Absent agency problems, can conflict emerge between a pre-existing angel investor, and an entering venture capitalist?

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Abstract

Suppose an angel investor who already is invested in a project and a venture capitalist (VC) who provides a new infusion of capital into self same project. With reference to feasibility of emergence of conflict, formal theoretical predictions establish feasibility of two general equilibrium outcomes, namely '*agreement-agreement*', or '*disagreement-disagreement*' between the VC and angel investor. Disagreement emerges, because while the angel investor infers deterioration to risk-return trade-offs, information myopia that is induced by exogenous exit market phenomena induces rational disagreement from the VC. In presence of evidence for Pareto non-optimality of disagreement, opportunity costs of disagreement likely are economically significant.

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1 Introduction

There exists a rich literature on feasibility of emergence of disagreements that are rooted in asymmetries of any of awareness, information, knowledge, bounded rationality, or behavioral biases (e.g. tastes), within populations of economic agents. In stated respect, while presence of symmetry between economic agents ought to induce attenuation of disagreement for arrival at some convergence (Aumann 1976), in presence of asymmetries, such as differences to evidence, or reasoned differences to interpretation of evidence, persistence of disagreement can have character of rationality (Harman 1980, Kelly 2019). With focus on context of financial economics, Hong and Stein (2007) group asymmetries that generate disagreement into three main groups, namely, *gradation of information flow*, equivalently, heterogeneity of any of awareness, information, or knowledge; *limited attention*, which encompasses each of behavioral biases or bounded rationality; and *heterogeneity of priors*, that is, heterogeneity of interpretation of information or evidence. Studies of impact of disagreement in financial markets all focus on investors, not financial intermediation, and are inclusive of, Mankiw, Reis, and Wolfers (2003), Fama and French (2007), Sadka and Scherbina (2007), Yu (2011), Cen, Lu, and Yang (2013), Kim, Reu, and Seo (2014), Cen, Wei, and Yang (2017), Montes and Curi (2017), and Gao et al. (2019). All of enumerated studies focus on evidence for, and impact of disagreement on price equilibriums that subsist in financial markets. Given heterogeneity of risk aversion parameters is a necessary condition for economic viability of stock markets (Grossman and Stiglitz 1980; Tirole 1982), differences of interpretation of, or response to same information is general equilibrium characteristic of investors that interact in stock markets. Disagreement then, is, absent any conditions, general equilibrium feature of stock markets, as such, non-costly. Are there conditions and financial economic interactions, however, in context of which, while disagreement need not occur, regardless, absent any intent on part of any and all economic agents, that is, in general equilibrium, there is arrival at asymmetries that induce costly disagreement and conflict?

The venture capital market incorporates interactions that feasibly induce disagreement and conflict, but yet interactions that need not be characterized by disagreements. Suppose optimality of contracting between entrepreneurs, venture capitalists (VCs), and angel investors, all of whom are equity participants in a pre-revenue start-up firm. In presence of alignment of all incentives towards achievement of the best possible innovation outcomes and valuations, financial economic interactions are amenable to absence of emergence of disagreement and conflict. In presence, however, of optimality of contracting, do there exist conditions, in context of which, absent any intent on part of any and all economic agents, regardless, there is arrival at disagreement and conflict between VCs and

angel investors? If disagreement is legitimate, it must arise in context of essence of the cooperative game theoretic interaction, that is, in relation to either of innovation outcomes, firm valuations, or both. While Hellmann and Thiele (2002) model emergence of conflict between an angel investor and a venture capitalist, conflict explicitly is predicated on moral hazard - deliberacy of non-optimality of contracting with angel investors - on part of a venture capitalist. Given moral hazard has character of 'off equilibrium' behavior, as such, is not expected to subsist in general equilibrium (Cho and Kreps 1987), and given moral hazard induces a non-cooperative game theoretic interaction, the model inherently is unable to address conditions, in context of which disagreement and conflict emerge in general equilibrium. For additional concreteness, while disagreement is considered 'normal' in context of activities of economic agents (Angouri and Locher 2012), moral hazard has character of deviant behavior (see for example, Campbell and Kracaw 1980; Hyytinen and Väänänen 2006; Tirelli 2019; Fu, Yang, and An 2019). Consistent with characterization of moral hazard as 'off equilibrium' behavior, Megginson and Weis (1991), Gompers (1996), Nahata (2008), Krishnan and Masulis (2011), and Obrimah (2016a, 2016b) all find VCs have regard as reputable delegated monitors in stock markets. It is straightforward that demand for reputation from VCs characterizes moral hazard as off equilibrium behavior. The discussion in Section 2.3 reconciles findings in this study with Hellmann and Thiele (2002), provides evidence for complementarity.

Suppose an entering VC offers a fair multiple to a pre-existing angel investor and entrepreneur, with outcome the angel investor does not have any feelings of being 'burned' (taken advantage of) by an entering VC who has significantly larger negotiation power for determination of financing terms. By assumption, we have that the entering VC is not characterized by moral hazard, as such, abstract away from the 'burned angels' problem that is tackled in Hellmann and Thiele (2002). Using the assumed 'harmonious' context, and with focus on feasibility of emergence of disagreement and conflict, formal theoretical predictions arrive at two dichotomous general equilibrium outcomes, namely, '*agreement-agreement*' or '*disagreement-disagreement*' rational expectations equilibriums. While '*agreement*' and '*disagreement*' equilibriums are robust to any feasible configurations of ability of entrepreneurs and angel investors, presence of a 'most able' VC (respectively, 'less able' VC) is necessary condition for arrival at agreement (respectively, disagreement) equilibriums. Given each of agreement or disagreement equilibriums are populated by either of 'most able' or 'less able' entrepreneurs, VCs develop reputation in context of optimal actions in relation to the two different realizations of entrepreneurial ability. In presence of formal theoretical evidence for non-coincidence of optimal actions in dealings with the two different realizations of ability, there is arrival at corroboration for the empirical finding in Obrimah (2016a) that there exist two general equilibrium

channels for development of reputation in venture capital markets.

Given agreement equilibriums outperform disagreement equilibriums within each risk class (within each industry segment), performance of venture capital backed projects is, at the margin, function of VCs' ability. We have then that each of exit success rates (see for example, Laine and Torstila 2005; Hochberg et al. 2007; Botazzi et al. 2008; Obrimah and Prakash 2010) and project returns (see for example, Kaplan and Schoar 2003; Phalippou 2010) have character of returns to venture capital financing. While each of exit success rates and project returns already are adopted as metrics for success of VCs, this study provides 'smoking gun' evidence for robustness of interpretation of enumerated metrics. Necessity of outnumbering of most able VCs by less able VCs establishes prevalence of disagreement equilibriums. Prevalence of disagreement equilibriums provides a formal theoretical explanation for evidence, in empirical studies (see for example, Chahine, Filatotchev, and Wright 2007; Ibrahim 2008; and Harrison, Botelho, and Mason 2016), for prevalence of segmentation of financing activities of VCs and angel investors. For concreteness, in presence of anticipation of disagreement equilibriums, each of VCs and angel investors can adopt an '*avoid the other if you can*' strategy in dealings with entrepreneurs, resulting in prevalence of segmentation of financing activities of VCs and angel investors. Consistent with evidence for segmentation, Mason and Stark (2004), Bruton et al. (2010), Bonnet and Wirtz (2012), and Hsu et al. (2014) provide evidence for presence of wedges between decision making rubrics of VCs and angel investors. Fiet (1995) anecdotally anticipates outcomes of the formal theoretical modeling, that is, costly segmentation of activities of VCs and angel investors.

For concreteness, general equilibriums that are parameterized by either of agreement or disagreement emerge as follows. First, formal predictions show rationality of openness of entrepreneurs to receipt of capital from angel investors demands, in general equilibrium, that angel investors precede VCs as participating equity investors. With focus on start-ups or seed stage ventures whose growth potential are projected to required larger infusions of capital from institutional investors in future periods, the finding that angel investors tend not to be 'hands-on' (see for example, Leshchinskii 2002 or Fairchild 2011) is shown to be first-best general equilibrium behavior. Second, consequent on entry as participating equity investors, if VCs act optimally, in presence of most able entrepreneurs they do not engage in any attempts at leveraging of project risk. Conversely, in presence of less able entrepreneurs, they seek to increase risk for generation of optimal realizations for project risk-return trade-offs. In presence of conformance (or deviation) from either of outlined optimal strategies, VCs arrive at agreement (or disagreement) equilibriums.

If disagreement is rational, as such, persistent, it is rooted in asymmetries, sources of which are

rational and exogenous to economic agents who arrive at disagreement (see for example, Whitcomb 2010; Elgin 2010; Lam 2011; Henderson et al. 2017; Kelly 2019). We arrive then at necessity of delineation of rationality or irrationality of arrival at equilibriums that are parameterized by disagreement. Suppose a VC seeks to develop reputation, as such is a 'less able' VC who seeks to demonstrate 'unanticipated' ability. In presence of overriding importance of development of reputation - a rational endeavor - the VC adopts a naive rationality rubric of attempts at leveraging risk of every project for enhancement of project returns. Given a most able entrepreneur already has maxed out risk-return trade-offs, necessity of strict concavity of project risk-return profiles ensures feasibility of deterioration to project risk-return trade-offs. Succinctly, the naive rationality transforms into a rational expectations equilibrium as follows. Combined, Kraus and Litzenberger (1976), Kane (1982), and Harvey and Siddique (2000) predict returns are a strictly concave function of conditional skewness. Using empirical findings in Cochrane (2005), Aggarwal and Hsu (2013), and Obrimah (2016a, 2016b), stated prediction implies (holding return volatility constant) that, while 'return-conditional skewness' profiles that emerge in context of exits via third party sales typically are of the optimal sort, on the contrary, return-conditional skewness profiles that subsist in context of IPO exits typically are of the 'less-than' or 'more-than' optimal variety. Given every 'less-than optimal' return-conditional skewness profile has a counterpart 'more-than optimal' profile with exactly the same project return (from strict concavity of the 'return-conditional skewness' relation), relative to maintenance of location on the efficiency frontier, that is, on the less-than frontier, there is not any return penalty to progression beyond the optimal return-conditional skewness profile. In presence of absence of return penalties to progression beyond the optimal profile, the VC's naive rationality is transformed into a rational expectations equilibrium (REE). The VC's unawareness translates, however, into a return cost. Given rationality always is conditioned on awareness, with outcome evidence for some unawareness does not nullify characterization of an equilibrium that is formed in context of stated unawareness as an REE, there is arrival at what is referred to as a 'procedural REE (Simon 1976,1978)', that is, an equilibrium that, conditioned on awareness of an agent, has character of a rational expectations equilibrium. If less able VCs interact with entrepreneurs and angel investors that are less able, and benchmark project outcomes to populations of venture capital backed IPOs, as opposed to fundamentals of specific projects, by the same token, that is, preponderance of IPOs that are characterized by either of less-than or more-than optimal return-conditional skewness profiles, there is arrival at risk-return trade-offs that are less than optimal.

In either instance, with angel investors not having any strict preference for IPOs (see for example, Landström 1993; Colliwaert 2012; Harrison, Botelho, and Mason 2016; Botelho, Harrison, and Mason

2019), as such basing inferences in respect of project innovation quality on more diverse samples of projects, there is arrival at inference of deterioration to trade-offs that subsist between returns and conditional skewness. In aggregate, with *information myopia* induced in populations of VCs by strictness of preference for IPO exits, and simultaneity of absence of information myopia in populations of angel investors, there is arrival at an asymmetry whose source is exogenous to VCs, as such, rational. Given disagreement on part of angel investors also is rooted in rational expectations, we arrive at disagreement equilibriums that have character of rational expectations equilibriums. Given each of VCs and angel investors derive inferences from phenomena that are exogenous to the specific project under consideration, and given both act rationally in relation to said information, regardless of disparity of awareness, there is arrival at a rational expectations equilibrium. Importantly, we arrive at analogue of predictions in Diamond (1991) that, in general equilibrium, it is 'less able' entrepreneurs that are able to profitably and sustainably entertain costs of bank monitoring; equivalently, that it is 'lower than stellar quality' projects that are able to profitably and sustainably support leveraging of risk and returns by VCs. While Amit, Glosten, and Muller (1990) and Huang and Litzenberger (1988) also predict VCs primarily attract lower than stellar quality projects, in this study, conditional on objective of development of reputation, the demand for lower than stellar quality projects from VCs is necessary condition for satisfaction of rational expectations equilibriums.

The foregoing implies the most able VCs do not restrict estimates of project innovation quality to populations of venture capital backed IPOs. In presence, however, of the expectation that VCs generate higher returns from exits via IPO (Gompers 1995), such an inference seems perhaps, counterfactual. Consider, however, that, for the same VC, exits via third party acquisitions occur faster than exits via IPOs (Gompers 1995; Cumming and McIntosh 2003). Let the time interval between an exit via third party acquisition and exit via IPO be denoted T, and let CFP and CFI denote, respectively, cash flows that accrue at exit to exits via third party acquisition and IPO. A sufficient condition for rationality of the finding, to wit, projects that are exited by third party acquisition typically are of higher innovation quality is, $CFP\,(1+r)^{T} \geq CFI$. Consistent with the rationality condition, upon accounting for differences in averages for time duration to exit of roughly two years (implied time-durations-to-exit of 2.0 versus 4.0 years), the 'full exit' U.S. sample in Cumming and McIntosh (2003) generates yearly compounded returns of 67.26% and 44.49%, respectively for exits via third party sales or IPOs. Using the aggregate sample consisting of full and partial exits, while aggregate returns for third party or IPO exits amount, respectively to 143.04% and 464.64%, corresponding yearly compounded returns amount, respectively, to 57.83% and 54.92 percent. In Chaplinsky and Gupta-Mukherjee (2016), while venture capital backed IPOs of the

highest quality generate, on average, aggregate returns of 570%, venture capital backed projects that are of the highest quality and that are exited via third party sales rake in aggregate returns that average 643 percent. In presence of the corroborating empirical evidence, clearly study outcomes are characterized by robustness. Hudson (1994), Puranam (2001), and Ozcan (2015) provide supporting evidence for desirability of acquisitions, on part of incumbents as strategy for acquisition of new innovations. In Ozmel, Robinson, and Stuart (2013), with exit outcomes of strategic alliances that transpire in the same industry as control group, relative to exits via IPO, participation of VCs increases proportions of exits that are actualized via sales to third parties.

In aggregate, disagreement and conflict cannot be dissociated from VCs' preference for IPOs. In light of the evidence, however, strictness of preference for IPOs has character of 'grandstanding'. We arrive then at formal theoretical support for the Gompers (1996) grandstanding hypothesis. Suppose each of VCs and angel investors adopt an '*avoid the other if you can*' strategy. Under stated conditions, in presence of the anticipation that the most promising start-ups or seed stage ventures will require venture capital financing in future periods, such ventures are avoided by angel investors, and at stated stage of growth are unable to secure venture capital financing. In essence, in presence of adoption of an 'avoid the other if you can', strategy, society ends up with shortfalls to quality of innovations and sub-optimality of cessation of business activities by, perhaps, some of the most innovative 'would be' entrepreneurs in the entrepreneurial ecosystem. In presence of binding nature of the stalemate, that is, 'damned (shortfalls to innovation quality) if you do', and 'damned (shortfalls to innovation quality and non-survival of some highly innovative ventures) if you don't', we arrive at costly, yet rational disagreement that subsists and persists in general equilibrium. The rest of the study is organized as follows. The model is developed in Section 2. Section 3 concludes the study.

2 The Model

There exist several models that attempt to characterize an entrepreneur's choice between either of angel financing or venture capital financing. These studies are inclusive of Leshchinskii (2002), Chemmanur and Chen (2006), and Fairchild (2011). This study does not delve into the choice between angel financing and venture capital financing. In this study, the entrepreneur is held exogenous to dynamics of interactions that subsist between a pre-existing angel investor, and an entering VC who provides a new infusion of capital. In the model, the venture capitalist (VC) is the '*unintentional protagonist*', and the angel investor feasibly can become a '*legitimate antagonist*'. The VC is an unintentional protagonist because any and all actions that induce conflict do not emanate

out of agency problems. Conflict remains feasible, because, in presence of symmetry of information in respect of the project and absence of moral hazard problems, but yet presence of asymmetries that are specific to either of the two agents, there remains opportunity for arrival at disagreement. With respect to coexistence of symmetry of information in respect of the project and feasibility of disagreement, in markets, such as venture capital markets, it is well established that interpretations of facts (information) have greater impact on decision making than facts. Studies that provide this evidence are inclusive of Tvervsky and Kahneman (1974), Zopounidis (1994), Muzyka et al. (1996), Allen and Gale (1999), Shepherd (1999), Zacharakis and Shepherd (2001), Levie and Gimmon (2008), and Mason and Botelho (2017). In presence of interpretation of facts as source of asymmetry - a source of disagreement that is acknowledged in Hong and Stein (2007) - set up of the model is robust to emergence of disagreement and conflict.

The set up of the model is as follows. At some origin time period, t_0, an early stage venture is, due to riskiness of it's highly innovative project, unable to attract venture capital financing (Freear et al. 1994, Prowse 1998, Lerner 1998). It is not then the case that the firm has a choice between angel financing, and venture capital financing. At that origin time period, t_0, the firm is successful at attracting angel financing. The firm expects, however, that consequent on securing of angel financing at time t_0, armed with project success to follow, it will be able to secure venture capital financing at some future date t_1. Hellmann and Thiele (2002) assume existence of such a structure, but do not focus on the same questions as in this study. Harrison and Mason (2000) provide empirical evidence for angel investors who strategically seek to fill such funding gaps. Predating of venture capital by angel finance is supported by findings, in studies, such as Ehrlich et al. (1994), Prowse (1998), and Hochberg (2011), that angel investors are not quite as sophisticated in their investment dealings as venture capitalists.

For avoidance of doubt, this study provides formal theoretical evidence that, in general equilibrium, any attempts at sequencing of angel financing and venture capital financing imply predating of venture capital financing by angel financing, and not vice versa. In this respect, the proof of Axiom 1 abstracts from all prior rationales that have been adduced for predating of venture capital by angel finance for arrival at a general equilibrium, as opposed to a behavioral or type-of-intermediary prediction. Given sequencing of angel financing and venture capital financing is a micro level economic decision, with all agents passive, as such not engaged in any game theoretic strategies, and with focus on general equilibrium of interactions, the modeling revolves around assumptions of a representative firm, representative angel investor, and representative venture capitalist.

Axiom 1 *Suppose either of angel financing (Φ), or venture capital financing (Ω) only are able to predate one another. Suppose also a pre-revenue early stage, equivalently, start-up project. In presence of the assumption that entrepreneurs (α), angels (β), and VCs (δ) all are fully rational, a rational expectations equilibrium (REE) is characterized by predating of venture capital financing by angel financing.*

Proof. By assumption, at some origin time period t_0, a firm i that owns an innovative asset attempts to strategically sequence Φ and Ω. Upon receipt of financing at time t_0, a successful firm i (the non-redundant scenario) increases it's scale from $\Gamma(t_0)$ to $\Gamma(t_1)$. In presence of

$$\Gamma(t_1) > \Gamma(t_0), \tag{1}$$

rationality of increase to scale demands that financing (λ) raised at times t_0 and t_1 satisfy:

$$\lambda(t_1) > \lambda(t_0). \tag{2}$$

It is normative that, with angels β investing their own wealth, and VCs δ investing wealth collated from many different institutional investors and wealthy agents, that capital (Θ) available to β and δ satisfy:

$$\Theta(\delta) > \Theta(\beta). \tag{3}$$

Let the symbol, '$\ll$' denote '*precedes*'. Combined, equations (1) through (3) demonstrate that sequencing of capital raising, which satisfies the *REE* that is characterized by equations (1) through (3) demands:

$$\Phi \ll \Omega. \tag{4}$$

Suppose otherwise, that is, violation of equation (4). Let financing amounts from β or δ that do not violate each financing entity's '*single obligor rules*' (the maximum amount that can be invested in any one project) be denoted, respectively by ϕ and ρ. Equation (3) implies:

$$\phi(t) < \rho(t) \ \forall\ t = 1, ..., \infty. \tag{5}$$

Suppose firm i receives the maximum possible financing, ρ from δ at time t_0. Using equation (2), we must have that:

$$\lambda(t_1) > \lambda(t_0) = \rho(t_0). \tag{6}$$

At time t_1, however,

$$\phi(t_1) < \rho(t_0) < \lambda(t_1), \tag{7}$$

with outcome, firm i is unable to secure financing from β. We arrive then at a contradiction. It is straightforward to see then, that the relation,

$$\phi(t_0) < \rho(t_0) = \rho(t_1), \tag{8}$$

which predates Ω by Φ guarantees non-violation of the rational expectations conditions in equations (1) through (3).

QED. ■

Prior literature have documented that angel investors either are not as hands on, or do not engage as much in governance of portfolio firms as venture capitalists. Axiom 1 provides a rational expectations equilibrium rationale for highlighted insight, namely, for firms with significant growth potential, angel investors only can be deemed to provide stop-gap financing - financing, which enables firms arrive at milestones that attract venture capital financing. Given firms funded are pre-revenue firms, and given failure of product development implies failure of the project, entrepreneurs' incentives are in perfect alignment with those of angel investors. As is documented in studies already enumerated, we have then that angel investors care significantly about quality of management, a concern, which satisfied, empowers abstraction from engagement with governance of portfolio firms. Rationality of stated abstraction implies, of course, contractual stipulations of well defined milestones and time frames for assessment of success or failure. Given it is achievement of innovation that is evidence for success, as opposed to generation of sales or management of inflows from sales, value that can be provided by angel investors is technological, as opposed to managerial. Consistent with the foregoing, in presence of effort that is observable in context of outcomes, for each of VCs and angel investors, debt that is convertible to equity, that is, convertible securities, is sufficient for mitigation of moral hazard (see for example, Berglof 1994; Bascha and Walz 2001; Schmidt 2003; Hellmann 2006; Wilton and Yerramilli 2008; Ibrahim 2008; Shane 2012). We have then, that it is not necessarily laziness (Leshchinskii 2002) or empathy (Fairchild 2011) that induces non-engagement with portfolio firms, but rather that non-engagement can be equilibrium outcome of stipulation of observable time dependent metric for success or failure at innovation - a metric that easily is ascertained satisfied or not, and provision of financing that serves primarily for attraction of venture capital financing, or other forms of institutional finance at some future date. If angel investors primarily provide capital,

which facilitates attraction of larger and more sophisticated investors in future periods, but yet anticipate conflict with VCs, they shy away from the sorts of projects that are preferred by VCs - exactly the sorts of projects that are most financially constrained in course of early stages of product development. In presence of such 'shying away', we arrive at inefficiencies of allocation of capital, and sub-optimality of survival outcomes within populations of innovators. Axiom 2 establishes non-optimality of meddling in corporate governance of portfolio projects with significant growth potential by angel investors.

Axiom 2 *Suppose angel investors provide financing primarily for achievement of innovation milestones that enable attraction of venture capital financing, or other alternate forms of institutional financing. The decision, on part of angel investors, not to be 'hands-on' with portfolio companies is consistent with rational expectations, as such is first-best rational. Correspondingly, the decision to be 'hands-on' is less than fully rational, as such inconsistent with rational expectations.*

Proof. At time $t = t_0$, angel β provides angel financing (Φ) to firm α. Provision of Φ is accompanied by specification of an innovation milestone, $\digamma\left(t_1|t_0\right)$ to be achieved at time t_1. At this point in time, firm α is a pre-revenue company, that is, a company, which as yet does not have any product to sell, as such does not have any revenues. In essence, the future of the firm is conditioned on success at innovation milestone, $\digamma\left(t_1|t_0\right)$.

If angel β monitors, that is, is hands-on, he or she incurs monitoring costs, $c > 0$. If angel β does not monitor, that is, is not hands-on, he or she incurs monitoring costs, $c = 0$. If angel β concludes, consequent on monitoring, that firm α does not make adequate progress towards $\digamma\left(t_1|t_0\right)$, the agreement being for time $t = t_1$, prior to arrival at time $t = t_1$, angel β is unable to shut down firm α. Further, the company being pre-revenue, angel β is unable to recover $c > 0$. More importantly, all possibility of harmony at time t_1 is lost, with outcome, conditional on achievement of $\digamma\left(t_1|t_0\right)$, it is possible the entrepreneur gangs up with an entering VC at time $t = t_1$ for burning or shafting of angel β with respect to financing terms. Let the expected shafting cost be denoted, $s\left(t_1|t_0\right)$. In aggregate, angel β incurs total non-recoverable costs of:

$$c + s\left(t_1|t_0\right) > 0.$$

If under the hands-on scenario, firm α is shut down, as per contractual stipulations, angel β receives:

$$B\left(\emptyset\right).$$

If angel β does not monitor, that is, is not hands-on, $c = 0$, and he or she waits until time t_1 for verification of success or failure at attainment to $F(t_1|t_0)$. If the firm is unsuccessful at time t_1, remedies that are contractually stipulated come into force and are executed, and equal

$$B(\emptyset).$$

If $F(t_1|t_0)$ is attained, there is not arrival at any disharmony, and $s(t_1|t_0) = 0$. In total, angel β incurs non-recoverable costs of:

$$c + s(t_1|t_0) = 0.$$

It is straightforward to see that it is only the decision not to be '*hands-on*' that is first-best rational.

QED. ■

Having established, in Axiom 1, the rational expectations outcome of predating of venture capital financing by angel financing, and non-meddling on part of angel investors in Axiom 2, we go on to assume receipt of angel financing at some origin time t_0, and receipt of venture capital financing at timing t_1 of achievement of project milestones. For conflict not to be endogenized in the modeling, financing terms arrived at between the entrepreneur, angel investor, and VC are assumed satisfactory to all parties, with outcome, at time t_1, relations between parties α, β, and δ are, in entirety, harmonious. We have then assumption of conditions that facilitate rational expectations in Axiom 2, specifically, we have that angel β did not engage in any hands-on monitoring between times t_0 and t_1, and has received fair valuation, from the entering VC, of capital invested in the project. With harmony of relations as backdrop, at time t_1, VC δ inputs his or her expertise into evolution of firm i's innovative project. Input of expertise into evolution of firm i's project is supported by empirical findings in studies, such as Kortum and Lerner (2000), Bottazzi et al. (2008), Nahata (2008), Krishnan and Masulis (2011), and Obrimah (2016a, 2016b) that VCs acquire market reputation in context of relations with entrepreneurs, fund principals, and investors located within exit markets. Evidence that reputation is linked with financing of innovative projects is provided in studies, such as, Lerner, Sorenson, and Stromberg (2011), Aggarwal and Hsu (2013), and Obrimah (2016a, 2016b).

In presence of input of expertise into firm i's project by VC δ, there exist three feasible *evolving scenarios*, Υ, namely:

1. Υ_1 : The risk profile implicit in the milestone ($F(t_1|t_0)$) that is achieved at time $t = t_1$ is maintained into the future.

2. Υ_2 : The risk profile implicit in the milestone ($\digamma\left(t_1|t_0\right)$ that is achieved at time $t = t_1$ is not maintained; rather VC δ raises the risk profile of firm i's project. Increase to riskiness of the project is the general equilibrium path to generation of increase to skewness of returns (Simkowitz and Beedles 1978), which is shown to be statistic for VCs' portfolio performance in Cochrane (2005) and Obrimah and Prakash (2010).

3. Υ_3 : The risk profile implicit in the milestone ($\digamma\left(t_1|t_0\right)$ that is achieved at time $t = t_1$ is not maintained; rather, VC δ lowers the risk profile of firm i's project. A priori, lowering of project risk is off equilibrium behavior. Study findings establish off equilibrium character of stated behavior.

In what follows, I turn attention towards modeling, in sequence, implications of each of Υ_1, Υ_2, and Υ_3 for probability of emergence of disagreement and conflict between angel β and VC δ.

2.1 Modeling of 'Conflict Propensities' Induced by Υ_1

In context of scenario, Υ_1, VC δ maintains risk profile of firm i's project. If conflict propensities are to be solely induced by interactions that transpire between angel β and VC δ, there is necessity of assumption of non-arrival of any adverse perturbations to the probability of success of firm i's project. Further, there is necessity of assumption of arrival at rational expectations outcomes. In presence of stated assumptions, Axiom 3 shows option Υ_1 is characterized by nullness of conflict propensities.

Axiom 3 *Suppose VC δ maintains the risk profile implicit in the milestone ($\digamma\left(t_1|t_0\right)$) that is achieved at time $t = t_1$ into the future. With conflict emanating from angel β, let π denote the probability of emergence of conflict - the propensity for conflict - between agents β and δ. Then, the resulting rational expectations equilibrium is characterized by,*

$$\pi\left(t_1\right) = \pi\left(t_2\right) = ... = \pi\left(t_N\right) = 0. \tag{9}$$

Proof. At time $t = t_1$, VC δ chooses to maintain the risk profile that is implicit in milestone $\digamma\left(t_1|t_0\right)$ that is achieved at time $t = t_1$. Milestone $\digamma\left(t_1|t_0\right)$ was specified by angel β at time t_0, achieved by firm i at time t_1, and valued appropriately by VC δ at time t_1. Let the probability of project success that is implicit in $\digamma\left(t_1|t_0\right)$ be denoted by $\upsilon\left(\digamma\right)$. Conditional on project success, let returns that accrue to firm i's project be denoted by $r\left(\digamma\right)$. At time $t = t_1$, prior to receipt of

financing from VC δ, we have that:

$$\upsilon_0 \left[\digamma \left(t_1 | t_0 \right) \right] = \bar{\upsilon} \tag{10}$$

$$r_0 \left[\digamma \left(t_1 | t_0 \right) \right] = \bar{r}. \tag{11}$$

Subsequent to provision of financing at time t_1, VC δ chooses to maintain the risk profile implicit in $\digamma \left(t_1 | t_0 \right)$. In presence of assumption of rational expectations outcomes and infusion of some expertise by VC δ, we have that

$$E_{t_1} \left\{ \upsilon_1 \left[\digamma \left(t_2 | t_1 \right) \right] \right\} \geq \upsilon_0 \left[\digamma \left(t_1 | t_0 \right) \right] = \bar{\upsilon} \tag{12}$$

$$E_{t_1} \left\{ r_1 \left[\digamma \left(t_2 | t_1 \right) \right] \right\} \geq r_0 \left[\digamma \left(t_1 | t_0 \right) \right] = \bar{r}. \tag{13}$$

Given equations (10) and (11) are established by angel β, and given equations (12) and (13), which are generated by VC δ, either establish or improve on angel β's contributions, VC δ's actions and expectations conform with those of angel β. In presence of conformance of actions and expectations, emergence of conflict from angel β implies conflict with attainment of his or her own parameters, clearly a contradiction. We conclude then that, in equilibrium,

$$\pi \left(t_1 \right) = \pi \left(t_2 \right) = ... = \pi \left(t_N \right) = 0.$$

QED. ■

Axiom 3 can, rather erroneously, be interpreted to imply that VC δ does not, in relation to angel β possess any expertise. This interpretation of Axiom 3 easily is shown, however, to be outcome of overlooking of necessity of backward induction compatibility of model parameters. Specifically, since angel β invests at time t_0 with the expectation that, ultimately, success of firm i's project will be facilitated by arrival of venture capital financing, or some alternate form of financing at time t_1, equations (10) and (11) already incorporate effects of arrival of a VC that is characterized by some representative ability. Suppose otherwise; then the milestone that is specified by angel β does not meet up with expectations of VCs, and there is arrival at contradiction of incapacity for attraction of venture capital financing. If the milestone is set higher than necessary for attraction of venture capital financing, the angel investor commits more capital and waits longer for achievement of the milestone, as such acts irrationally. Irrationality is evident in the fact that, given VCs arrive with more capital and more expertise, in presence of satisfaction of rational expectations, traversing of the

distance that subsists between the optimal milestone and a higher feasible milestone transpires at a faster rate, with outcome specification of the optimal milestone maximizes speed of progression for achievement of innovation outcomes. In presence of the foregoing, Axiom 3 does not embed the implication that ability of the representative VC does not exceed that of the representative angel investor. For concreteness, the general equilibrium assumption that technological ability of entrepreneurial teams exceeds that of VCs (see for example, Boyd and Prescott 1985; Takalo and Toivanen 2012) implies it is not ability of angels that is embedded in milestones, but rather, angels' understanding of milestones that will attract interest of VCs, milestones that reside within reach of entrepreneurial teams. In this respect, note that presence of a distribution of ability within continuums of entrepreneurial ability is consistent with higher realizations for technological ability within populations of entrepreneurs. Note also that, in presence of financing constraints that are binding, the finding in Amit, Glosten, and Muller (1990) that higher ability entrepreneurs withhold their projects from VCs ceases to be binding.

2.2 Modeling of 'Conflict Propensities' Induced by Υ_2

In context of scenario, Υ_2, subsequent to provision of financing, VC δ ramps up the risk profile for firm i's project. This choice induces two opposing outcomes. In presence of increase to the risk profile, rationality of increase to risk demands arrival at increase to probability of project failure. Simultaneously, conditional on project success, there is arrival at increase to project expected returns. In presence of assumption of rational expectations, and necessity of non-inducement of conflict by adverse actions on part of VC δ, conditions necessary for robustness of model workout are,

$$\upsilon_1 \left[F\left(t_2|t_1\right)\right] < \upsilon_0 \left[F\left(t_1|t_0\right)\right] = \bar{\upsilon} \tag{14}$$

$$E_{t_1}\left\{ r_1 \left[F\left(t_2|t_1\right)\right]\right\} > r_0 \left[F\left(t_1|t_0\right)\right] = \bar{r}. \tag{15}$$

$$\upsilon_1 \left[F\left(t_2|t_1\right)\right] \cdot E_{t_1}\left\{ r_1 \left[F\left(t_2|t_1\right)\right]\right\} > \upsilon_0 \left[F\left(t_1|t_0\right)\right] \cdot r_0 \left[F\left(t_1|t_0\right)\right] = \bar{\upsilon} \cdot \bar{r}. \tag{16}$$

While equations (14) through (16), respectively characterize probabilities, conditional returns, and expected returns, it already is established that projects which attract venture capital are characterized by relatively small probabilities of a huge payoff (see for example, Cochrane 2005; Obrimah and Prakash 2010). Huang and Pearce (2015) provide empirical evidence that angel investors look out for innovative projects that are characterized by small probabilities of a huge payoff. Wiltbank et al. (2009) and Mitteness et al. (2012) provide evidence that angel investors evaluate criteria that are predictive, not only of expected returns, but return distributions that feasibly could accrue from

projects. In presence of the evidence, we arrive at the inference that each of VCs and angel investors are characterized by skewness preference, with outcome projects funded by either of the two sets of agents have skewness profiles.

While each of Kraus and Litzenberger (1976) and Harvey and Siddique (2000) provide formal theoretical and empirical evidence for rationality of skewness preference, Kane (1982) establishes feasibility of irrationality of skewness preference. In presence of feasibility of predication of skewness preference on either of ability or irrationality, it cannot be assumed that, whenever demonstrated, skewness preference strictly is beneficial for project or portfolio outcomes. Obrimah (2019) provides corroborating formal theoretical and empirical evidence that skewness preference - preference for huge payoffs that occur with relatively low probabilities - can derive from either of expertise at identification of projects having such characteristics, or preference for lotteries. Studies that associate skewness preference with deviation from rational expectations, that is, deviations from full rationality link skewness preference with preference for lotteries and are inclusive of, Golec and Tamarkin (1998), Garrett and Sobel (1999), and Cain, Peel, and Law (2002). Evidence for increase to skewness of returns with asset risk, or increase to the price for skewness with improvements to skewness profiles of portfolios are provided in, respectively,Simkowitz and Beedles (1978) and Obrimah et al. (2015).

In presence of the foregoing, the risk profile for firm i's project is parameterized not only by expected returns (equation (16)), but also by the skewness of the conditional return distribution. Given increase to risk must be assumed not to produce deterministic outcomes, else arrival at a contradiction, that is, a riskless increase to risk, and given it is sub-optimal performance that has feasibility of generation of frictions, there is demand for arrival at a structured mapping from sub-optimal performance to probability of disagreement and conflict. The discussion to follow establishes what is termed, *conditional relative skewness*', ϖ_i to be a measure for probability of sub-optimal performance, and demonstrates existence of a well structured probability mapping from the probability of sub-optimal performance to propensity for emergence of disagreement and conflict between an entering VC, and a pre-existing angel investor.

Importantly, given the angel investor interacted with the entrepreneur with focus on achievement of innovation milestones, the angel investor's vested interest resides in innovation quality of the project. Given rational expectations demands project valuations increase with innovation quality, improvement to innovation quality is sufficient condition for maximization of project valuation. We have then that maintenance of focus on quality of the innovation that is embedded in the project is consistent with rational expectations. In the same vein, given IPOs provide highest non-time weighted returns to VCs (Gompers 1995), pursuit of an IPO exit by the entering VC is, absent

recourse to time-weighting of returns, consistent with rational expectations. Suppose, however, that the future value of proceeds from a third party acquisition exit at time $t = t_2$ compare favorably with IPO proceeds that are anticipated at some earliest future date, $t = t_2 + \varkappa$, $\varkappa > 0$. Combined, findings in Aggarwal and Hsu (2013) and Obrimah (2016a), both of which predict derivation of more reputation from an acquisition exit, recommend the third party acquisition exit, that is, a deviation from pursuit of an IPO exit.

Let CF denote cash flows, ϑ, a third party acquisition exit, and ζ, an IPO exit. In presence of satisfaction of stated condition, but yet maintenance of pursuit of an IPO exit, we arrive at inference of either of '*information myopia*', that is, non-recognition that,

$$CF\left(\vartheta, t_2\right)\left(1+r\right)^{\varkappa} \geq CF\left(\zeta, t_2+\varkappa\right), \tag{17}$$

or the belief that it always is the case that,

$$CF\left(\vartheta, t_2\right)\left(1+r\right)^{\varkappa} < CF\left(\zeta, t_2+\varkappa\right), \tag{18}$$

as such, at skewness preference that can turn out to be irrational, as such, having characterization as '*preference for lotteries*'. It is straightforward that while equation (17) is outcome of a non-computation, as such evidence for information myopia, that equation (18) derives from a belief. We have then that it cannot be asserted that equation (17) implies equation (18), or vice versa. Evidence that investments in stocks that are listed in public equity markets have character of 'gambles over lotteries' in studies, such as, Barberis, Huang, and Thaler (2006), Barberis and Huang (2008), and Kumar (2009) establish the necessarily empirical link between equation (18) and preference for lotteries. Axioms 4 through 7 all have character of customized applications of the finding in Cochrane (2005) that returns to venture capital backed IPOs are parameterized by conditional skewness, and predictions that skewness preference can turn out to be rational or irrational (Kraus and Litzenberger 1976; Kane 1982; Harvey and Siddique 2000; Obrimah 2019).

Definition 1 *Let project risk be parameterized by the variance of the conditional return distribution (Rothschild and Stiglitz 1970). Let ω_i and $\sigma_i = \bar{\sigma}$ denote, respectively, the skewness and riskiness of the conditional return distribution for firm i's project. Let $opm\left(\beta|\bar{\sigma}\right) = \omega\left(\beta\right)$ be the optimum for estimates of the skewness of conditional returns accruing to all projects that are comparable to firm i,*

of which angel β is cognizant. Then 'conditional relative skewness', ϖ_i is defined as,

$$\varpi_i = prob\left\{\omega_i > \left[opm\left(\beta|\bar{\sigma}\right) = \omega\left(\beta\right)\right]\right\}. \tag{19}$$

The function of conditional relative skewness is as follows. In Madan and Yen (2004), in presence of satisfaction of rational expectations, skewness is a sufficient statistic for expected returns. The finding, in Simkowitz and Beedles (1978), that, in equilibrium, riskiness of assets increases with skewness of returns implies anticipation of satisfaction of rational expectations induces economic agents to abstract away from variance and focus only on skewness. We have then that findings in Cochrane (2005) indicate VCs tend to function in context of formation and satisfaction of rational expectations equilibriums.

Let $\bar{\mu}$ denote expected returns, and $\bar{\sigma}$, the conditional standard deviation of returns. In presence of deviations from rational expectations, there is arrival at conditions in context of which skewness preference can be irrational (Kane 1982). Specifically, whereas satisfaction of rational expectations implies:

$$\varphi = \bar{\sigma} \cdot \omega \tag{20}$$

functionally is equivalent to,

$$\dot{\varphi} = \bar{\sigma} \cdot \bar{\mu}, \tag{21}$$

in the sense that there exists a structural monotone mapping, h satisfying,

$$\dot{\varphi} = h\left(\varphi\right), \tag{22}$$

in presence of deviations from rational expectations,

$$\dot{\varphi} \neq h\left(\varphi\right) \tag{23}$$

because the structural relation that subsists between $\bar{\sigma}$ and ω, as such, between $\bar{\sigma}$ and μ is broken. The variable, *Conditional Relative skewness* enables transformation of the foregoing into a metric for expertise of VCs. Axiom 4 establishes the feasibility that a project ranks dead last in universe of similar projects with respect to *Conditional Relative skewness*. Axiom 5 demonstrates that, $\varpi_i = prob\left\{\omega_i > \left[opm\left(\beta|\bar{\sigma}\right) = \omega\left(\beta\right)\right]\right\} < 0.50$ is sufficient condition for inducement of a positive probability for deterioration to risk-return trade-offs. Axiom 6 establishes existence of a mapping from $\varpi_i = prob\left\{\omega_i > \left[opm\left(\beta|\bar{\sigma}\right) = \omega\left(\beta\right)\right]\right\}$ to probability of emergence of disagreement (equivalently,

probability of deterioration to risk-return trade-offs) between the entering VC and pre-existing angel investor. Importantly, Axiom 6 establishes, conditional on rightness of the angel investor's prior that the entering VC has induced deterioration to risk-return trade-offs, that disagreement and conflict have character of a rational expectations equilibrium.

Axiom 4 *Suppose assets κ all having similar conditional risk, $\bar{\sigma}_\kappa = \bar{\sigma}_i = \bar{\sigma}$. If $\varpi_i = prob\{\omega_i > [opm(\beta|\bar{\sigma}) = \omega(\beta)]\} < 0.50$, and $\varpi_i < \varpi_\kappa$ for all κ, the increase to risk profile of firm i's project that is induced by VC δ evinces preference for lotteries.*

Proof. Suppose

$$\varpi_i = prob\{\omega_i > [opm(\beta|\bar{\sigma}) = \omega(\beta)]\} < 0.50.$$

Suppose $\exists$ some alternate comparable firm, κ that resides within angel β's investment opportunity set for which, $\bar{\sigma}_i = \bar{\sigma}_\kappa = \bar{\sigma}$ is accompanied by,

$$\varpi_\kappa = prob\{\omega_\kappa > [opm(\beta|\bar{\sigma}) = \omega(\beta)]\} \geq \varpi_i.$$

Clearly,

$$\begin{aligned} \varphi_i &= \bar{\sigma} \cdot \omega_i \\ &< \bar{\sigma} \cdot \omega_\kappa \\ &= \varphi_\kappa. \end{aligned}$$

We have then that,

$$\varphi_i < \varphi_\kappa \ \forall \ \kappa. \tag{24}$$

In presence of ubiquity of equation (24), angel β infers that VC δ's actions are representative of preference for lotteries. Imposition of rational expectations, that is, absence of perturbations to either of ϖ_i or ϖ_κ completes the proof.

QED. ■

Axiom 5 *If $\varpi_i = prob\{\omega_i > [opm(\beta|\bar{\sigma}) = \omega(\beta)]\} < 0.50$, there exists a strictly positive probability, $q_1 > 0$ that*

$$v_1[F(t_2|t_1)] \cdot E_{t_1}\{r_1[F(t_2|t_1)]\} < v_0[F(t_1|t_0)] \cdot r_0[F(t_1|t_0)],$$

with outcome VC δ feasibly induces performance that is worse than already is made possible by angel β.

Proof. Let $\bar{\mu}$ denote the mean that subsists in context of satisfaction of rational expectations. In presence of deviation from rational expectations, we arrive at either of, $\mu_i > \bar{\mu}$ or $\mu_i < \bar{\mu}$. Using statistical theory, it normatively must be the case that the ω_i that correspond to the two deviations from rational expectations satisfy,

$$[\omega_i (\mu_i > \bar{\mu})] > [\omega_i (\mu_i = \bar{\mu})] > [\omega_i (\mu_i < \bar{\mu})]. \tag{25}$$

The assumption that deviations from rational expectations occur randomly, are normally distributed, and yield risk that is not anticipated generates:

$$prob\{\omega_i (\mu_i < \bar{\mu})\} < 0.50. \tag{26}$$

and

$$\mu_i \neq f(\bar{\sigma}_i), \tag{27}$$

with outcome, the conditional variance of returns, $\bar{\sigma}_i$ no longer is a statistic for expected returns. Clearly, equations (25) through (27) imply the condition, $\varpi_i = prob\{\omega_i > [opm(\beta|\bar{\sigma}) = \omega(\beta)]\} < 0.50$, is equivalent to *negative conditional relative skewness*, and embeds unanticipated risks. Given VC δ priced the project in context of rational expectations at time $t = 1$, the rational expectations boundary condition, $\upsilon_1 [F(t_1|t_0)] \cdot r_1 [F(t_1|t_0)]$, coincides with $\omega_i (\mu_i = \bar{\mu})$.

Let $\mu_1 [F(t_2|t_1)]$ denote actual outcomes, and $\upsilon_i [F(t_{i+1}|t_i)] \cdot E_{t_i} \{r_i [F(t_{i+1}|t_i)]\}$ the rational expectations outcome. We have that, $\varpi_i = prob\{\omega_i > [opm(\beta|\bar{\sigma}) = \omega(\beta)]\} < 0.50$ coincides with $\omega_i (\mu_i < \bar{\mu})$, with outcome we arrive at feasibility of:

$$\begin{aligned} \mu_1 [F(t_2|t_1)] &< \upsilon_0 [F(t_1|t_0)] \cdot r_0 [F(t_1|t_0)] \\ &\leq \upsilon_1 [F(t_2|t_1)] \cdot E_{t_1} \{r_1 [F(t_2|t_1)]\}. \end{aligned} \tag{28}$$

Simultaneously, $\varpi_i = prob\{\omega_i > [opm(\beta|\bar{\sigma}) = \omega(\beta)]\} > 0.50$ coincides with $\omega_i (\mu_i > \bar{\mu})$, with outcome we arrive at feasibility of:

$$\begin{aligned} \mu_1 [F(t_2|t_1)] &> \upsilon_1 [F(t_2|t_1)] \cdot E_{t_1} \{r_1 [F(t_2|t_1)]\} \\ &\geq \upsilon_0 [F(t_1|t_0)] \cdot r_0 [F(t_1|t_0)]. \end{aligned} \tag{29}$$

We conclude then that $\exists$ a strictly positive probability $q_1 > 0$ for arrival at the outcome:

$$\begin{aligned} \mu_1 \left[F\left(t_2|t_1\right)\right] &< \upsilon_0 \left[F\left(t_1|t_0\right)\right] \cdot r_0 \left[F\left(t_1|t_0\right)\right] \\ &\leq \upsilon_1 \left[F\left(t_2|t_1\right)\right] \cdot E_{t_1} \left\{ r_1 \left[F\left(t_2|t_1\right)\right]\right\}, \end{aligned}$$

as such, at deterioration to project risk-return trade-offs - increase to risk and decrease to the marginal return to risk evinces deterioration to risk-return trade-offs.

QED. ■

Axiom 6 *Suppose conditional relative skewness, that is,* $\varpi_i = prob\left\{\omega_i > \left[opm\left(\beta|\bar{\sigma}\right) = \omega\left(\beta\right)\right]\right\}$. *Let* g *be a monotone decreasing function of* ϖ_i. *Then, conflict propensity,* π *satisfies,*

$$\pi_{1,i}\left(\beta\right) = g\left(\varpi_i\right) > 0 \ \forall \ \kappa \tag{30}$$

$$\pi_i\left(\beta\right) = 1 \ \textit{if} \ \varpi_i = 0 \tag{31}$$

$$\sum_{i=1}^{N} \pi_{1,i}\left(\beta\right) = 1 \ \textit{only if} \ \pi_{1,i}\left(\beta\right) \neq 0, \tag{32}$$

with outcome, (a) the probability of deterioration to risk-return trade-offs, π, *equivalently, the probability of emergence of disagreement and conflict satisfies conditions specified in Savage (1972) for existence of a rational expectations equilibrium 'if and only if', relative to universe of all comparable risk projects,* κ, *project* i *satisfies:*

$$\varpi_i = prob\left\{\omega_i > \left[opm\left(\beta|\bar{\sigma}\right) = \omega\left(\beta\right)\right]\right\} \neq 0; \tag{33}$$

that is, only if there exists a strictly positive probability for the deterioration to risk-return trade-offs.

Proof. Angel β's reservation return is:

$$\upsilon_1 \left[F\left(t_1|t_0\right)\right] \cdot r_1 \left[F\left(t_1|t_0\right)\right] > 0. \tag{34}$$

Using Axioms 4 and 5, $\exists$ a strictly positive probability, $q_1 > 0$ that

$$\begin{aligned} \mu_1 \left[F\left(t_2|t_1\right)\right] &< \upsilon_1 \left[F\left(t_2|t_1\right)\right] \cdot E_{t_1} \left\{ r_1 \left[F\left(t_2|t_1\right)\right]\right\} \\ &< \upsilon_0 \left[F\left(t_1|t_0\right)\right] \cdot r_1 \left[F\left(t_1|t_0\right)\right], \end{aligned}$$

with outcome $\exists$ a strictly positive probability π_i, satisfying,

$$\pi_1 \neq q_1 > 0 \tag{35}$$

$$0 < \pi_1 < q_1 \tag{36}$$

that

$$\mu_1 \left[F\left(t_2|t_1\right)\right] < \bar{\mu}_0 \left[F\left(t_1|t_0\right)\right]. \tag{37}$$

Let Σ denote the set consisting of all ϖ_i satisfying,

$$\varpi_i = prob\left\{\omega_i > \left[opm\left(\beta|\bar{\sigma}\right) = \omega\left(\beta\right)\right]\right\}. \tag{38}$$

Let $\{\varpi_1, \varpi_2\} \in \Sigma$, satisfy $\varpi_1 < \varpi_2$. Then, rationality of angel β demands,

$$\pi_1\left(\varpi_1\right) > \pi_1\left(\varpi_2\right). \tag{39}$$

By iteration,

$$0 \leq \varpi_1 < \varpi_2 < ... < \varpi_N \leq 1.00 \tag{40}$$

$$\rightarrow 1 \geq \pi_1\left(\varpi_1\right) > \pi_1\left(\varpi_2\right) > ... > \pi_1\left(\varpi_N\right) \geq 0. \tag{41}$$

Combined, equations (40) and (41) imply existence of a monotone decreasing function, g satisfying:

$$\pi_{1,i}\left(\beta\right) = g\left(\varpi_i\right) \geq 0 \ \forall \ i. \tag{42}$$

Suppose $\varpi_i \cong 0$. Then since ϖ_i parameterizes all projects that are similar in risk to firm i's project, the probability $\pi_1 \neq q_1 > 0$ that

$$\mu_1 \left[F\left(t_2|t_1\right)\right] < \bar{\mu}_0 \left[F\left(t_1|t_0\right)\right]$$

generates

$$\pi_1\left(\beta\right) = 1.$$

Given $opm\left(\omega_\kappa\right)$ exists, because N produced by, $\kappa = 1, ..., n$ is finite,

$$\varpi_i = prob\left\{opm\left(\omega_i\right) > \left[opm\left(\beta|\bar{\sigma}\right) = \omega\left(\beta\right)\right]\right\} = 0,$$

$$\rightarrow \pi_{1,i}(\beta) = 0 \text{ is feasible.}$$

If $\pi_1(\beta) = 1$, $\exists$ only one feasible realization for π, and the necessary condition, $\sum_{i=1}^{N} \pi_{1,i}(\beta) = 1$ is satisfied. If $\pi_1(\beta) = 0$, there is not any risk created, and probability, π is inappropriate to characterization of risk of project i. If $0 < \pi_i(\beta) < 1$, all feasible realizations for $\pi_i(\beta)$ necessarily satisfy, $\sum_{\kappa=1}^{N} \pi_{1,i}(\beta) \equiv \sum_{\kappa=1}^{N} \pi_{1,\kappa}(\beta) = 1$. We arrive then at $\pi_{1,i}(\beta) > 0$ as necessary condition for satisfaction of rational expectations. Given all projects, κ are unique and disjoint, as such, non-aggregable, the set, $\{[\pi_{1,\kappa}(\beta)] \cup [\pi_{1,\kappa+1}(\beta)] = \emptyset,\ \kappa = 1, ..., n-1\}$ and the set, $\cup_{\kappa=1}^{n} \pi_{1,\kappa}(\beta) = \emptyset$, that is, are non-existent. We arrive then at non-applicability of one of three conditions stipulated to be satisfied in Savage (1972). In aggregate, conditional on $\pi_{1,i}(\beta) > 0$, we arrive at the inference that $\pi_{1,i}$ is well defined, that is, satisfies all conditions - endogenous to its context - that are enumerated in Savage (1972) for its characterization as a qualitative probability measure.

QED. ■

Axiom 6 establishes the first main result of the study. Importantly, disagreement and conflict arise in context of a rational expectations equilibrium '*if and only if*' the relative conditional skewness of the project under consideration is not equivalent to the optimum for all projects of similar risk, of which the angel investor has awareness. In presence of satisfaction of stated necessary and sufficient condition, disagreement and conflict has character of a rational expectations equilibrium, that is, is 'normal' and is general equilibrium path for interactions that subsist between the entering VC and the pre-existing angel investor. Consider then, that we arrive at two feasible paths for general equilibrium, namely the path, in context of which there does not exist any rational expectations basis for disagreement and conflict, and the path that validates disagreement and conflict as rational expectations equilibrium. In presence of validation of two feasible paths, we arrive at robustness of the formal theoretical structure, that is, robustness of assumptions, modeling, and formal theoretical predictions.

Combined, Axioms 4 through 6 establish conditions that justify emergence of disagreement and conflict from the pre-existing angel investor. We have yet, however, to establish conditions under which the entering VC rationally and absent willful intention, unable to agree with the pre-existing angel investor. Equivalently, we have yet to establish essence of asymmetries, such as beliefs or information myopia that, absent any wilful intention, induce the entering VC to disagree with evidence proffered by a pre-existing angel investor. Axiom 7 establishes that the entering VC is characterized by either of information myopia, or preference for lotteries. While preference for lotteries ideally is inconsistent with rational expectations, Axiom 7 shows that, regardless of pricing of

skewness in stock markets induces a rational expectations equilibrium. In essence, by backward induction compatibility (Kohlberg and Mertens 1986), pricing of skewness in stock markets confers legitimacy, equivalently, rationality on preference for lotteries. We arrive then at the implication that it is, perhaps the manner in which risk is priced in stock markets that induces investment decisions to take on character of gambles over lotteries (Barberis and Huang 2008).

Axiom 7 *Suppose the necessary and sufficient condition for emergence of disagreement and conflict from the pre-existing angel investor that is established in Axiom 6. We have that either of information myopia, or combination of information myopia and preference for lotteries induce an entering VC to disagree with the pre-existing angel investor for arrival at a 'disagreement-disagreement' rational expectations equilibrium.*

Proof. Suppose findings in Cochrane (2005), to wit, returns that accrue to venture capital backed IPOs are defined by skewness. Suppose also that skewness preference can be rational (Kraus and Litzenberger 1976; Harvey and Siddique 2000; Obrimah 2019), that is, beneficial for expected returns, but past some optimal realization, $opm\left(\omega_i\right)$, becomes irrational, as such, costly (Kane 1982). Using enumerated studies, we arrive at:

$$\frac{\partial r_i}{\partial \omega_i} > 0 \tag{43}$$

$$\frac{\partial^2 r_i}{\partial \omega_i^2} < 0. \tag{44}$$

Combined, equations (43) & (44) predict $\exists\ \dot{r}_i < r_i\left[opm\left(\omega_i\right)\right]$ and $\ddot{r}_i > r_i\left[opm\left(\omega_i\right)\right]$ satisfying:

$$\dot{r}_i = \ddot{r}_i < r_i\left[opm\left(\omega_i\right)\right]. \tag{45}$$

Equation (45) establishes that, relative to returns, rational skewness cannot be distinguished from skewness that is irrational. We have then that returns, which accrue to 'more than optimum' skewness are sufficient statistics for returns that accrue to 'less than optimum' skewness. We arrive then at following consistency with Axiom 6, namely,

$$\varpi_i = prob\left\{\omega_i > \left[opm\left(\beta|\bar{\sigma}\right) = \omega\left(\beta\right)\right]\right\} \equiv prob\left\{\omega_i < \left[opm\left(\beta|\bar{\sigma}\right) = \omega\left(\beta\right)\right]\right\}, \tag{46}$$

and the inference that each of rational 'less than optimum' skewness and corresponding irrational, 'more than optimum' skewness are priced exactly the same in stock markets. In presence then, of evidence from the pre-existing angel investor for deterioration to risk-return trade-offs, the empirical

evidence available to the entering VC is consistent with arrival at rational 'less than optimum' skewness. We arrive then at information myopia. The VC, as such, disagrees.

Let $\Vdash$ denote '*less compact than*'. The mathematical principle that, a mean preserving spread, $F(\hat{r}_i)$ of $F(\tilde{r}_i)$ satisfying,

$$F(\hat{r}_i) \Vdash F(\tilde{r}_i) \tag{47}$$

necessarily implies combination of:

$$E(\hat{r}_i) = E(\tilde{r}_i) \tag{48}$$

$$\omega(\hat{r}_i) > \omega(\tilde{r}_i) \tag{49}$$

and necessity of satisfaction of,

$$[\omega(\hat{r}_i) > \omega(\tilde{r}_i)] \rightarrow E(\hat{r}_i) > E(\tilde{r}_i) \tag{50}$$

in general equilibrium establishes the combination in equations (48) & (49) to be characteristic of realizations that subsist off equilibrium. Disagreement with the angel investor that is facilitated by equation (45) and optimality of disagreement on part of the angel investor that is established in Axiom 6 transforms the off equilibrium path into an alternate *disagreement-disagreement* general equilibrium path.

Suppose optimal realization for riskiness of the project is σ^*. If $\bar{\sigma} < \sigma^*$, satisfaction of rational expectations implies (Simkowitz and Beedles 1978; Cochrane 2005; Obrimah and Prakash 2010) increase of risk from $\bar{\sigma}$ to σ^* induces increase to skewness of returns from ω to ω^*, with outcome there is arrival at increase to expected returns from, $\bar{\mu}$ to μ^*.

Given the entering VC bought into the project in context of satisfaction of rational expectations, it must be the case that

$$\bar{\sigma} \not> \sigma^*,$$

else the VC acts irrationally.

Suppose then, that, at timing of buy-in of the VC,

$$\bar{\sigma} = \sigma^*.$$

Imposition of rational expectations demands that increase to risk, such that $\bar{\sigma} > \sigma^*$, implies deterioration to returns, that is, $\bar{\mu} < \mu^*$. Given $[\bar{\sigma} > \sigma^*] \rightarrow [\omega_i > opm(\omega_\kappa)]$ - Simkowitz and Beedles

(1978) - absent pricing of conditional skewness in IPO markets, the VC is parameterized by skewness preference that is irrational. Given it is contradictory, however, that a less able VC achieves $\omega_i = opm(\omega_\kappa)$, equivalence of pricing of *more-than* or *less-than* optimum sequence in equation (45) confers backward induction compatibility rationality (Kohlberg and Mertens 1986) on skewness preference that, otherwise, is irrational. We arrive then, yet again, at a *disagreement-disagreement* rational expectations equilibrium.

QED. ■

The proof of Axiom 7 establishes that, empirically, an entering VC that is characterized by information myopia is not distinguishable from an entering VC that is characterized by preference for lotteries. However, while preference for lotteries is induced at timing of buy-in into a project - insistence on demonstration of ability in context of a project whose risk-return trade-offs already are maxed out - information myopia transpires at timing of realization of efforts at inducement of increase to project returns via increase to project risk. In essence, while preference for lotteries is induced by behaviors of VCs, such as overconfidence or preference for lotteries, the assumption that VCs have ability, as such are able to distinguish, $\bar{\sigma} = \sigma^*$ from $\bar{\sigma} < \sigma^*$ implies information myopia is induced only in context of evaluation of project outcomes. As with information myopia that is not accompanied by preference for lotteries, it is pricing of more-than optimal conditional skewness in IPO markets that, by the backward induction compatibility principle (Kohlberg and Mertens 1986) confers rationality on preference for lotteries. We arrive then at the implication that there exists room, perhaps, for improvements to pricing of securities in stock markets.

Importantly, Axiom 7 corroborates Axiom 6, establishes, in presence of either of preference for lotteries or information myopia that disagreement is general equilibrium response of the entering VC to emergence of disagreement from the pre-existing angel investor. Given we arrive at a *disagreement-disagreement* equilibrium, we arrive at a general equilibrium outcome that is alternate to the main equilibrium, namely, *agreement-agreement*. Given *agreement-agreement* is feasible only if the necessary and sufficient condition in Axiom 6 is not satisfied, that is, only if, $\omega_i = opm(\omega_\kappa)$, in presence of greater feasibility of $\omega_i < opm(\omega_\kappa)$, there is arrival at *disagreement-disagreement* as the prevalent general equilibrium. If VCs and angel investors anticipate *disagreement-disagreement* as prevalent general equilibrium, adoption of an '*avoid the other if you can*' strategy facilitates exact same equilibrium, but yet avoids frictions that come along with emergence of disagreement and conflict in context of specific projects. While the 'avoid the other if you can' strategy eliminates deadweight costs that are induced by disagreement and conflict in respect of specific projects,

simultaneously, it transfers said deadweight costs to 'would be' entrepreneurs and society at large. The rationale is straightforward. First, since innovations that have the most potential at seed or start-up stage are more likely than not to require venture capital in future, the avoid the other if you can strategy implies avoidance of such ventures by angel investors. Given VCs tend not to want to invest in such ventures at seed or start-up stage, there exists likelihood of non-survival of some of the most innovative projects in the entrepreneurial ecosystem. We arrive then at shortfalls to innovation, and shortfalls of innovations that are of the highest quality.

2.3 Robustness to Hellmann and Thiele (2002)

Suppose an entering VC finds adverse realizations for ϖ_i that are accompanied by more than commensurate increases to scale of firm i, tolerable. In presence of a negative relation between ownership of VCs and angel investors that is induced by additional infusions of capital by the VC (Wright et al. 2007), while increase to scale is beneficial for the VC, angel investors lose out on each of scale and return effects. Relative to the equilibrium that subsists prior to participation of the entering VC then, there is loss of *relative wealth* - loss of returns and proportional ownership - for the pre-existing angel investor. We arrive then at transfers of wealth from the angel investor to the entering VC. Absent an entering VC's personal commitment to maintenance of beneficial realizations for ϖ_i, with control of firm i ceded to the VC, the reality is, a pre-existing angel investor is, in entirety, at mercy of an entering venture capitalist. Given we arrive at presence of self interest that is prejudicial to the angel investor, and that is not first-best rational - project returns could be higher - we arrive at an off equilibrium behavior and outcome. Dichotomy of the foregoing from findings in this study is evident in the fact that, whereas combination of attenuation of ϖ and increase to scale induces a beneficial outcome for the VC, in this study, in absence of increase to scale, the VC is as worse off as the angel investor. In aggregate, in presence of awareness of the trade-off, of which ϖ is representative, with outcome we arrive at deliberacy of actions and adverse impact of those actions on angel investors, we arrive at effects that are predicted in Hellmann and Thiele (2002). In essence, we arrive at deliberacy of the decision to 'grandstand', as such, deliberacy of crafting of a project that investors find attractive, perhaps because, as is necessary to subsist in general equilibrium (Axiom 6), investors are unable to distinguish rational realizations of skewness from irrational realizations of skewness. Consider, however, that 'burning' of the angel investor via payment of less than fair multiples by the entering VC is not a necessary condition for achievement of grandstanding - all that is necessary for grandstanding is overinvestment on part of the entering VC that produces irrational realizations of skewness. We have then that moral hazard is not a necessary condition for equivalents

of Axioms 6 and 7 that derive from deliberacy of grandstanding on part of a VC. Overinvestment is, of course beneficial for increases to scale of venture capital activity. For a discussion of feasibility of incorporation of the agency problem paradigm into studies of angel financing, see Fiet (1995) and Hsu, Simmons, and Mckelvie (2014). For a survey of, among other types of entrepreneurial financing, angel financing, see Drover et al. (2017).

In aggregate, with exception of the assumption that angel investors fund start up firms with foreknowledge that they prepare the ground for receipt of financing from more sophisticated investors, such as VCs, neither of the formal theoretical structure nor predictions in this study overlap with formal theoretical structure and predictions in Hellmann and Thiele (2002). For avoidance of doubt, while the 'burned angel' problem is found, in Hellmann and Thiele (2002), to be beneficial for sizes of angel and venture capital markets, in this study, disagreement that engenders conflict is inimical to efficiency of venture capital markets and detrimental to Pareto optimality of financing of innovation activities. Given increase to size is known not to necessarily imply absence of deterioration to either of efficiency or Pareto optimality (see for example, DeYoung 1997; Chapin and Schmidt 1999; Kwoka and Pollitt 2007), there is not arrival at any contradictions between this study and Hellmann and Thiele (2002). We arrive then at complementarity of modeling assumptions and outcomes, and absent moral hazard, robustness of predictions in this study to generation of scale effects that are essence of findings in Hellmann and Thiele (2002).

2.4 Modeling of 'Conflict Propensities' Induced by Υ_3

In context of the evolving scenario, Υ_3, subsequent to provision of financing, VC δ chooses to lower the risk profile of firm i's project. This choice induces two outcomes that reinforce one another. In presence of a lowering of the risk profile, there is arrival at a decrease to the probability of project failure. Simultaneously, conditional on project success, there is arrival at a decrease to project returns. Imposition of rationality demands that, combined, the lower probability of project failure, and decrease to conditional returns induce arrival at a decrease to conditional expected returns. Necessity of stated outcome is evident in the fact that were each of combination of higher probability of success and lower conditional returns, and combination of lower probability of success, and higher conditional returns (Axiom 6) to be associated with higher conditional expected returns, VCs are lacking in preferences that are well defined, clearly a contradiction. Contradiction is evident in the immediate corollary that, absent increase to expected returns, VCs cannot be deemed to have expertise.

Immediately, we arrive at an irrationality on part of VC δ, whom we already have assumed, in all of prior analyses to be rational. Irrationality is evident in the fact that, having paid for the level of

expected returns represented by $\upsilon_0 \left[F\left(t_1|t_0\right)\right] \cdot r_0 \left[F\left(t_1|t_0\right)\right]$ in order to become an investor in firm i's project, relative to the cost of participation, VC δ is willing to lose money. In presence of highlighted contradiction, and abstraction away from events that endogenize conflict, such as arrival of an adverse shock to firm i's investment opportunity set, we arrive at invalidity of option Υ_3 and an axiomatic condition for feasibility of demonstration of ability on part of VCs.

Axiom 8 *In presence of the assumption that VC δ is rational, and abstraction away from arrival of adverse shocks, which as reasonably could be expected, induce conflicts between entrepreneurs, angel investors, and VCs, option Υ_3 is an invalid evolving scenario.*

Proof. Follows from the foregoing. ■

Axiom 9 *Suppose Axioms 1 through 8, and suppose VCs that are not characterized by either of information myopia or preference for lotteries. If VCs generate performance surprises, they do not accept projects that are owned by the most able entrepreneurs and/or the most able angel investors.*

Proof. Only evolving scenario, Υ_2 facilitates increases to project returns. The necessary condition for increase to project returns in context of Υ_2 is,

$$\bar{\sigma} < \sigma^*. \tag{51}$$

The condition, $\bar{\sigma} < \sigma^*$ implies neither of entrepreneurs nor pre-existing angel investors have ability sufficient for maxing out of a project's risk-return profile. We have then that $\bar{\sigma} < \sigma^*$ is evidence for entrepreneurs and/or angel investors that are not the most able entrepreneurs or angel investors. With focus then, on seed stage or start-up ventures, absent financial constraints that are binding, the highest ability entrepreneurs and/or angel investors are unable to attract venture capital financing from VCs that seek to demonstrate ability.

QED. ■

2.5 Discussion of Study Findings

Essence of emergence of disagreement that is modeled in Axioms 4 through 7 is as follows. While each of Cochrane (2005) and Obrimah and Prakash (2010) find skewness of returns is statistic for project and portfolio expected returns within venture capital markets, and while Huang and Pearce (2015) find angel investors also are characterized by skewness preference, Kane (1982) finds skewness preference feasibly is irrational. Commencing then, with a normally distributed return distribution,

combined, we arrive at a strictly concave function for the skewness profile of an innovative project. In presence of a strictly concave function, increase to skewness of returns that is sub-optimally high can induce deterioration to structure of risk-return trade-offs. Refer to such sub-optimally high skewness as '*non-credible relative conditional skewness'*. It is straightforward that non-credible skewness has character of a gamble over lotteries (Garrett and Sobel 1999; Cain, Peel, and Law 2002). It further is true that, for every realization of non-credible skewness, there exists a realization of '*lower than optimum relative conditional skewness*' that generates exactly the same return. Given the two sets of projects earn exactly the same returns, VCs erroneously can regard the two sets of projects to be informationally equivalent. While then, the two sets of projects differ informationally, with focus on returns, VCs regard the two sets of projects to be identical. With returns having character of public information, and ranking with respect to relative conditional skewness having character of fundamental information, Docherty and Hurst (2018) arrive at similar prediction, that is, arrival at myopia in respect of fundamental information. We arrive then at information myopia that induces acceptance of gambles over lotteries. Rational expectations response of disagreement from the pre-existing angel investor induces an alternate *disagreement-disagreement* general equilibrium. Axiom 7 shows conferring of rationality on non-credible conditional skewness by pricing of conditional skewness in IPO markets facilitates the same *disagreement-disagreement* general equilibrium. The discussion in Section 2.3 shows deliberacy of decision to grandstand in spirit of Gompers (1996) also is more likely than not to produce the same *disagreement-disagreement* equilibrium. In aggregate, consistent with findings in literature on persistence of disagreement (see for example, Whitcomb 2010; Elgin 2010; Lam 2011; Kelly 2019; Henderson et al. 2017), we arrive at asymmetries that are rational, that is, that induce an alternate specification of general equilibrium. Importantly, as is explicitly developed in Axiom 9, we arrive at the inference that neither of the probability of an IPO exit, nor post-IPO growth rates of firms that are backed by angel investors yield robust inferences in respect of ability of angel investors. Said prediction remains robust in presence of angel investors only as financiers of firms, because pressure from an entrepreneur who holds majority votes can, regardless of disagreement from an angel investor, force an IPO exit. In stated respect, it is well established that liquidity and diversification concerns induce demand for IPOs in populations of entrepreneurs (see for example, Ritter and Welch 2002, and relevant citations therein).

3 Conclusions

Suppose a firm in need of external equity financing. If the firm is amenable to receipt of each of angel financing and venture capital financing, and seeks to sequence the two forms of financing, formal theoretical predictions show conformance with general equilibrium demands angel financing predate receipt of venture capital financing. This result does not depend on application of labels of 'angel investor' or 'venture capitalist', rather is predicate of the general equilibrium path for the demand for growth financing. While a start-up or seed stage venture feasibly receives venture capital financing prior to participation of an angel investor, such a reversal subsists 'off equilibrium', implies existence of some imperfection or friction that is source of the deviation. If angel investors primarily fund achievement of innovation milestones, the finding that angel investors tend not to 'meddle' in running of start-ups or seed stage ventures in which they are invested (Leshchinskii 2002; Fairchild 2011) has character of a rational expectations equilibrium.

Suppose satisfaction of enumerated general equilibrium conditions, and suppose an entering venture capitalist (VC) offers fair terms for participation in a project that already is invested in by a business angel. In presence of an offer of fair terms, there is avoidance of the "burned angels" problem that is modeled in Hellmann and Thiele (2002), and arrival at what can be referred to as an 'harmonious' setting for interactions that subsist between the entrepreneur, the angel investor, and the venture capitalist. In context of the harmonious setting, and in absence of any agency problems, this study addresses the question, "does there exist any feasibility of inducement of conflict between the angel investor and the venture capitalist?" Given the model in Hellmann and Thiele (2002) explicitly assumes moral hazard on part of a venture capitalist (VC), it is straightforward that the model in that study does not address stated objective.

In presence of stated harmonious setting and absence of agency problems, formal theoretical predictions establish existence of two general equilibrium paths characterized by '*agreement-agreement*', or '*disagreement-disagreement*' between the VC and angel investor. Given the disagreement-disagreement equilibrium is established to be the more prevalent of the two feasible general equilibrium outcomes, there is arrival at the inference that disagreement is general equilibrium feature of interactions that subsist between VCs and angel investors. We arrive then at formal theoretical evidence that disagreement that is persistent can be rational, normal, and essence of interactions that subsist in general equilibrium between economic agents. If disagreement is rational, as such, persistent, there exist asymmetries whose sources are exogenous to economic agents that induce disagreement (see for example, Whitcomb 2010; Elgin 2010; Lam 2011; Henderson et al. 2017;

Kelly 2019). Rational and exogenous sources of asymmetry that induce persistence of disagreement are as follows.

In presence of a strictly concave relation between expected returns and the conditional skewness of returns (combined, Kraus and Litzenberger 1976; Kane 1982; Axioms 6 and 7), and evidence that VCs' expected returns from IPOs are parameterized by conditional skewness (Cochrane 2005), for each realization of '*lower than optimal conditional skewness*', there exists some realization of '*higher than optimal conditional skewness*', which generates exactly the same expected return. For projects then that are parameterized by exactly the same riskiness, that is, native volatility, each of lower or higher than optimal conditional skewness generate exactly the same returns. Given investors rank performance of VCs on risk-return trade-offs, investors rationally are 'blind' to higher than optimal realizations for conditional skewness. Blindness is rational, because conditional on interest in IPOs that are characterized by higher than optimal conditional skewness, awareness does nothing to alter pricing of a venture capital backed IPOs. In light of rationality of blindness of investors to higher than optimal conditional skewness, rationality of VCs induces same blindness. We arrive, as such, at information myopia that is rooted in rationality of VCs and investors in public equity markets. The assumption that angel investors fund start-ups or seed stage ventures primarily for achievement of innovation objectives implies presence of vested interest in quality of innovation. The finding, in Aggarwal and Hsu (2013) and Obrimah (2016a, 2016b) that the most innovative ventures tend to be exited via third party sales, as opposed to IPOs implies dearth of ventures that are characterized by optimal conditional skewness in public equity markets. Given quality of innovation, equivalently, project risk-return trade-offs, is maximized at the optimal realization for conditional skewness, in absence of a strict preference for IPOs (Landström 1993; Colliwaert 2012; Harrison, Botelho, and Mason 2016; Botelho, Harrison, and Mason 2019), angel investors are not blinded by pricing of conditional skewness in public equity markets, as such have capacity for inferring arrival at higher than optimal conditional skewness. With angel investors generating inferences from fundamentals of ventures; VCs basing inferences on anticipated responses of investors in public equity markets; and dearth of ventures parameterized by optimal conditional skewness in public equity markets; there is arrival at asymmetry of estimation of risk-return trade-offs, as such, arrival at disagreement and conflict. In essence, while the VC maintains that pricing of IPOs implies arrival at a desirable realization for conditional skewness, fundamental information available to the angel investor evinces arrival at higher than optimal conditional skewness. Docherty and Hurst (2018) provide corroborating evidence; in presence of each of fundamental and publicly available information, find investors exhibit information myopia in respect of fundamental information. While information

myopia in respect of venture outcomes remains necessary for inducement of disagreement, the formal theory establishes that preferences for lotteries at timing of investment decisions on part of VCs also induces arrival at a *disagreement-disagreement* general equilibrium.

Study context and predictions all obtain in context of general equilibrium, with implication disagreement and conflict can, absent any agency problems, be legitimate and ubiquitous. In presence of general equilibrium nature of disagreement and conflict, there is prediction of segmentation of activities of angel investors and VCs, as such, arrival at a robust formal theoretical explanation for empirical evidence of exactly such segmentation between financing activities of VCs and angel investors (see for example, Chahine, Filatotchev, and Wright 2007; Ibrahim 2008; and Harrison, Botelho, and Mason 2016). In light of the empirical evidence, we arrive at the inference that VCs and angel investors anticipate prevalence of *disagreement-disagreement* equilibriums, as such, adopt an 'avoid the other if you can' strategy. With the realization in tow that the most innovative ventures typically are unable to attract either of venture capital or debt financing at seed stage (see for example, Freear et al. 1994, Prowse 1998, Lerner 1998), in presence of shying away of angel investors from such firms - because they are anticipated to require venture capital financing at later stages of firm development - we arrive at feasibility of failure of some of the most innovative projects in an economy. Regardless then, of adoption of an '*avoid the other if you can*' strategy, society ends up with sub-optimality of each of, quality of innovations, quantities of high quality innovations, and cessation of business activities by, perhaps, some of the most innovative 'would be' entrepreneurs in the entrepreneurial ecosystem. Given all of the sub-optimality that is induced is of the opportunity cost type, non-visibility of the costs cannot be presumed to imply non-significance of the costs.

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