those lacking credible signals or benchmarks (Hsu et al., 2013; Tian and Wang, 2014; Ewens et al., 2018). In the setting of drug development and clinical trials, a therapeutic condition defines the market, where each mechanism of action (MOA) represents a distinct technological strategy or scientific hypothesis aimed at addressing the same clinical need. Within the market, different mechanisms of action (MOAs) compete for shared market resources, such as patient populations, regulatory approval, and investment capital (Cunningham et al., 2021, Li et al., 2021; Aghamolla and Thako, 2022b; Krieger et al., 2022). Besides competition, learning from disclosure of other drug candidates within the same MOAs and within the same markets also occurs frequently and trial sponsors usually use the disclosure (nondisclosure) strategically (Krieger, 2021; Aghamolla and Thako, 2022a; Capkun et al., 2023; Zhang, 2024). In the context of investment in clinical trials, disclosure of failure serves as a valuable learning event to reduce venture capitalists' ambiguity of other drug candidates that target the same condition but pursue different MOAs from the failed clinical trials.[9] First, such disclosure helps investors eliminate ineffective mechanisms, narrow the set of plausible probability distributions, thus reducing their

[9] Failure in one mechanism of action does not change the objective success rate of other mechanisms. Such disclosure affects investment decisions by reducing the perceived ambiguity and investors' discomfort with ambiguity for other mechanisms.

perceived ambiguity. Second, the learning process itself improves investors' confidence in evaluating the remaining drug candidates and alleviates their pessimism about unknowns, thus reducing their aversion attitudes to ambiguity. Consequently, venture capitalists behave more like expected utility maximizers, becoming more willing to invest in uncertain but better-understood opportunities. In contrast, disclosure of successful clinical trials does not necessarily encourage investment for other trials targeting the same condition but pursuing different mechanisms. While it also reduces ambiguity about the condition, such disclosure signals their leading position, establishes a competitive edge, and ultimately limits the available market space for other drug candidates. If the resulting loss in market share outweighs the benefit of reduced ambiguity, investors will decide not to provide funding to the remaining drug candidates

I formally state my hypothesis as follows:

H: *Firms' disclosure of failed clinical trials increases venture capital investment in their peer firms that innovate in the same market but pursue different technological approaches.*

This hypothesis is not without tension. If the disclosed failure casts doubt on the entire therapeutic condition rather than a specific mechanism, it may lead to a broad loss of investor confidence across all sponsor firms innovating for the condition. In such cases, failure disclosure could discourage investment for the entire market. Ultimately, whether firms' disclosure of failed clinical trials increases VC investment for their peer firms is an empirical question.

3. Data, Sample, and Research Design

3.1 Sample selection

I obtain data on clinical trials and their sponsor firms from ClinicalTrials.gov, the online platform where sponsors register their clinical trials and submit the corresponding results, as described in the prior subsection 2.1. I begin with clinical trials whose funding sources are from

firms, classified as "Industry" by the platform. Then I construct a firm-year panel dataset based on each firm's registration year of its first clinical trial and the later of the completion year or the most recent update year of its latest clinical trial. I keep gap years between trials as the firm remains active after a phased completion of its trial. I adopt four steps to construct a sample of U.S. private firms. First, I exclude U.S. and foreign public-traded firms by fuzzy matching firm names with those in Compustat and Compustat Global. Second, I exclude foreign private firms by requiring at least one clinical trial facility in the U.S. Third, I exclude firm-years after the firm is acquired by fuzzy matching firm names with those in SDC-Mergers & Acquisitions and matching years with deal announcement years. Fourth, I manually search each firm and exclude foreign or public firms left from the previous three steps. I obtain VC investment records from SDC-Venture Capital Investment and merge them with my sample by fuzzy linking investee names of investment records to sample firm names. My sample period is from 2012 to 2021, 5 years before (2012-2016) and 5 years after (2017-2021) the event year 2017, when results of failed clinical trials are mandated to be reported by the Final Rule.

3.2 Identification strategy

To capture the effects of failed clinical trial disclosure on venture capitalists' investment decisions, I directly compare firms using different technologies from the failed trial but in the same market as the failed trial with those using different technologies and in different markets. The underlying logic is that the disclosure of failed clinical trials should only be relevant for firms who innovate in the same market by eliminating ineffective technology options and potential rivals for market shares and should be irrelevant for firms who innovate in different markets. This sample construction gives me a clean control group and addresses the concern that my findings are driven by the VC investment decline in firms sharing the same technologies as the failed clinical trials.

As shown in Figure 1, I exclude firm-years with at least one technology same as the failed trials both in the same market and in different markets (labeled in red textboxes on the left), including disclosing firm-years themselves. After excluding observations with missing data to construct control variables and singleton observations, my final sample contains 19,318 firm-years and 2,087 unique firms.

[Insert Figure 1 here]

3.3 Variable measurement

3.3.1 Results of failed clinical trials

Regulatory agencies and academia commonly focus on the primary outcome (the endpoint that a trial is designed for) and adopt a statistical significance of the 5% level as the threshold to assess whether the trial is successful or not (FDA Statistical Principles for Clinical Trials, 1998; Ioannidis, 2005; Zarin et al., 2011). I follow this standard and define a clinical trial as failed if the significance level of its primary outcome does not reach 5%.

3.3.2 Market and technology

Following prior research (Krieger 2021, Cunningham et al., 2021, Li et al., 2021, Zhang, 2024), I use clinical trials' intended therapeutic conditions to define their markets. Clinical trials registered at ClinicalTrials.gov use the U.S. National Institutes of Health (NIH)'s Medical Subject Heading (MeSH) terminology to report their intended conditions. MeSH terms follow a tree-like hierarchical structure, where medical experts classify diseases into layered levels, ranging from broad to specific. I follow Zhang (2024) and use the third level to define markets, which is the finest level of granularity commonly available across most clinical trials and the level used by researchers and regulators to compare therapeutic similarities (Brown and Patel, 2017). Based on

this definition, my sample clinical trials span across 1,486 markets. An example of the MeSH term tree is presented in Panel A, Figure 2.

Also following prior literature (Krieger, 2021; Cunningham et al., 2021), I use clinical trials' mechanisms of action (MOAs) to define their technologies. MOA refers to the specific biochemical or physiological process through which a drug produces its therapeutic effect. It describes how a substance interacts with cellular targets, such as receptors, enzymes, or signaling pathways, to bring about a change in biological function. Cortellis, a comprehensive and widely used pharmaceutical database, identifies 581 unique MOAs of my sample clinical trials and divides them into 23 unique categories. An example of the MOA structure is presented in Panel B, Figure 2.

A mechanism of action can be applied to multiple therapeutic conditions and a therapeutic condition can be treated through multiple mechanisms. The following example illustrates the bipartite relationship. For example, the DNA gyrase (bacterial) inhibitors is a MOA that can be applied to treat multiple therapeutic conditions, including bacterial pneumonia, urinary tract infections, infectious bone diseases, and gastrointestinal infections. Conversely, a single therapeutic condition, such as bacterial pneumonia, can be treated through multiple MOAs, including DNA gyrase (bacterial) inhibitors, cell division protein FtsZ inhibitors, penicillin-binding protein (PBP) inhibitors, and ribosome inhibitors. The example is illustrated in Panel C, Figure 2.

[Insert Figure 2 here]

3.3.3 VC investment

I use three variables to measure VC investment decisions for start-up sponsor firms. The first variable, *VC Indicator*, is an indicator variable equal to one when the firm gets VC investment

in the given year, and zero otherwise. The second variable, *VC Fund Num*, is the total number of VC funds investing in the firm in the given year. The third variable, *VC Investment*, is the total funding amount of VC investment that the firm receives in the given year.

3.3.4 Control variables

To account for other firm-level determinants of VC investment that might be correlated with peer firms' failed clinical trial disclosure, I control for the following factors. First, I control for firms' research pipelines with two variables: the number of trials that the firm is conducting (*Trial Num*) and the number of conditions of the ongoing trials (*Market Num*). Next, I control for firms' research network resources with the number of the firm's industry partners that collaborate in the ongoing trials (*Partner Num*). Then, I control for firms' visibility to potential venture capitalists with the number of facilities of the firms' ongoing projects (*Facility Num*). Last, I follow prior literature (Li et al., 2021) and control for firms' age (*Age*).

3.4 Summary statistics

Table 1 presents the summary statistics for the sample from 2012 to 2021. The mean probability that a startup sponsor firm gets VC investment in a given year (*VC Indicator*) is 0.068. The average number of VC funds investing in the firm in a given year (*VC Fund Num*) is 0.085 and the average funding amount of VC investment for the firm in a given year (*VC Investment*) is 0.492 thousand. The mean value of *Disclosure Failure* is 0.057, indicating that 5.7% of firm-years in my sample experience the shock of other firms' disclosure of failed clinical trials within the same market but with different technologies. On average, my sample firm-years conduct 1.835 clinical trials, innovate for 3.586 conditions, collaborate with 0.247 industry partners, have 4.228 facilities, and have registered with the platform for 3.850 years.[10]

[10] Table 1 presents the log transformation for *VC Fund Num*, *VC Investment*, *Trial Num*, *Market Num*, *Partner Num*, *Facility Num*, and *Age*.

[Insert Table 1 here]

Table 2 presents the time trend of the result submission for successful and failed clinical trials. Panel A presents the number of successful and failed clinical trials submitting their results by each calendar year. In the pre-period (2010-2015), the number of successful clinical trials submitting their results consistently outweighed that of failed clinical trials. In the post-period (2017-2022), the number of failed clinical trials submitting their results increases sharply and exceeds that of successful clinical trials consistently.[11] Panel B presents the change in result submission from the pre-period to the post-period. After the Final Rule is implemented, the number of failed clinical trials submitting their results increases by 75.4% and the number of successful clinical trials submitting their results increases only by 19.9%. When divided based on whether the trial is sponsored by public-traded or private firms, the effects on failed result submission are similar between public and private firms, while the effects on successful ones are stronger for public firms compared with private firms.

[Insert Table 2 here]

3.5 Research design

I examine the effects of firms' disclosure of failed clinical trials on VC investment for their peer firms, who innovate in the same market but with different technologies, by estimating the following staggered difference-in-differences (DID) specification at the firm-year level:

$$VC\ Invest_{i,t} = \beta_0 + \beta_1 Disclosure\ Failure_{i,t} + Controls + \delta_i + \gamma_t + \varepsilon_{i,t} \quad (1)$$

In the equation above, i and t index firms and calendar year, respectively. The dependent variable, *VC Invest*, is either *VC Indicator*, *VC Fund Num*, or *VC Investment*. $Disclosure\ Failure_{i,t}$ is an indicator variable equal to one for firm-years if a failed clinical trial has been disclosed prior

[11] I exclude the year 2016 because the Final Rule was under discussion and got passed in 2016. Some sponsor firms expected that and started to disclose the results of their failed clinical trials.

to year *t* in the market where firm *i* is innovating, and zero otherwise.[12] *Controls* represents the vector of control variables described in Section 3.3.3, and δ_i and γ_t represent firm and calendar year fixed effects, respectively.

The coefficient on *Disclosure Failure*$_{i,t}$, β_1, captures the changes in venture capitalists' investment for peer firms (innovate in the same market but pursue different technologies from the disclosing firm) from the pre to the post disclosure of failed clinical trials relative to the changes for non-peer firms (innovate in different markets and pursue different technologies from the disclosing firm). I predict $\beta_1 > 0$, indicating that following firms' disclosure of failed clinical trials, their peer firms will be more likely to get VC investment and get larger funding amounts from a larger number of VC funds, compared to non-peer firms.

4. Main Results

4.1 Benchmark analysis: Effects of successful trial disclosure on VC investment

I first examine whether firms' disclosure of successful clinical trial results affects VC investment for their peer firms, who conduct clinical trials in the same market (condition) but with different technologies (MOAs). I replace *Disclosure Failure* with *Disclosure Success*, an indicator variable for firm-years if a successful clinical trial has been disclosed by other firms prior to year *t* in the market where firm *i* is innovating, in Eq.(1) to estimate the effects. Similar to the sample construction of examining disclosure of failed clinical trial results, I exclude firm-years pursuing the same technologies as those disclosing successful clinical trial outcomes, both for the same markets and different markets.

[12] If firm *i* has experienced more than one disclosure of peer firms' failed clinical trials in my sample period, I use the first disclosure date to measure the treatment year.

The results are presented in Table 3. The dependent variables are whether the firm gets VC investment or not (*VC Indicator*) in columns 1–2, the number of VC funds investing the firm (*VC Fund Num*) in columns 3–4, and the total funding amount of VC investment in the firm (*VC Investment*) in columns 5–6. The coefficients on *Disclosure Success* are indifferent from zero across all specifications, indicating that firms' disclosure of phased success does not have significant impact on VC investment for their peer firms innovating for the same conditions but pursuing different mechanisms from the disclosing firm, compared with those innovating for different conditions and pursuing different mechanisms from the disclosing firm. These results provide benchmark evidence that a firm's disclosure on phased success in the innovation process does not change the investing landscape for venture capitalists when they consider allocating resources to its peer firms with different technologies.

[Insert Table 3 here]

4.2 Effects of failed trial disclosure on VC investment

I next examine my main hypothesis: after firms disclose failed clinical trial results, whether VC investment increases for their peer firms who innovate for the same condition but pursue different technologies. I estimate Eq. (1) with a staggered DiD research design. The results are reported in Table 4.

Columns 1–2 show the results for the VC investment likelihood without and with control variables, respectively. Both columns report positive and significant coefficients on *Disclosure Failure* (coef. = 0.030; t-stat. = 2.52 and coef. = 0.031; t-stat. = 2.57), indicating that after a firm discloses the results of a failed clinical trial, its peer firms who innovate for the same condition but pursue different technologies are more likely to get VC investment compared with those innovating for different conditions and pursuing different technologies. Economically, the

coefficient translates into a 45.59% (0.031÷0.068=45.59%) increase relative to the sample mean. Columns 3–4 and 5–6 show the results for the number of VC funds and the funding amount of VC investment, respectively. The coefficients on *Disclosure Failure* are positive and significant, implying that after firms disclose failed clinical trial results, their peer firms receive more investment funding from a larger number of VC funds compared with non-peer firms.

[Insert Table 4 here]

The key identifying assumption underlying my DiD analysis is the parallel trends assumption. Although this assumption cannot be directly tested, I assess its validity by comparing the pre-disclosure trends in VC investment between peer firms and non-peer firms (Roberts and Whited, 2013). Figure 3 presents the estimated annual coefficients from a modified version of Eq. (1), which includes separate year indicators for the five years before and after the failed clinical trial disclosure. Year T–5 serves as the benchmark year, such that each plotted point represents the difference in VC investment between peer firms and non-peer firms relative to the difference in year T-5. Figure 3 shows no evidence of differential trends for peer firms versus non-peer firms in the years preceding year T, consistent with the parallel trends assumption being satisfied. Moreover, peer firms exhibit significant increases both in the number of VC funds and in the funding amount starting in year T compared to non-peer firms, consistent with disclosure on failed clinical trials helping venture capitalists rule out ineffective mechanisms and encouraging their investment for the remaining firms with different mechanisms.

[Insert Figure 3 here]

4.3 Cross-sectional analyses

Having established a relation between disclosure of failed clinical trials and VC investment for peer firms, I next conduct three cross-sectional tests based on market opacity, market

concentration, and knowledge stock to further support my findings.

Market opacity

Mandatory disclosure on failed clinical trials helps venture capitalists open the "black box" of the innovation process by ruling out candidates using ineffective technologies and preserving the market opportunities. The effects should benefit sponsor firms innovating in more opaque markets more, as the available information for ventral capitalists interested in these markets is more scarce, making failure disclosure a more credible signal to reduce ambiguity about the market. I measure market transparency (the flip side of market opacity) with the ratio of trials reporting their results to the total number of ongoing trials in the given market and year. I define firm-years with average market transparency over the prior three years below the sample median as *High Opacity*, and firm-years as *Low Opacity* otherwise. I re-estimate Eq. (1) separately for the high- and low-opacity groups and report the results in Panel A, Table 5.

For the tests of VC investment likelihood, the coefficient on *Disclosure Failure* is significantly positive for the high opacity group (column 1) but insignificant for the low opacity group (column 2) and the coefficient magnitude difference is significant. These results imply that following the disclosure of failed clinical trials, peer firms in opaque markets are more likely to obtain VC investment compared with those in transparent markets. Similarly, for the tests of VC fund numbers and VC investment amount, the significant coefficients concentrate in the high opacity group, indicating that peer firms innovating in more opaque markets benefit more from the mandatory disclosure of trial failure by getting more funding amount from a large number of VC funds, compared with those innovating in more transparent markets.

Market concentration

In contrast to disclosure of successful clinical trials, disclosure of failed clinical trials preserves the market opportunity for drug candidates when providing market-specific technical information. The benefit is expected to be more pronounced for sponsor firms innovating in more concentrated markets, as there is less competition in drug candidates and a higher expected payoff from becoming the dominant solution for the condition, making elimination of competing candidates more material. Following prior literature (Zhang, 2024), I measure market concentration with the sum of squared terms of each sponsor firm's clinical trials in the given market and year. I define firm-years with average market concentration above the sample median as *High Concentration*, and firm-years as *Low Concentration* otherwise. I re-estimate Eq. (1) separately for the high- and low-concentration groups and report the results in Panel B, Table 5.

For the tests of VC investment likelihood, VC fund numbers, and VC investment amount, the coefficients on *Disclosure Failure* are significantly positive for the high concentration group (columns 1, 3, and 5) but insignificant for the low concentration group (columns 2, 4, and 6), and the coefficient magnitude differences are significant. These results suggest that after firms disclose the results of their failed clinical trials, peer firms innovating in more concentered markets are more like to get VC investment and larger funding amounts from a larger number of VC funds compared to those innovating in less concentrated markets.

Knowledge stock

The mandatory disclosure of failed clinical trials helps rule out incompetent drug candidates and reduces ambiguity for ongoing clinical trials. Sponsor firms with more clinical trials in the market are viewed as stronger candidates as they accumulate more experience and

knowledge in the relevant field (Zhang, 2024). Following prior literature (Zhang, 2024), I calculate the accumulated number of clinical trials (including both completed and ongoing ones) for each sponsor firm in the given market and year to proxy for knowledge stock. Then I define firm-years with average knowledge stock above the sample median as *High Knowledge Stock*, and firm-years as *Low Knowledge Stock* otherwise. I re-estimate Eq. (1) separately for the high- and low-knowledge-stock groups and report the results in Panel C, Table 5.

For the tests of VC investment likelihood, VC fund numbers, and VC investment amount, the coefficients on *Disclosure Failure* are significantly positive for the high-knowledge-stock group (columns 1, 3, and 5) but insignificant for the low-knowledge-stock group (columns 2, 4, and 6), and the coefficient magnitude differences are significant. These results show that following a firm's disclosure of failed clinical trials, peer firms with more knowledge stocks become the next promising candidates, as they are more likely to get VC investment and more funding from a larger number of VC funds compared to those with fewer.

[Insert Table 5 here]

The findings from Table 5 indicate that, following the disclosure of failed clinical trial results, peer firms innovating in more opaque markets, in more concentrated markets, and with more knowledge stocks benefit more from VC investment. The three sets of findings are consistent with my hypothesis that the mandatory disclosure of failure in the innovation process helps venture capitalists reduce ambiguity without reducing the potential market share and therefore, venture capitalists invest more in markets with more reduction in ambiguity and more increase in expected payoff, as well as firms with higher potential.

5. Additional Analyses

5.1 Deal level analysis: Market expertise or technology expertise?

Having established evidence of an increase in VC investment following firms' disclosure of clinical trial failure for their peer firms, I next study whether the observed increase reflects a reallocation of resources within the market or external funding infuse aimed at advancing new technologies. Specifically, the increase could be driven by venture capitalists who had previously invested in unsuccessful drug candidates and are now redirecting their capital toward more promising drug candidates. Alternatively, it may be driven by venture capitalists who are familiar with new technologies and actively seek innovative solutions to the targeted condition. To examine which motivation underlies my findings, I define market expertise (*Market Expertise*) as having invested in the same market as the current deal in the past three years, and technology expertise (*Technology Expertise*) as having invested in firms employing the same technology as the current deal in the past three years. I estimate the following specification with a sample of deal–VC funds investment records in 2012-2021 for private sponsor firms:

$$Expertise_{j,t} = \alpha_0 + \alpha_1 Disclosure\ Failure_{j,t} + Controls + \delta_j + \gamma_t + \varepsilon_{j,t} \quad (2)$$

In the equation above, *j* and *t* index funds and calendar years, respectively. The dependent variable, *Expertise*, is an indicator variable for either *Market Expertise* or *Technology Expertise*. *Disclosure Failure*$_{j,t}$ is an indicator variable equal to one if fund *j* makes the investment after other firms' disclosure of failed clinical trials in year t, and zero otherwise. Controls represents the vector of control variables described in Section 3.3.3, and two deal-specific control variables, the round stage (*Round Stage*) and the number of funds participating in the deal (*Fund Num Deal*).

The results are presented in Table 6. Column 1 reports the results for *Market Expertise* and reveals an insignificant coefficient on *Disclosure Failure*, indicating that venture capitalists familiar with the market do not change their funding allocation significantly after the disclosure of

failed clinical trials. Column 2 reports the results for *Technology Expertise* and reveals a significantly positive coefficient on *Disclosure Failure*, implying that the increased investment following the disclosure of failed clinical trials is driven by venture capitalists with expertise in technologies and ambitions to apply them in new conditions.

[Insert Table 6 here]

5.2 Social welfare analysis: Technology novelty

Lack of novelty in drug development has been an ongoing concern for social welfare. The low-novelty drugs (e.g., me-too drugs) often have only minor modifications based on the pioneer drug and offer moderate clinical advantage on side effect profiles, dosing convenience, or formulation over existing treatments (Aronson and Green, 2020). Pharmaceutical firms are increasingly investing in developing and promoting these marginally different drugs. Therefore, these low-novelty drugs divert funding resources away from radical innovation, prioritize marketing over meaningful research, and burden healthcare systems with unnecessary costs while providing minimal benefit to patients (Angell, 2010). Drug novelty highly relies on their mechanisms of action, which is the determinant in "first-in-class drug" evaluation by the FDA (Osipenko et al., 2024).

A salient friction impeding sponsor firms from engaging in radical innovation is the huge risk and firms' inability to bear the risk. The case is more severe for financial-constrained private sponsor firms (Krieger et al., 2022). Venture capitalists share the risk with start-up firms and obtain the risk premium from "winners" in their portfolios, who will be acquired or go public in the future. The mandatory disclosure of failed clinical trial results reduces the ambiguity in the market and helps venture capitalists evaluate the remaining candidates who pursue technologies different from

the failed ones more confidently. Therefore, the novelty will be supported to a greater extent with venture capitalists' risk-sharing characteristics.

In contrast, such encouraging effects on technology novelty can not be achieved with the mandatory disclosure of successful innovation outcomes. Prior literature widely documents that such disclosure in the patent application setting spurs follow-on innovations and increases technology similarity across innovations (Kim and Valentine, 2021; Hegde et al., 2022; Dyer et al., 2023). In the clinical trial setting, I hypothesize that disclosure of successful clinical trials will discourage drug novelty, i.e., the exploration of new MOAs. If one MOA is proved effective, the market for certain conditions will be narrower and the bar for new drug approval will be higher for other drug candidates with different MOAs. Conditional on this, developing similar drugs with marginal improvements based on the successful ones will be less risky, less costly, and more likely to get approval compared with developing drugs with totally different MOAs.

I then explore the effects of mandatory disclosure of clinical trial failure on drugs' technology novelty empirically. I define MOAs in the clinical trials as novel if they have not been used for certain conditions before and use both an indicator (*New MOA Indicator*) and the number of them (*New MOA Num*) as my measures. To further examine whether the change in drugs' technology novelty following the disclosure of failed clinical trials is supported by venture capitalists' investment, I use three measures for VC support: an indicator variable for whether any venture capitalists invest in the given condition and year (*VC Backed Indicator*), the number of VC funds investing in the given condition and year (*VC Backed Fund Num*), and the total funding amount of VC investment in the given condition and year (*VC Backed Investment*). I estimate the following specification with a sample of clinical trial–conditions registered by firms in 2012-2021:

$$New\ MOA_{m,n} = \alpha_0 + \alpha_1 Disclosure\ Failure_{m,n} + \delta_m + \gamma_n + \varepsilon_{m,n} \quad (3a)$$

$$New\ MOA_{m,n} = \alpha_0 + \alpha_1 Disclosure\ Failure_{m,n} \times VC\ Backed_{m,n} + \alpha_2 VC\ Backed_{m,n} + \delta_m + \gamma_n + \varepsilon_{m,n} \quad (3b)$$

In the equation above, *m* and *n* index clinical trials and conditions, respectively. The dependent variable, *New MOA*, is either *New MOA Indicator* or *New MOA Num*. *Disclosure* $Failure_{m,n}$ is an indicator variable equal to one if clinical trial *m* is registered after competing firms' disclosure of a failed clinical trial for condition *n*, and zero otherwise. *VC Backed* is either *VC Backed Indicator*, *VC Backed Fund Num*, or *VC Backed Investment*. δ_m and γ_n represent clinical trial and condition fixed effects, respectively.[13]

I first examine whether the disclosure of successful clinical trial results reduces newly registered clinical trials' MOA novelty. I replace *Disclosure Failure* with *Disclosure Success*, an indicator variable equal to one if clinical trial *m* is registered after competing firms' disclosure of a successful clinical trial for the condition *n* in Eq.(4a) to estimate the effects. The results are presented in Panel A, Table 7. Columns 1 and 2 show negative and significant coefficients on *Disclosure Success*, indicating that after a new MOA proves to be effective, peer sponsor firms are less likely to explore different new MOAs compared with non-peer firms.

I next examine the effects of failed clinical trial disclosure on newly registered clinical trials' MOA novelty by estimating Eq.(4a) and the effects of VC support in moderating this relationship by estimating Eq.(4b). The results are reported in Panel B, Table 7. Columns 1–4 show the results with the new MOA indicator as the dependent variable. Column 1 shows the results for the overall effects of failed clinical trial disclosure on newly registered clinical trials' MOA novelty. The significantly positive coefficients indicate that after an MOA proves ineffective in a public disclosure, peer sponsor firms are more likely to explore different new MOAs. Columns 2–4 show the results for the moderating effects of VC support. The significantly positive coefficients on the interactions between disclosure and VC support variables (*VC Backed Indicator, VC Backed Fund*

[13] Controls are not included because I include clinical trial and condition fixed effects. The strict fixed effect structure subsumes the control variables I include in prior sections.

Num, and *VC Backed Investment*) suggest that the increase in MOA novelty is driven by markets with VC investment, with more VC fund concentration, and greater VC investment funding amount. Columns 5–8 show the results with new MOA numbers as the dependent variable, which are similar to the findings in columns 1–4.

[Insert Table 7 here]

Summing up, the results in Table 7 provide evidence on how mandatory disclosure on the failed (successful) results of clinical trials affects technology novelty in the innovation process. In contrast to successful result disclosure, which significantly reduces MOA novelty of the newly registered clinical trials, failed result disclosure significantly encourages the exploration of different MOAs. And such exploration is largely driven by the support from venture capitalists.[14]

5.3 Deal quality analysis: IPOs and M&As

Next, I investigate the quality of VC investments facilitated by competing firms' disclosure of their failed clinical trials' results. Going public and being acquired by dominant firms are two main cashing-out exit strategies for venture capitalists (Lemley and McCreary, 2021). I examine the likelihood and the return of both exit strategies. If the VC investment deal identifies promising candidates and promotes their development successfully, venture capitalists are more likely to exit through the investee's IPO or being acquired by dominant firms instead of recapitalization (Cumming 2008; Gompers et al., 2020). Conditional on that, successful investment deals obtain higher returns for the venture capitalists in the IPO and acquisitions.

I start with the likelihood and the return of IPOs. First, I examine whether investee firms in the deals following competing firms' disclosure of failed clinical trials are more likely to go

[14] One possible outcome of mandatory disclosure on innovation outcomes is inventors' reduction in R&D due to proprietary costs. I do not find a significant decline in the number of newly registered clinical trials in the market with disclosure of failed clinical trials compared with those without.

public. I define an indicator variable, *IPO*, equal to one if the investee firm goes public as of January 1, 2025, and zero otherwise. Second, I examine whether investee firms in the deals following competing firms' disclosure of failed clinical trials generate higher returns in the IPO for venture capitalists. SEC requires the IPO firms to disclose the names and share numbers of beneficial owners with 5% or more of the firm's shares in S-1 filings. I match VC funds' names with those of beneficial owners and get their pre-IPO shareholdings. I calculate the first day return as the closing price of the IPO day times the number of shares owned by the VC fund, divided by its investment before the IPO. As there is no mandatory disclosure requirement on VC funds' exit dates, I collect the length of lock-up period disclosed in the S-1 filings and calculate the post lock-up period return as the closing price of the first trading day after the lock-up period times the number of shares owned by the VC fund divided by its investment before the IPO. I replace the dependent variable with measures of the likelihood and return of IPO and re-estimate Eq.(2).

The results are presented in Panel A, Table 8. Column 1 shows the result for the likelihood of IPO, with a positive and significant coefficient on *Disclosure Failure*. This result implies that venture capitalists are more likely to exit through investee firms' IPO in the deals made after other firms' disclosure of failed clinical trials. Columns 2–3 show the results for the return of IPO, with positive and significant coefficients of *Disclosure Failure* for the IPO day return and post lock-up period return. These results indicate that venture capitalists obtain higher returns from the IPOs of their investee firms in the deals made after other firms' disclosure of failed clinical trials.

Then I explore the likelihood and return of being acquired. Similar to the IPO test, I define an indicator variable, *M&A Target*, equal to one if the investee firm is acquired by other firms as of January 1, 2025, and zero otherwise. To examine whether the M&A transaction generates profit for venture capitalists, I follow prior literature (Yao and O'Neill, 2022) and define an indicator

variable, *M&A Profit*, equal to one if the deal value is larger than the total amount of funds invested in the firm, and zero otherwise. I replace the dependent variable with measures of the likelihood and the return of M&A transactions and re-estimate Eq.(2).

The results are presented in Panel B, Table 8. Columns 1 and 2 show the results for the likelihood and the profitability of M&A transactions, respectively. The positive and significant coefficients on *Disclosure Failure* in both columns suggest that investee firms in the deals following other firms' disclosure of failed clinical trials are more likely to get acquired and more likely to generate positive returns for venture capitalists in the acquisition transactions.

[Insert Table 8 here]

In sum, the results in Table 8 demonstrate that the mandatory disclosure of failed clinical trials provides material information for venture capitalists to screen candidates and therefore, increases their investment deals' quality, proxied with the likelihood and returns of successful exit.

5.4 Effects on firms' disclosure of failed clinical trials

Mandatory disclosure of failed clinical trials changes the landscape of VC investment and increases the social welfare and the welfare of venture capitalists by improving technology novelty and deal returns. Next, I explore the effects of the disclosure regulation on firms' voluntary disclosure policies to provide further evidence supporting my main findings.

Mandatory disclosure regulation could have a positive impact on firms' voluntary disclosure (Enache et al., 2022). If sponsor firms are required to report their clinical trials' results, they are more likely to increase their transparency in voluntary disclosure to reduce litigation risk and build credibility with investors (e.g., Houston et al., 2019; Gu and Li, 2007). I analyze two voluntary disclosure channels: SEC filings and press release. I search for clinical-trial-result-

related disclosure and analyze whether its failure component increases after the Final Rule implementation. I estimate the following specification with a sample of firm-years in 2012-2021[15]:

$$Voluntary\ Failure\ Disclosure_{i,t} = \alpha_0 + \alpha_1 Post\ Final\ Rule_t + \delta_i + \varepsilon_{i,t} \quad (4)$$

In the equation above, *i* and *t* index firms and calendar years, respectively. The dependent variable, *Voluntary Failure Disclosure*, is the number of failed result disclosures in SEC filings (*SEC Failure Disclosure*) and in press release (*Press Release Failure Disclosure*).[16] *Post Final Rule* is an indicator variable equal to one if the year is 2017 or later, and zero otherwise. The results are reported in Table 9.

Columns 1–3 report positive and significant coefficients on *Post Final Rule*, suggesting that sponsor firms are more likely to report their failed clinical trial results in SEC filings and press release. These results also help address the concern that sponsor firms already widely and voluntarily disclose their failed clinical trials' results through other channels instead of ClinicalTrials.gov, and my findings are just coincidental with the VC investment response to these voluntary disclosures. The increased transparency of failed clinical trials' results in voluntary disclosure lends more support to the material impact of mandatory disclosure and addresses the concern of information disclosure in other channels.

[Insert Table 9 here]

5.5 Falsification test: Zombie clinical trials

One concern of my findings is that venture capitalists, especially those specialized in the pharmaceutical industry, rely on their private information networks instead of public disclosure to learn from clinical trial outcomes. If it is the case, the effects documented above just coincide with

[15] The sample size is smaller than the main analysis in Table 4, as I only include public-traded U.S. firms, which are the major filers of SEC filings and users of press release.
[16] The results hold if I include the number of terminated trial disclosure.

the investment decisions induced by their private information. However, it still supports the investment relevance of information embedded in failed clinical trials for their peer firms. Moreover, the large number of private sponsor firms and the high searching friction impede venture capitalists from being fully aware of every trial failure in their interested areas. Prior literature (Breuer, 2021; Ortiz et al., 2023; Baik et al., 2025) shows that venture capitalists need to learn information from public disclosure and mandatory disclosure regulation will significantly increase their target range.

To address the concern empirically, I use zombie clinical trials to further assure the effects of mandatory public disclosure. Zombie clinical trials refer to registered clinical trials with no follow-ups on outcomes from the sponsor firms and are regarded as discarded (Li et al., 2023). Even well-established data vendors (e.g., Cortellis) can not get the accurate date and reasons for the discard and code them as "No Development Reported". If venture capitalists have stronger private information networks to learn from trial failure and do not need public disclosure, the market should observe changes in VC investments following zombie clinical trials' completion dates. I define clinical trials completed before 2016 without result submission and each sponsor firm not starting a new clinical trial in the same market and latter phase following their completion as zombie trials. Similar to the definition of *Disclosure Failure*, *Zombie Completion* is an indicator variable equal to one for firm-years if a zombie clinical trial is completed prior to year *t* in the market where firm *i* is innovating, and zero otherwise. I replace *Disclosure Failure* with *Zombie Completion* and re-estimate Eq.(1) with a firm-year sample from 2007-2016.

The results are presented in Table 10. The coefficients on *Zombie Completion* are insignificant in columns 1–4 and even significantly negative in columns 5–6, indicating that

venture capitalists' private networks are not sufficient compared with public disclosure of failed clinical trials. Table

[Insert Table 10 here]

5.6 Robustness Tests

I conduct several tests to assess the robustness of my main results. First, to alleviate the concerns regarding biased estimates in the presence of treatment effect heterogeneity raised in the staggered DiD research design (Goodman-Bacon 2021; Baker et al., 2022), I adopt a stacked DiD specification. I first construct stacked DiD cohorts. For each year in which the results of failed clinical trials are disclosed, I construct a cohort of treated firms and control firms using firm-year observations for the 5 years before and the 5 years after the disclosure. Treatment firms are those that innovate in the same market as the failed clinical trials but pursue different technologies. Control firms are those who (i) innovate in different markets and pursue different technologies from the failed clinical trials and (ii) never experience any disclosure of failed clinical trials in their markets from 2012 to 2023. This procedure results in three cohorts (treatment years 2017, 2018, and 2019) over my sample period, each representing a year in which the failed clinical trials are disclosed. I stack these cohorts across all years and estimate a firm-cohort-year panel regression. The results, shown in Panel A, Table 11, indicate that my findings are not affected by the biased estimates stemming from treatment effect heterogeneity in the staggered DiD research design.

Second, to ensure my results are not sensitive to the definition of markets (conditions), I use the second level of MeSH terms as an alternative definition for markets. The results, shown in Panel B, Table 11, indicate that my findings are robust across definitions of markets.

I next use alternative sample windows around the Final Rule implementation in 2017 to test the robustness of my main analysis. Specifically, I repeat my analysis using 3 years and 7 years

before and after the Final Rule implementation. The results, shown in Table 12 Panel C, are consistent with my main findings based on 5 years before and after the Final Rule implementation.

In the end, I follow Hegde et al. (2022) and match each treatment firm with its "twin" firm, who pursues the same technology as the *treatment* firm but innovate in different markets from the *treatment* firm in the same year, and then use the matched "twin" firms as my control group. The results, shown in Panel D, Table 11, indicate that my findings are robust with more rigorous control group construction.

[Insert Table 11 here]

6. Conclusion

Innovation is of critical importance to economic growth. However, its process remains a "black box" for external investors and leads to high friction for its financing. This study leverages a unique regulation shock which opens the black box by mandating disclosure of failed attempts in the process and explores whether disclosure of innovation failure is value-relevant for venture capitalists, a key source for innovation funding. I hypothesize that in the context of clinical trials, disclosure of failed trials reduces ambiguity for venture capitalists by eliminating ineffective mechanisms from the set of possibilities, narrowing the range of unknowns, and clarifying the scientific landscape for the condition and therefore increases their investment for the remaining candidates with different technologies. I find consistent evidence and the effects are more significant when the disclosure is more material and impactful: when the market is more opaque, when the market is more concentrated, and when the firm has more knowledge stock. In further analyses, I find that the increase in VC investment is driven by venture capitalists with technology expertise instead of those with market expertise. I also find that, in contrast to disclosure of

successful clinical trials, which reduces technology novelty in the following trials, disclosure of failed clinical trials encourages technological novelty. Such disclosure also generates more profitable exits for venture capitalists. These results suggest that such disclosures can reduce ambiguity, mitigate financing frictions, and encourage radical exploration.

This study contributes to the literature in three main ways. First, it shifts the focus from prior literature on the disclosure of successful innovation outcomes to the largely overlooked innovation process, which is essential yet unobservable. By leveraging a regulatory shock that mandates disclosure of innovation failure, this study opens the "black box" of the innovation process and provides evidence that such disclosures reduce ambiguity, alleviate financing frictions, and encourage more radical technological exploration. Second, it extends the literature on ambiguity aversion theory by providing empirical evidence that learning from past observations can alleviate such aversion and differentiating varied effects of past observations with varied characteristics (failure vs. success). Third, it contributes to the literature on target screening of venture capitalists by showing the spillover effects of peer firms' disclosure.

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Appendix A
Variable definitions

This table describes the variables used in the analyses. Data come from ClinicalTrials.gov, Cortellis, and SDC-Private Equity. Continuous variables are winsorized at the 1st and 99th percentiles.

Firm-year level variables:

Variable	Definition
VC Indicator	Indicator equal to one when the firm gets VC investment in the given year, and zero otherwise
VC Fund Num	The natural log of one plus the total number of VC funds that invest in the firm in the given year.
VC Investment	The natural log of one plus the total funding amount of VC investment.
Disclosure Failure	Indicator variable equal to one for firm-years if a failed clinical trial has been disclosed prior to year *t* in the market where firm *i* is innovating, and zero otherwise.
Disclosure Success	Indicator variable equal to one for firm-years if a successful clinical trial has been disclosed prior to year *t* in the market where firm *i* is innovating, and zero otherwise.
Zombie Completion	Indicator variable equal to one for firm-years if a zombie clinical trial is completed prior to year *t* in the market where firm *i* is innovating, and zero otherwise.
SEC Failure Disclosure	Number of failed result disclosures in SEC filings. Specifically, I search for clinical trials and failure-related keywords (within proximity of 10 words) without modal verbs in between in firms' 10-Ks, 10-Qs, and 8-Ks. *SEC Failure Disclosure* equals the annual frequency of "clinical trials". Failure related keywords are "fail", "failure", "not succeed", "not achieve", "not meet endpoint", "flop", "negative outcome", "lack of", "insignificant", "insufficient", "ineffective", "unsuccessful", "unable".
Press Release Failure Disclosure	Number of press release with failed result disclosures. I use the same search rules of *SEC Failure Disclosure* in press release's headlines.
Trial Num	Number of trials that the firm is conducting in the given year.
Market Num	Number of conditions of the ongoing trials conducted by the firms in the given year.
Partner Num	Number of the firm's industry partners that collaborate in the ongoing trials in the given year.
Facility Num	Number of facilities of the firms' ongoing projects in the given year.
Age	Years since the first registration year of the firm.
Post Final Rule	Indicator variable equal to one if the year is 2017 or later, and zero otherwise.

Deal-VC fund level variables:

Variable	Definition
Market Expertise	Indicator variable equal to one if the VC fund has invested in the same market as the current deal in the past three years, and zero otherwise.
Technology Expertise	Indicator variable equal to one if the VC fund has invested in firms employing the same technology as the current deal in the past three years, and zero otherwise.
IPO	Indicator variable equal to one if the investee firm goes public, and zero otherwise.
IPO Day Return	Closing price of the IPO day times the number of shares owned by the VC fund, divided by its investment before the IPO.

Deal-VC fund level variables (continued):

Variable	Definition
Post Lock-Up Return	Closing price of the first trading day after the lock-up period times the number of shares owned by the VC fund, divided by its investment before IPO.
M&A Target	Indicator variable equal to one if the investee firm is acquired, and zero otherwise.
M&A Profit	Indicator variable equal to one if the deal value is larger than the total funding amount invested in the firm, and zero otherwise.
Disclosure Failure	Indicator variable equal to one if the fund makes the investment after competing firms' disclosure of failed clinical trials, and zero otherwise.
Round stage	Number of the round stage.

Clinical trial-market level variables:

Variable	Definition
New MOA Indicator	An indicator variable equal to one if at least one mechanism of action (MOA) in the clinical trial has never been used for the trial's targeted condition before the trial's submission date, and zero otherwise.
New MOA Num	Number of mechanisms of action (MOAs) in the clinical trial that have never been used for the trial's condition before the trial's submission date.
Disclosure Failure	Indicator variable equal to one if the clinical trial is registered after competing firms' disclosure of a failed clinical trial for the condition, and zero otherwise.
Disclosure Success	Indicator variable equal to one if the clinical trial is registered after competing firms' disclosure of a successful clinical trial for the condition, and zero otherwise.

Appendix B

Anecdotal Evidence of Learning from Failure

Epacadostat's Failure and Cross-Technology Learning in Melanoma Drug Development

In April 2018, Incyte Corporation announced that the Phase III ECHO-301 trial, which tests Epacadostat (an IDO1 inhibitor) in combination with the PD-1 inhibitor pembrolizumab, had failed to improve progression-free survival in patients with unresectable or metastatic melanoma.

The failure of Epacadostat served as a disambiguating event for other firms developing melanoma therapies. For developers of other immunotherapy platforms, the Epacadostat failure offered strategic differentiation. By clearly demonstrating that marginal immune modulators with limited mechanistic depth could not meaningfully improve outcomes, the failure increased the perceived value and credibility of mechanistically distinct, more robust immunologic strategies.

Different from IDO1 inhibition based on a single-enzyme, tumor-extrinsic mechanism, mRNA-4157 uses personalized neoantigen delivery to directly activate patient-specific T cell responses. Epacadostat's failure reveals the limits of non-specific immune enhancement and increases confidence in antigen-specific and adaptive immune strategies. Moderna and Merck, already in early development, continued with greater certainty, ultimately achieving positive Phase II results by 2022.

TIL therapy, developed by Iovance, offers a fundamentally different approach from enzymatic immune modulation, relying on the direct reinfusion of expanded tumor-reactive lymphocytes. Rather than attempting to reshape the immune environment, as Epacadostat did, TIL therapy delivers high-potency effector cells derived from the patient's tumor. The failure of IDO1 inhibitors reveals the challenge of reprogramming dysfunctional immunity within the tumor microenvironment, thereby boosting confidence in more aggressive, cell-based strategies. Following promising response rates in post-checkpoint inhibitor patients, Iovance's Lifileucel received FDA accelerated approval in 2024, solidifying TIL therapy as a viable option for advanced melanoma and validating its mechanistic distinctiveness.

In sum, the Epacadostat failure reduced ambiguity not just about one drug, but about a whole class of immuno-oncology strategies. By eliminating implausible models and recalibrating prior beliefs, it enabled more disciplined trial design and capital deployment across melanoma therapeutics. It illustrates how learning from failure can generate systemic clarity, especially in innovation domains characterized by high model uncertainty and biological complexity.

Figure 1
Illustration of Identification Strategy

Figure 1 illustrates the identification strategy. Firms innovating in the same market as the failed clinical trial but pursuing different technologies from the failed clinical trial are my treated firms (the blue textbox in the upper right corner). Firms innovating in different markets and pursuing different technologies from the failed clinical trials are my control firms (the blue textbox in the bottom right corner). Firm-years with at least one technology the same as the failed trials, both in the same market and in different markets, are excluded (the red textboxes on the left).

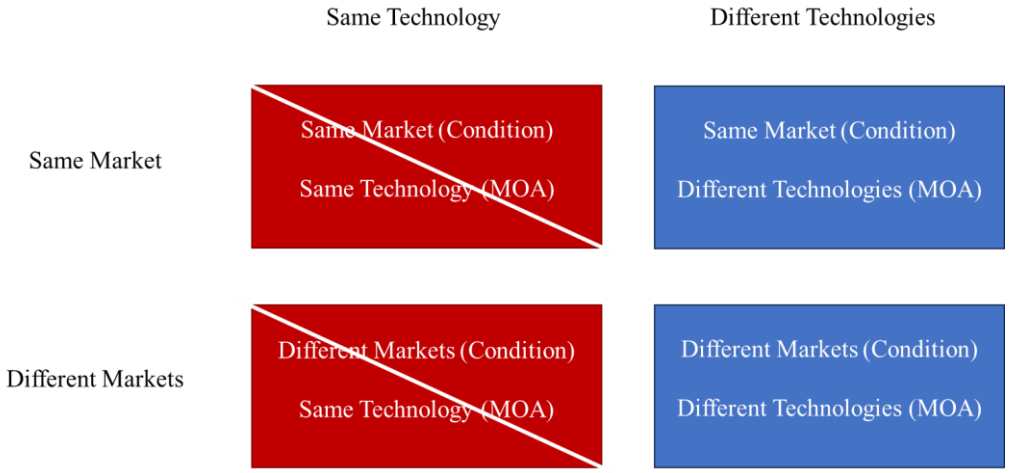

Figure 2
Examples of conditions, MOAs, and their bipartite relationship

Figure 2 gives examples of the MeSH term tree, MOA structure, and their bipartite relationship. Panel A shows the MeSH tree structure of bacterial pneumonia. Panel B shows the MOA structure of DNA Gyrase (Bacterial) Inhibitors. Panel C shows the bipartite relationship between bacterial pneumonia and DNA Gyrase (Bacterial) Inhibitors.

Panel A: MeSH tree structure of bacterial pneumonia

Infections [C01]
Respiratory Tract Infections [C01.748]
Pneumonia [C01.748.610]
Bronchopneumonia [C01.748.610.127]
Healthcare-Associated Pneumonia [C01.748.610.300]
Pleuropneumonia [C01.748.610.473]
Pneumonia, Aspiration [C01.748.610.529]
Pneumonia, Bacterial [C01.748.610.540]
Pneumonia, Necrotizing [C01.748.610.608]
Pneumonia, Pneumocystis [C01.748.610.675]
Pneumonia, Viral [C01.748.610.763]

Panel B: MOA structure of DNA Gyrase (Bacterial) Inhibitors

DRUGS ACTING ON BACTERIAL PROTEINS
Anti-Diphteria Toxin (Corynebacterium diphtheriae)
Anti-IHF (Integration Host Factor) (Bacterial)
Carbonic Anhydrase (Bacterial) Inhibitors
Cell Division Protein FtsZ (Bacterial) Inhibitors
Chlamydia Protease-Like Activity Factor (cPAF) Inhibitors
DNA Gyrase (Bacterial) Inhibitors
DNA Topoisomerase (Bacterial) Inhibitors
Dihydrofolate Reductase (DHFR) (Bacterial) Inhibitors
Dihydrofolate Reductase (DHFR) (Mycobacterium ulcerans) Inhibitors
Drugs Targeting Acinetobacter baumannii Proteins
Drugs Targeting Bacillus anthracis Proteins
Drugs Targeting Bacteroides fragilis Proteins
Drugs Targeting Borrelia burgdorferi Proteins
Drugs Targeting Campylobacter jejuni Proteins
Drugs Targeting Clostridium botulinum Proteins
Drugs Targeting Clostridium difficile Proteins
Drugs Targeting Clostridium tetani Proteins
Drugs Targeting Escherichia coli Proteins
Drugs Targeting Helicobacter pylori Proteins
Drugs Targeting Klebsiella pneumoniae Proteins
Drugs Targeting Lipopolysaccharide (LPS) (Bacterial)

Figure 2 (continued)

Panel C: Bipartite relationship between bacterial pneumonia and DNA Gyrase (Bacterial) Inhibitors

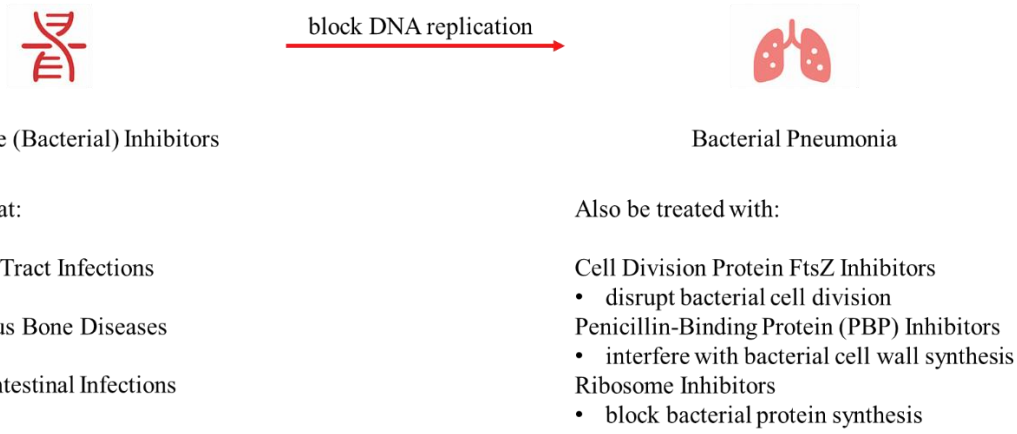

Figure 3
VC investment for peer firms and non-peer firms after disclosure of failed clinical trials by year

This figure provides a visual representation of the effect of firms' disclosure of failed clinical trials on VC investment for their peer firms who innovate in the same market but pursue different technologies. The x-axis represents time by calendar year. In Panel A, the y-axis represents the effect on the number of VC funds investing in the firm in a given year. In Panel B, the y-axis represents the effect on the funding amount of VC investment received by the firm in a given year. A modified Eq. (1) is estimated where *Disclosure Failure* is replaced with separate indicators for 5 years before and after the failed clinical trial disclosure. The coefficients are plotted along with a 90% confidence interval, calculated based on standard errors clustered at the firm level. Note that T-5 has a coefficient of zero and no confidence interval because it serves as the benchmark period. Hence, the plotted coefficients capture the difference in the number of VC funds (the funding amount of VC investment) for peer firms and non-peer firms in each year relative to the difference in year T-5.

Panel A: Effects of firms' disclosure of failed clinical trials on the number of VC funds investing in their peer firms

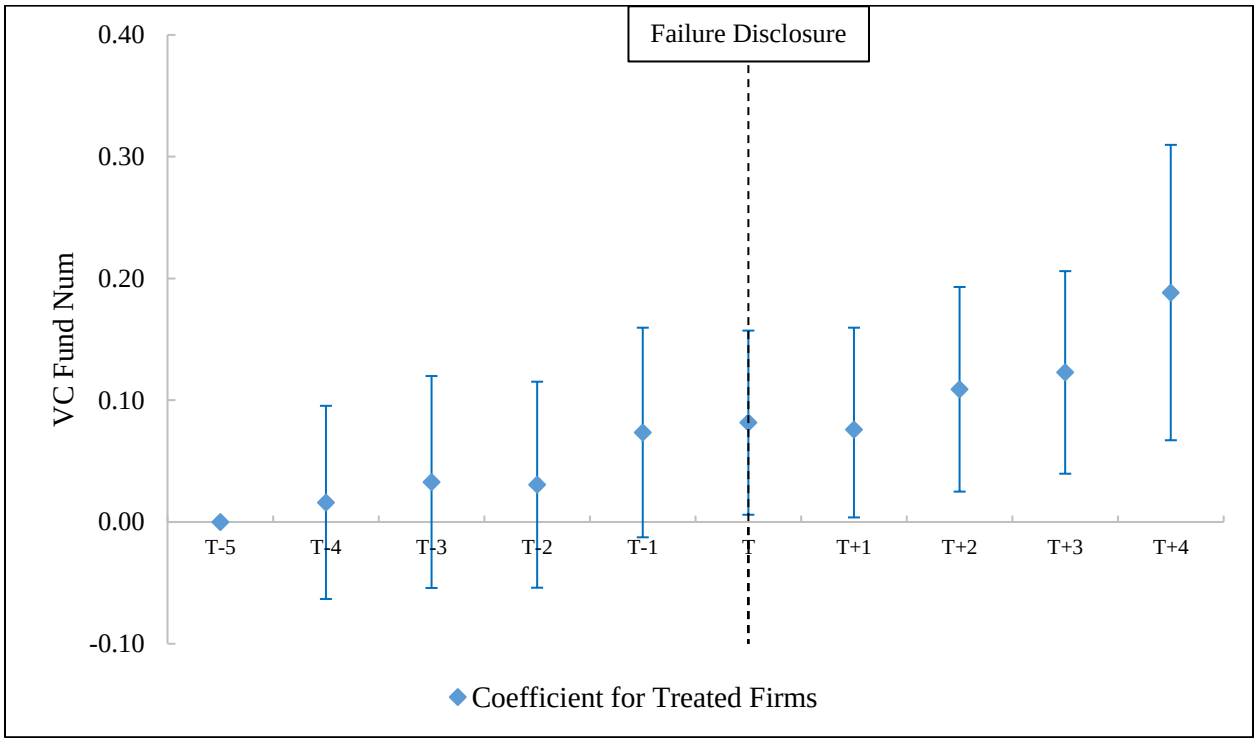

Figure 3 (continued)

Panel B: Effects of firms' disclosure of failed clinical trials on the funding amount of VC investment in their peer firms

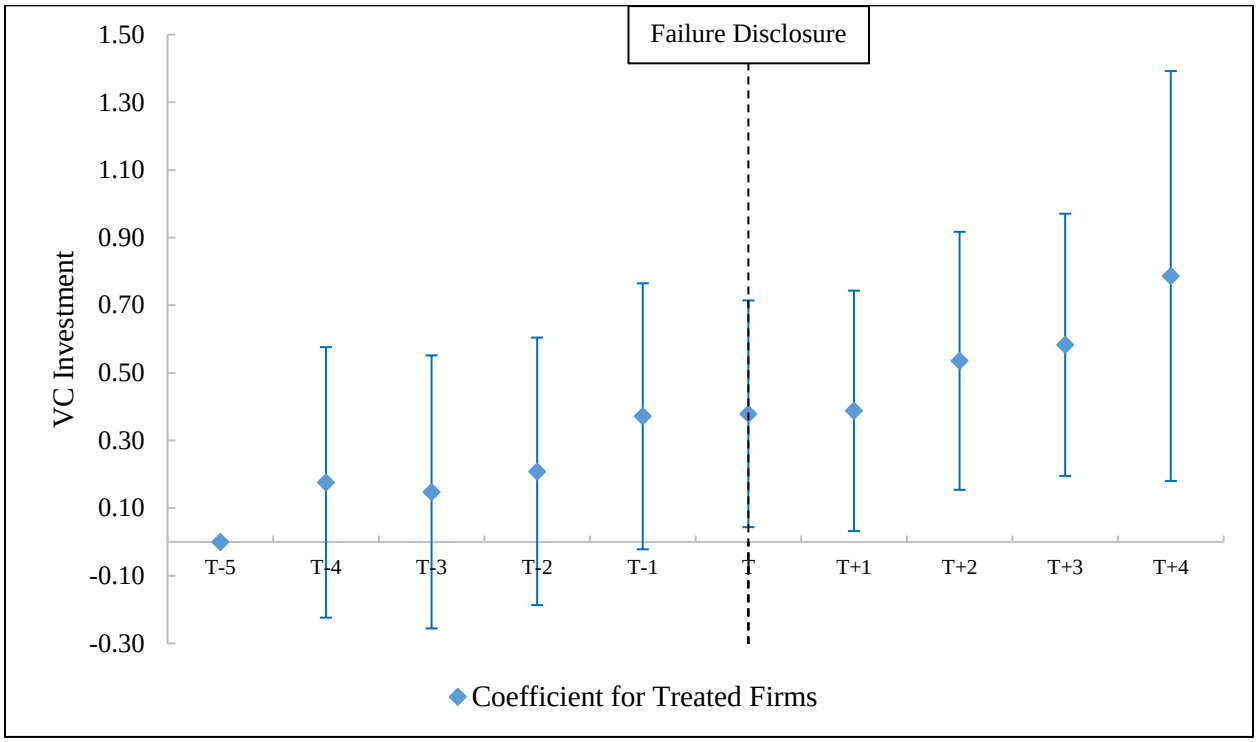

Table 1
Summary statistics

This table presents summary statistics for the sample and variables of interest. The sample consists of firm-year observations, clinical trial observations, and investment round–VC fund observations with the required data from 2012-2021. Details of variable construction are contained in Appendix A.

Variables	N	Mean	SD	P25	P50	P75
Firm-Year Level Analysis:						
VC Indicator	19,318	0.068	0.252	0.000	0.000	0.000
VC Fund Num	19,318	0.082	0.328	0.000	0.000	0.000
VC Investment	19,318	0.400	1.625	0.000	0.000	0.000
Disclosure Failure	19,318	0.057	0.231	0.000	0.000	0.000
Trial Num	19,318	1.042	0.525	0.693	1.099	1.386
Market Num	19,318	1.523	0.708	1.099	1.609	1.946
Partner Num	19,318	0.221	0.391	0.000	0.000	0.693
Facility Num	19,318	1.654	1.166	0.693	1.386	2.565
Age	19,318	1.579	0.783	1.099	1.792	2.197
Trial Level Analysis:						
New MOA Indicator	73,050	0.072	0.293	0.000	0.000	0.000
New MOA Num	73,050	0.062	0.242	0.000	0.000	0.000
Disclosure Failure	73,050	0.494	0.500	0.000	0.000	1.000
VC Market Indicator	73,050	0.922	0.268	1.000	1.000	1.000
VC Market Fund Num	73,050	2.148	1.039	1.386	2.303	2.944
VC Market Investment	73,050	8.973	3.165	8.608	9.890	10.810
Deal Level Analysis:						
Market Expertise	4,685	0.873	0.333	1.000	1.000	1.000
Technology Expertise	4,685	0.156	0.363	0.000	0.000	0.000
IPO	4,685	0.035	0.185	0.000	0.000	0.000
IPO Day Return	321	0.955	1.830	0.165	0.316	0.698
Post Lock-Up Return	321	2.281	8.823	0.096	0.272	0.514
M&A Target	4,685	0.168	0.374	0.000	0.000	0.000
M&A Profit	503	0.155	0.362	0.000	0.000	0.000
Disclosure Failure	4,685	0.058	0.234	0.000	0.000	0.000
Trial Num	4,685	1.156	0.491	0.693	1.099	1.386
Market Num	4,685	1.537	0.657	1.099	1.386	1.946
Partner Num	4,685	1.203	0.740	0.693	1.099	1.792
Facility Num	4,685	0.129	0.292	0.000	0.000	0.000
Age	4,685	2.072	1.119	1.099	2.079	2.944
Round Num	4,685	5.803	4.087	3.000	5.000	8.000
Party Num	4,685	4.577	3.145	2.000	4.000	6.000

Table 2
Result submission of successful and failed clinical trials

This table presents the time trend of result submission for successful and failed clinical trials. Panel A presents the numbers of clinical trials with result submission in the year for successful trials and failed trials, respectively. Panel B compares the average number of clinical trials with result submission in the year for successful trials and failed trials during the pre-period (2011-2015) and the post-period (2017-2022), respectively.

Panel A: Numbers of clinical trials with result submission by year

	Clinical Trials					
	Successful			Failed		
Year	Total	Public	Private	Total	Public	Private
2010	248	105	143	165	57	108
2011	241	72	169	165	61	104
2012	262	77	185	170	72	98
2013	304	68	236	220	53	167
2014	339	103	236	277	74	203
2015	323	120	203	238	103	135
2017	390	134	256	394	96	298
2018	328	125	203	359	109	250
2019	312	124	188	337	121	216
2020	360	142	218	369	127	242
2021	363	152	211	377	133	244
2022	306	148	158	330	133	197

Panel B: Changes in the numbers of clinical trials with result submission from the pre- to the post-period

	Clinical Trials					
	Successful			Failed		
Year	Total	Public	Private	Total	Public	Private
2010-2015	286.17	90.83	195.33	205.83	70.00	135.83
2017-2022	343.17	137.50	205.67	361.00	119.83	241.17
% Change	**19.9%**	**51.4%**	**5.3%**	**75.4%**	**71.2%**	**77.5%**

Table 3
Benchmark analysis: Effects of successful trial disclosure on VC investment

This table presents the results for the effects of firms' disclosure of successful clinical trials affect VC investment for focal firms, who conduct clinical trials in the same market (condition) but with different technologies (MOAs). The sample consists of firm-year observations during calendar years 2012-2021. The dependent variable in columns 1-2, *VC Indicator*, equals one when the firm receives VC investment in the given year, and zero otherwise. The dependent variable in columns 3-4, *VC Fund Num*, equals the total number of VC funds that invest in the firm in the given year. The dependent variable in columns 5-6, *VC Investment*, equals the total funding amount of VC investment that the firm receives in the given year. *Disclosure Success* is an indicator variable equal to one for firm-years if a successful clinical trial has been disclosed prior to year *t* in the market where firm *i* is innovating, and zero otherwise. All variables are defined in Appendix A. The *t*-statistics are reported below coefficient estimates in parentheses and are calculated based on standard errors clustered by firm. *, **, *** indicate statistics significance at the 0.10, 0.05, and 0.01 levels, respectively, using a two-tailed *t*-test.

Dependent variable:		*VC Indicator*		*VC Fund Num*		*VC Investment*	
	Pr. sign	(1)	(2)	(3)	(4)	(5)	(6)
Disclosure Success	0	0.007	0.008	0.014	0.014	-0.005	-0.006
		(0.61)	(0.68)	(0.88)	(0.92)	(-0.06)	(-0.08)
Trial Num			0.008		0.009		-0.018
			(0.88)		(0.75)		(-0.30)
Market Num			-0.002		0.001		0.045
			(-0.39)		(0.09)		(1.13)
Partner Num			-0.016		-0.025		-0.113
			(-1.29)		(-1.54)		(-1.33)
Facility Num			0.001		0.001		0.024
			(0.16)		(0.12)		(0.81)
Age			-0.005		-0.003		-0.012
			(-0.69)		(-0.34)		(-0.30)
Year FE		Yes	Yes	Yes	Yes	Yes	Yes
Firm FE		Yes	Yes	Yes	Yes	Yes	Yes
S.E. clustered by firm		Yes	Yes	Yes	Yes	Yes	Yes
No. of observations		19,880	19,880	19,880	19,880	19,880	19,880
Adj. R-Squared		0.403	0.403	0.378	0.378	0.356	0.356

Table 4
Effects of failed trial disclosure on VC investment

This table presents the results for the effects of firms' disclosure on failed clinical trials on VC investment in their peer firms, who conduct clinical trials in the same market (condition) but with different technologies (MOAs). The dependent variable in columns 1-2, *VC Indicator*, equals one when the firm receives VC investment in the given year, and zero otherwise. The dependent variable in columns 3-4, *VC Fund Num*, equals the total number of VC funds that invest in the firm in the given year. The dependent variable in columns 5-6, *VC Investment*, equals the total funding amount of VC investment that the firm receives in the given year. The sample consists of firm-year observations during calendar years 2012-2021. *Disclosure Failure* is an indicator variable equal to one for firm-years if a failed clinical trial has been disclosed prior to year *t* in the market where firm *i* is innovating, and zero otherwise. All variables are defined in Appendix A. The *t*-statistics are reported below coefficient estimates in parentheses and are calculated based on standard errors clustered by firm. *, **, *** indicate statistics significance at the 0.10, 0.05, and 0.01 levels, respectively, using a two-tailed *t*-test.

Dependent variable:		*VC Indicator*		*VC Fund Num*		*VC Investment*	
	Pr. sign	(1)	(2)	(3)	(4)	(5)	(6)
Disclosure Failure	+	0.030**	0.031**	0.045***	0.046***	0.183**	0.181**
		(2.52)	(2.57)	(3.20)	(3.19)	(2.46)	(2.40)
Trial Num			0.009		0.006		-0.016
			(1.01)		(0.53)		(-0.28)
Market Num			-0.003		0.002		0.045
			(-0.52)		(0.25)		(1.12)
Partner Num			-0.002		0.000		0.001
			(-0.37)		(0.05)		(0.02)
Facility Num			-0.014		-0.016		-0.082
			(-1.02)		(-0.90)		(-0.90)
Age			-0.002		-0.003		0.003
			(-0.47)		(-0.48)		(0.09)
Year FE		Yes	Yes	Yes	Yes	Yes	Yes
Firm FE		Yes	Yes	Yes	Yes	Yes	Yes
S.E. clustered by firm		Yes	Yes	Yes	Yes	Yes	Yes
No. of observations		19,318	19,318	19,318	19,318	19,318	19,318
Adj. R-Squared		0.396	0.396	0.373	0.373	0.348	0.348

Table 5
Cross-sectional tests of market opacity, market concentration, and knowledge stock

Panel A presents the results from examining cross-sectional variation in the change of VC investment for peer firms following a competing firm's disclosure of failed clinical trials compared to the change for non-peer firms based on market opacity. Firm-years with average market transparency over the prior three years below the sample median are defined as *High Opacity*, and firm-years as *Low Opacity* otherwise. Market transparency (the flip side of market opacity) is measured with the ratio of trials reporting their outcomes to the total number of ongoing trials in the given market and year. Panel B presents the results from examining cross-sectional variation based on market concentration. Firm-years with average market concentration above the sample median are defined as *High Concentration*, and firm-years as *Low Concentration* otherwise. Market concentration is measured with the sum of squared terms of each sponsor firm's clinical trials in the given market and year. Panel C presents the results from examining cross-sectional variation based on knowledge stock. Firm-years with average knowledge stock above the sample median are defined as *High Knowledge Stock*, and firm-years as *Low Knowledge Stock* otherwise. Knowledge stock is measured with the accumulated number of clinical trials (including both completed and ongoing ones) for each sponsor firm in the given market and year. All variables are defined in Appendix A. The *t*-statistics are reported below coefficient estimates in parentheses and are calculated based on standard errors clustered by firm. *, **, *** indicate statistics significance at the 0.10, 0.05, and 0.01 levels, respectively, using a two-tailed *t* -test.

Panel A: Peer firms' disclosure of failed clinical trials, VC investment, and market opacity

Dependent variable:		*VC Indicator*		*VC Fund Num*		*VC Investment*	
		High Opacity	Low Opacity	High Opacity	Low Opacity	High Opacity	Low Opacity
	Pr. sign	(1)	(2)	(3)	(4)	(5)	(6)
Disclosure Failure	+ / 0	0.021	0.056***	0.031	0.068***	0.106	0.319**
		(1.22)	(3.20)	(1.56)	(3.13)	(1.06)	(2.45)
Trial Num		0.015	-0.008	0.013	-0.017	-0.007	-0.119
		(1.23)	(-0.54)	(0.78)	(-0.82)	(-0.08)	(-1.18)
Market Num		0.007	0.002	0.014	0.012	0.100	0.091
		(0.83)	(0.19)	(1.06)	(0.78)	(1.63)	(1.17)
Partner Num		-0.026***	0.019*	-0.025*	0.023*	-0.154**	0.154**
		(-2.67)	(1.79)	(-1.90)	(1.73)	(-2.41)	(2.29)
Facility Num		-0.006	-0.034*	-0.012	-0.035	0.034	-0.250*
		(-0.33)	(-1.66)	(-0.48)	(-1.39)	(0.26)	(-1.81)
Age		-0.000	0.005	-0.001	0.004	0.003	0.053
		(-0.02)	(0.74)	(-0.11)	(0.52)	(0.07)	(1.20)
Year FE		Yes	Yes	Yes	Yes	Yes	Yes
Firm FE		Yes	Yes	Yes	Yes	Yes	Yes
S.E. clustered by firm		Yes	Yes	Yes	Yes	Yes	Yes
P -value for difference in coef.		0.084		0.068		0.093	
No. of observations		10,120	8,428	10,120	8,428	10,120	8,428
Adj. R-Squared		0.377	0.434	0.361	0.397	0.346	0.366

Table 5 (continued)

Panel B: Peer firms' disclosure of failed clinical trials, VC investment, and market concentration

Dependent variable:		*VC Indicator*		*VC Fund Num*		*VC Investment*	
		High HHI	Low HHI	High HHI	Low HHI	High HHI	Low HHI
	Pr. sign	(1)	(2)	(3)	(4)	(5)	(6)
Disclosure Failure	+ / 0	0.038**	0.002	0.055***	0.017	0.228**	0.037
		(2.33)	(0.08)	(2.71)	(0.55)	(2.04)	(0.23)
Trial Num		0.009	0.005	-0.000	-0.009	-0.034	-0.032
		(0.65)	(0.36)	(-0.02)	(-0.49)	(-0.35)	(-0.36)
Market Num		-0.001	-0.002	0.015	0.000	0.089	0.033
		(-0.05)	(-0.21)	(0.90)	(0.03)	(0.96)	(0.44)
Partner Num		-0.009	0.002	-0.010	0.010	-0.051	0.025
		(-0.80)	(0.21)	(-0.73)	(0.74)	(-0.72)	(0.37)
Facility Num		-0.010	-0.036*	-0.020	-0.028	-0.088	-0.212
		(-0.49)	(-1.67)	(-0.71)	(-1.06)	(-0.64)	(-1.47)
Age		-0.007	0.005	-0.007	0.006	-0.006	0.044
		(-0.98)	(0.68)	(-0.67)	(0.67)	(-0.14)	(0.93)
Year FE		Yes	Yes	Yes	Yes	Yes	Yes
Firm FE		Yes	Yes	Yes	Yes	Yes	Yes
S.E. clustered by firm		Yes	Yes	Yes	Yes	Yes	Yes
P -value for difference in coef.		0.094		0.047		0.045	
No. of observations		8,034	9,654	8,034	9,654	8,034	9,654
Adj. R-Squared		0.422	0.382	0.382	0.361	0.346	0.341

Table 5 (continued)

Panel C: Peer firms' disclosure of failed clinical trials, VC investment, and knowledge stock

Dependent variable:		*VC Indicator*		*VC Fund Num*		*VC Investment*	
		High Knowledge	Low Knowledge	High Knowledge	Low Knowledge	High Knowledge	Low Knowledge
	Pr. sign	(1)	(2)	(3)	(4)	(5)	(6)
Disclosure Failure	+ / 0	0.055***	0.004	0.070***	0.019	0.289***	0.069
		(3.83)	(0.18)	(3.75)	(0.79)	(3.08)	(0.61)
Trial Num		0.014	0.033	0.013	0.042	-0.004	0.090
		(1.23)	(1.42)	(0.88)	(1.44)	(-0.06)	(0.60)
Market Num		0.002	-0.025**	0.003	-0.026	0.046	-0.045
		(0.23)	(-2.05)	(0.27)	(-1.58)	(0.80)	(-0.57)
Partner Num		-0.044**	0.001	-0.049*	0.001	-0.216*	0.021
		(-2.26)	(0.08)	(-1.94)	(0.09)	(-1.65)	(0.41)
Facility Num		-0.030*	-0.035	-0.028	-0.041	-0.142	-0.245
		(-1.75)	(-1.39)	(-1.27)	(-1.07)	(-1.24)	(-1.31)
Age		-0.006	0.009	-0.009	0.009	-0.019	0.067
		(-0.88)	(1.21)	(-0.94)	(0.90)	(-0.42)	(1.25)
Year FE		Yes	Yes	Yes	Yes	Yes	Yes
Firm FE		Yes	Yes	Yes	Yes	Yes	Yes
S.E. clustered by firm		Yes	Yes	Yes	Yes	Yes	Yes
P -value for difference in coef.		0.034		0.074		0.039	
No. of observations		8,983	9,558	8,983	9,558	8,983	9,558
Adj. R-Squared		0.394	0.434	0.348	0.423	0.32	0.406

Table 6
Deal level analysis: Market expertise or technology expertise

This table presents the results from examining whether the increase in VC investment is driven by venture capitalists with market expertise or venture capitalists with technology expertise. *Market Expertise* is an indicator variable equal to one if the VC fund has invested in the same market as the current deal in the past three years, and zero otherwise. *Technology Expertise* is an indicator variable equal to one if the VC fund has invested in firms employing the same technology as the current deal in the past three years, and zero otherwise. *Disclosure Failure*$_{j,t}$ is an indicator variable equal to one if fund *j* makes the investment after competing firms' disclosure of failed clinical trials in year t, and zero otherwise. All variables are defined in Appendix A. The *t*-statistics are reported below coefficient estimates in parentheses and are calculated based on standard errors clustered by firm. *, **, *** indicate statistics significance at the 0.10, 0.05, and 0.01 levels, respectively, using a two-tailed *t*-test.

Dependent variable:		*Market Expertise*	*Technology Expertise*
	Pr. sign	(1)	(2)
Disclosure Failure	0 / +	-0.075	0.336**
		(-0.71)	(2.13)
Trial Num		-0.035	0.003
		(-1.07)	(0.09)
Market Num		0.167***	0.042
		(4.42)	(1.30)
Partner Num		0.458***	0.117***
		(9.57)	(3.00)
Facility Num		0.037	0.031
		(0.69)	(0.31)
Age		0.063***	0.022
		(3.18)	(1.02)
Round Stage		0.013*	-0.001
		(1.88)	(-0.08)
Fund Num Deal		-0.000	0.003
		(-0.02)	(1.13)
Year FE		Yes	Yes
Fund FE		Yes	Yes
S.E. clustered by firm		Yes	Yes
No. of observations		4,685	4,685
Adj. R-Squared		0.566	0.815

Table 7
Social welfare analysis: technology novelty

This table presents the results from examining the effects of clinical trial result disclosure on newly registered clinical trials' MOA novelty. *New MOA Indicator* is an indicator variable equal to one if the MOAs in the clinical trials have not been used for certain conditions before, and zero otherwise. *New MOA Num* is the number of MOAs in the clinical trials that have not been used for certain conditions before. All variables are defined in Appendix A. The *t* -statistics are reported below coefficient estimates in parentheses and are calculated based on standard errors clustered by firm. *, **, *** indicate statistics significance at the 0.10, 0.05, and 0.01 levels, respectively, using a two-tailed *t* -test.

Panel A: Disclosure of successful clinical trials and technology novelty

Dependent variable:		*New MOA Indicator*	*New MOA Num*
	Pr. sign	(1)	(2)
Disclosure Success	-	-0.005*	-0.003**
		(-1.71)	(-2.46)
Year FE		Yes	Yes
Market FE		Yes	Yes
MOA FE		Yes	Yes
S.E. clustered by year		Yes	Yes
S.E. clustered by market		Yes	Yes
No. of observations		70,152	70,152
Adj. R-Squared		0.682	0.686

Table 7 (continued)

Panel B: Disclosure of failed clinical trials and technology novelty

Dependent variable:		*New MOA Indicator*				*New MOA Num*			
	Pr. sign	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Disclosure Failure	+	0.044***	0.016	0.033**	0.016	0.034***	0.012	0.024**	0.011
		(3.28)	(0.92)	(2.37)	(1.02)	(3.14)	(0.91)	(2.21)	(0.89)
Disclosure Failure × VC Market Indicator	+		0.030**				0.024**		
			(2.07)				(2.18)		
Disclosure Failure × VC Market Fund Num	+			0.006*				0.005*	
				(1.79)				(1.94)	
Disclosure Failure × VC Market Investment	+				0.003***				0.003***
					(2.58)				(2.84)
VC Market Indicator			-0.023**				-0.013		
			(-2.05)				(-1.52)		
VC Market Fund Num				-0.006				-0.003	
				(-1.47)				(-0.93)	
VC Market Investment					-0.002				-0.001
					(-1.61)				(-0.96)
Year FE		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Market FE		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
S.E. clustered by clinical trial		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations		70,152	70,152	70,152	70,152	70,152	70,152	70,152	70,152
Adj. R-Squared		0.683	0.683	0.683	0.683	0.687	0.687	0.687	0.687

Table 8
Deal quality analysis: IPOs and M&As

This table presents the results from examining the likelihood and return of venture capitalists' successful exit. Panel A presents the results examining the likelihood and return of the IPOs of investee firms in the deals following competing firms' disclosure of failed clinical trials. *IPO* is an indicator variable equal to one if the investee firm goes public, and zero otherwise. *IPO Day Return* equals the closing price of the investee firm on the IPO day times the number of shares owned by the VC fund, divided by its investment before the IPO. *Post Lock-Up Return* equals the closing price of the investee firm on the first trading day after the lock-up period times the number of shares owned by the VC fund, divided by its investment before IPO. *Disclosure Failure* is an indicator variable equal to one if the fund makes the investment after competing firms' disclosure of failed clinical trials, and zero otherwise. Panel B presents the results examining the likelihood and profitability of the M&A transactions of investee firms in the deals following competing firms' disclosure of failed clinical trials. *M&A Target* is an indicator variable equal to one if the investee firm is acquired, and zero otherwise. *M&A Profit* is an indicator variable equal to one if the deal value is larger than the total funding amount invested in the firm, and zero otherwise. All variables are defined in Appendix A. The *t*-statistics are reported below coefficient estimates in parentheses and are calculated based on standard errors clustered by firm. *, **, *** indicate statistics significance at the 0.10, 0.05, and 0.01 levels, respectively, using a two-tailed *t*-test.

Panel A: Likelihood and returns of IPOs

Dependent variable:		*IPO*	*IPO Day Return*	*Post-Lock Return*
	Pr. sign	(1)	(2)	(3)
Disclosure Failure	+	0.062***	0.143*	0.138*
		(2.66)	(1.81)	(1.68)
Control		Yes	Yes	Yes
Year FE		Yes	Yes	Yes
Fund FE		Yes	Yes	Yes
S.E. clustered by firm		Yes	Yes	Yes
No. of observations		4685	321	321
Adj. R-Squared		0.316	0.067	0.065

Table 8 (continued)

Panel B: Likelihood and returns of M&As

Dependent variable:		*M&A Target*	*M&A Profit*
	Pr. sign	(1)	(2)
Disclosure Failure	+	0.017*	0.078*
		(1.84)	(1.71)
Trial Num		0.003	-0.028
		(0.16)	(-0.53)
Market Num		-0.034***	-0.006
		(-2.67)	(-0.10)
Partner Num		-0.019*	-0.028
		(-1.71)	(-0.48)
Facility Num		0.153***	-0.007
		(4.77)	(-0.09)
Age		0.034***	0.019
		(3.35)	(0.63)
Round Stage		0.005**	0.008
		(2.33)	(0.66)
Fund Num Deal		-0.002	-0.020
		(-0.74)	(-1.15)
Year FE		Yes	Yes
Fund FE		Yes	Yes
S.E. clustered by firm		Yes	Yes
No. of observations		4,685	503
Adj. R-Squared		0.274	0.151

Table 9
Firms' disclosure of failed clinical trials

This table presents the results from examining whether the mandatory disclosure of clinical trial failure affects firms' voluntary disclosure of innovation failure. *SEC Failure Disclosure* equals the number of failed result disclosures in SEC filings. *Press Release Failure Disclosure* equals the number of press release with failed result disclosures. *Post Final Rule* is an indicator variable equal to one if the year is 2017 or later, and zero otherwise. All variables are defined in Appendix A. The *t*-statistics are reported below coefficient estimates in parentheses and are calculated based on standard errors clustered by firm. *, **, *** indicate statistics significance at the 0.10, 0.05, and 0.01 levels, respectively, using a two-tailed *t*-test.

Dependent variable:		*SEC Failure Disclosure*	*Press Release Failure Disclosure*
	Pr. sign	(1)	(2)
Post Final Rule	+	0.026**	0.001*
		(2.01)	(1.79)
Trial Num		-0.150***	-0.001
		(-6.52)	(-0.90)
Market Num		0.054***	0.002
		(3.08)	(0.89)
Partner Num		-0.020	0.001
		(-0.92)	(0.67)
Facility Num		-0.019	0.003*
		(-1.16)	(1.71)
Age		0.031***	-0.000
		(2.81)	(-0.04)
Firm FE		Yes	Yes
S.E. clustered by firm		Yes	Yes
No. of observations		7,861	7,861
Adj. R-Squared		0.544	0.041

Table 10
Falsification test: Zombie clinical trials

This table presents the results of ruling out the alternative explanation of venture capitalists' private information networks. *Zombie Completion* is an indicator variable equal to one for firm-years if a zombie clinical trial is completed prior to year *t* in the market where firm *i* is innovating, and zero otherwise. Zombie clinical trials are clinical trials completed before 2016 without result submission and each sponsor firm not starting a new clinical trial in the same market and the latter phases following their completion. All variables are defined in Appendix A. The *t*-statistics are reported below coefficient estimates in parentheses and are calculated based on standard errors clustered by firm. *, **, *** indicate statistics significance at the 0.10, 0.05, and 0.01 levels, respectively, using a two-tailed *t* -test.

Dependent variable:		*VC Indicator*		*VC Fund Num*		*VC Investment*	
	Pr. sign	(1)	(2)	(3)	(4)	(5)	(6)
Zombie Completion	0	-0.015	-0.017	-0.023	-0.026	-0.222*	-0.234*
		(-0.88)	(-0.95)	(-0.88)	(-0.96)	(-1.87)	(-1.90)
Trial Num			-0.000		-0.006		-0.056
			(-0.02)		(-0.29)		(-0.62)
Market Num			0.014		0.021		0.097
			(1.61)		(1.62)		(1.64)
Partner Num			-0.005		-0.016		-0.073
			(-0.70)		(-1.58)		(-1.58)
Facility Num			-0.046**		-0.053*		-0.239
			(-2.02)		(-1.68)		(-1.63)
Age			0.012**		0.017**		0.089**
			(2.35)		(2.19)		(2.54)
Year FE		Yes	Yes	Yes	Yes	Yes	Yes
Firm FE		Yes	Yes	Yes	Yes	Yes	Yes
S.E. clustered by firm		Yes	Yes	Yes	Yes	Yes	Yes
No. of observations		12,360	12,360	12,360	12,360	12,360	12,360
Adj. R-Squared		0.447	0.448	0.428	0.429	0.370	0.371

Table 11
Robustness Tests

This table presents the results from examining the robustness of my main findings. Panel A presents the results from examining my findings' robustness with a stacked DiD specification. Panel B presents the results from examining my findings' robustness with a different definition of markets. Market is defined with the second level of MeSH terms. Columns 1-3 report the results with a staggered DiD specification. Columns 4-6 report the results with a stacked DiD specification. Panel C presents the results from examining my findings' robustness with different sample periods. Columns 1-3 report the results with the sample period 2010-2023. Columns 4-6 report the results with the sample period 2014-2019. Panel D presents the results from examining my findings' robustness with matched "twin" firms as the control group. Columns 1-3 report the results with a staggered DiD specification. Columns 4-6 report the results with a stacked DiD specification. All variables are defined in Appendix A. The *t*-statistics are reported below coefficient estimates in parentheses and are calculated based on standard errors clustered by firm. *, **, *** indicate statistics significance at the 0.10, 0.05, and 0.01 levels, respectively, using a two-tailed *t* -test.

Panel A: Stacked DiD specification

Dependent variable:		*VC Indicator*		*VC Fund Num*		*VC Investment*	
	Pr. sign	(1)	(2)	(3)	(4)	(5)	(6)
Disclosure Failure	+	0.028**	0.030***	0.040***	0.041***	0.159**	0.166**
		(2.47)	(2.61)	(3.10)	(3.16)	(2.24)	(2.30)
Trial Num			0.004		0.003		-0.032
			(0.38)		(0.25)		(-0.50)
Market Num			-0.002		0.000		0.042
			(-0.34)		(0.06)		(0.94)
Partner Num			-0.003		0.002		0.005
			(-0.37)		(0.21)		(0.10)
Facility Num			-0.013		-0.015		-0.100
			(-0.84)		(-0.75)		(-0.93)
Age			-0.003		-0.004		-0.007
			(-0.67)		(-0.52)		(-0.19)
Year-Cohort FE		Yes	Yes	Yes	Yes	Yes	Yes
Firm-Cohort FE		Yes	Yes	Yes	Yes	Yes	Yes
S.E. clustered by firm		Yes	Yes	Yes	Yes	Yes	Yes
No. of observations		47,407	47,407	47,407	47,407	47,407	47,407
Adj. R-Squared		0.394	0.394	0.365	0.365	0.343	0.343

Table 11 (continued)

Panel B: Markets defined with the second level of MeSH terms

Dependent variable:		*VC Indicator*	*VC Fund Num*	*VC Investment*	*VC Indicator*	*VC Fund Num*	*VC Investment*
	Pr. sign	(1)	(2)	(3)	(4)	(5)	(6)
Disclosure Failure	+	0.025**	0.042***	0.138*	0.020*	0.033**	0.108*
		(1.99)	(2.65)	(1.76)	(1.65)	(2.19)	(1.71)
Trial Num		0.008	0.007	-0.024	0.004	0.003	-0.034
		(0.95)	(0.63)	(-0.41)	(0.42)	(0.22)	(-0.52)
Market Num		-0.004	0.001	0.046	-0.002	0.001	0.041
		(-0.58)	(0.10)	(1.14)	(-0.38)	(0.06)	(0.91)
Partner Num		-0.002	0.002	0.005	-0.002	0.003	0.012
		(-0.29)	(0.18)	(0.11)	(-0.27)	(0.34)	(0.25)
Facility Num		-0.016	-0.019	-0.089	-0.014	-0.016	-0.102
		(-1.22)	(-1.10)	(-1.00)	(-0.90)	(-0.79)	(-0.95)
Age		-0.001	-0.001	0.014	-0.002	-0.003	0.001
		(-0.14)	(-0.24)	(0.45)	(-0.45)	(-0.45)	(0.02)
Specification		Staggered	Staggered	Staggered	Stacked	Stacked	Stacked
Year FE		Yes	Yes	Yes	Yes	Yes	Yes
Firm FE		Yes	Yes	Yes	Yes	Yes	Yes
S.E. clustered by firm		Yes	Yes	Yes	Yes	Yes	Yes
No. of observations		19,241	19,241	19,241	47,028	47,028	47,028
Adj. R-Squared		0.400	0.377	0.355	0.396	0.369	0.345

Table 11 (continued)

Panel C: Alternative sample periods

Dependent variable:		*VC Indicator*	*VC Fund Num*	*VC Investment*	*VC Indicator*	*VC Fund Num*	*VC Investment*
	Pr. sign	(1)	(2)	(3)	(4)	(5)	(6)
Disclosure Failure	+	0.027***	0.042***	0.148**	0.018*	0.029**	0.099*
		(2.70)	(3.43)	(2.34)	(1.67)	(2.28)	(1.84)
Trial Num		0.015**	0.020*	0.066	0.001	-0.009	-0.043
		(2.02)	(1.88)	(1.32)	(0.09)	(-0.55)	(-0.49)
Market Num		-0.005	-0.005	-0.012	0.001	0.004	0.053
		(-0.88)	(-0.72)	(-0.34)	(0.16)	(0.37)	(0.85)
Partner Num		-0.018***	-0.024***	-0.116***	-0.005	-0.008	-0.029
		(-3.31)	(-3.38)	(-3.38)	(-0.50)	(-0.60)	(-0.44)
Facility Num		-0.024**	-0.038**	-0.136*	-0.015	-0.009	-0.109
		(-2.03)	(-2.42)	(-1.80)	(-0.79)	(-0.38)	(-0.83)
Age		0.001	0.004	0.025	-0.008	-0.011	-0.053
		(0.39)	(0.72)	(1.00)	(-1.38)	(-1.33)	(-1.24)
Sample Period		2010-2023	2010-2023	2010-2023	2014-2019	2014-2019	2014-2019
Year FE		Yes	Yes	Yes	Yes	Yes	Yes
Firm FE		Yes	Yes	Yes	Yes	Yes	Yes
S.E. clustered by firm		Yes	Yes	Yes	Yes	Yes	Yes
No. of observations		26,666	26,666	26,666	11,411	11,411	11,411
Adj. R-Squared		0.373	0.353	0.319	0.421	0.382	0.354

Table 11 (continued)

Panel D: "Twin" firms as control group

Dependent variable:		*VC Indicator*	*VC Fund Num*	*VC Investment*	*VC Indicator*	*VC Fund Num*	*VC Investment*
	Pr. sign	(1)	(2)	(3)	(4)	(5)	(6)
Disclosure Failure	+	0.046**	0.063***	0.329***	0.054**	0.066**	0.371**
		(2.23)	(2.59)	(2.60)	(2.31)	(2.40)	(2.52)
Trial Num		0.052**	0.049*	0.221*	0.042	0.042	0.192
		(2.55)	(1.81)	(1.69)	(1.55)	(1.10)	(1.02)
Market Num		-0.018	-0.012	-0.019	-0.019	-0.019	-0.077
		(-1.30)	(-0.72)	(-0.23)	(-1.24)	(-1.00)	(-0.74)
Partner Num		-0.028	-0.047**	-0.213*	-0.062**	-0.087***	-0.426**
		(-1.54)	(-1.98)	(-1.74)	(-2.32)	(-2.63)	(-2.42)
Facility Num		-0.013	0.001	0.036	-0.007	-0.002	0.013
		(-0.48)	(0.02)	(0.22)	(-0.26)	(-0.04)	(0.08)
Age		-0.003	-0.004	-0.027	-0.010	-0.013	-0.067
		(-0.33)	(-0.24)	(-0.39)	(-0.75)	(-0.59)	(-0.67)
Specification		Staggered	Staggered	Staggered	Stacked	Stacked	Stacked
Year FE		Yes	Yes	Yes	Yes	Yes	Yes
Firm FE		Yes	Yes	Yes	Yes	Yes	Yes
S.E. clustered by firm		Yes	Yes	Yes	Yes	Yes	Yes
No. of observations		4,050	4,050	4,050	6,865	6,865	6,865
Adj. R-Squared		0.384	0.362	0.341	0.378	0.339	0.326