Intermediation Variety

JASON RODERICK DONALDSON, GIORGIA PIACENTINO, and ANJAN THAKOR*

ABSTRACT

We explain why banks and nonbank intermediaries coexist in a model based only on differences in their funding costs. Banks enjoy a low cost of capital due to safety nets and money-like liabilities. We show that this can actually be a disadvantage: it generates a soft-budget-constraint problem that makes it difficult for banks to credibly threaten to withhold additional funding to failed projects. Nonbanks emerge to solve this problem. Their high cost of capital is an advantage: it allows them to commit to terminate funding. Still, nonbanks never take over the entire market, but other coexist with banks in equilibrium.

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Corresponding author: Giorgia Piacentino. Contact information: g.piacentino@gsb.columbia.edu.

Depository financial institutions—"banks"—have a low cost of capital,[1] arguably because their liabilities benefit from a moneyness premium and government safety nets. Perhaps due to this funding cost advantage over nonbanks, banks provided the bulk of finance until the late 1970s, when deregulation removed barriers to entry. Incumbent banks then faced increased competition from new entrants,[2] particularly from nondepository financial institutions—"nonbanks." As Remolona and Wulfekuhler (1992) observe,

> During the 1980s, U.S. commercial banks faced increased competition in their lending activities from other financial intermediaries...[which] enjoyed their success despite carrying apparently heavier capital burdens and lacking the advantage of deposit insurance (p. 25).

Indeed, it even seemed that nonbanks, such as venture capitalists (VCs) and finance companies, could replace banks. In a paper entitled "Are Banks Dead?," Boyd and Gertler (1994) write that

> It is widely believed that in the United States, commercial banking is a declining industry [because] nonbank credit alternatives have grown rapidly over the last 15 years (p. 2).

But banks remain alive and well today, with over \$12.5 trillion in deposits in the US.[3] At the same time, nonbanks continue to compete with banks, overcoming their funding cost disadvantage and providing a substitute form of business finance.

Nonbanks differ from banks in a number of ways. Compared to banks, they (i) finance different kinds of entrepreneurs. Specifically, they are particularly likely to finance start-ups and other innovative entrepreneurs, which are associated with relatively high agency costs due to imperfect information or misaligned incentives. Further, they (ii) charge entrepreneurs relatively high rates, (iii) have relatively short-term relationships, (iv) are relatively intolerant of failure, (v) exist in relatively competitive financial markets, and (vi) are relatively scarce. Nonbank-financed entrepreneurs also differ from their bank-financed counterparts. Compared to bank-financed entrepreneurs, those financed by nonbanks (vii) pursue relatively

[1] For example, Startz (1979) and Nagel (2016, Internet Appendix B) estimate that deposit rates are one-third to one-half of the competitive rate. In Section IV.A, we discuss how banks' funding advantage in the deposit market results in a lower weighted-average cost of capital overall in light of empirical evidence (Kovner and Van Tassel (2020)). See, for example, Diamond (2019), Donaldson and Piacentino (2019), and Merton and Thakor (2019) for theories of moneyness premiums.

[2] See, for example, Stiroh and Strahan (2003) on how late-1970s deregulation removed "restrictions...shielding banks from outside competition...[and] created a more competitive environment" (p. 801).

[3] See the FDIC Quarterly Banking Profile at https://www.fdic.gov/bank/statistical/stats/2018dec/industry.pdf.

high-agency-cost projects (see Section IV.B for references). What explains this variety in bank versus nonbank finance?

We develop a model that suggests that all of these differences between bank and nonbank finance could result from a single source: heterogeneity in financiers' cost of capital.

Model preview. In the model, financiers enter and become either banks or nonbanks. Banks and nonbanks are identical in every way but one: banks have a lower cost of capital. Each financier meets an entrepreneur, who chooses one of two types of projects to seek financing for. Both types can last for up to two stages—if a project fails at the first stage, it is either terminated or refinanced for a second stage. In addition, both types require (unobservable) effort at each stage to be profitable. The difference between the two types is that the cost of effort can be high or low. Therefore we refer to the projects as "high-agency-cost" (HAC) or "low-agency-cost" (LAC) projects.

To incentivize effort, financiers must either surrender "agency rents" to the entrepreneurs in the event of success or terminate entrepreneurs in the event of failure. It is cheaper for financiers to rely on the termination threat. However, the termination threat may not be credible due to the soft-budget-constraint problem inherent in staged financing[4]—even if financiers would like to commit ex ante to terminate, ex post they may prefer not to. Colloquially, financiers may want to throw good money after bad, even if they would have liked to commit not to. We assume that absent a credible termination threat, only LAC projects are viable, because HAC projects are too costly to finance net of agency rents even though they may have higher total value.

Result preview. Our first main result is that nonbanks' high cost of capital can be an advantage. The reason is that it makes refinancing failed entrepreneurs unattractive, which leads to a credible termination threat. In other words, nonbanks, with their high cost of capital, can harden soft budget constraints, making the financing of HAC projects profitable. In contrast, banks, with their low cost of capital, cannot do so, making the financing of HAC projects unprofitable. This indirect advantage of nonbanks' high cost of capital counteracts their direct funding-cost disadvantage and therefore allows them to compete with banks. Indeed, we find that nonbanks coexist with banks and that only nonbanks fund HAC projects in equilibrium (fact (i)). Moreover, because the termination threat reduces the agency rents that they must surrender to entrepreneurs, they can charge higher rates (fact (ii)). However, because, unlike banks they terminate rather than refinance failed projects, their relationships with entrepreneurs are relatively short term (facts (iii) and (iv)).

[4]See, for example, Dewatripont and Maskin (1995) and Kornai (1979, 1980).

This result echoes Bolton and Scharfstein (1990) in that "committing to terminate funding if a firm's performance is poor...mitigate[s] managerial incentive problems" (p. 93). Our insight is that it is a financier's own high cost of capital that makes this commitment credible. Thus, as in, for example, Jensen and Meckling (1976) and Zwiebel (1995), debt disciplines entrepreneurs, but, unlike in these papers, it is not debt on entrepreneurs' own balance sheets but rather that on their financiers' balance sheets that matters. This result also resonates with practice. Nonbanks' ability to harden soft budget constraints is arguably their main disciplining tool. As Sahlman (1990) stresses for VCs, "the credible threat to abandon a venture, even when the firm is economically viable, is the key to the relationship between the entrepreneur and the VC" (p. 507). On the flip side, banks' inability to harden soft budget constraints was a first-order concern for economists worried about the decline of banking. As Jensen (1989) puts it, "banks' chief disciplinary tool, their power to withhold capital from...companies, has been vastly reduced."

Our second main result is that nonbanks' hard budget constraints decrease not only the agency rents they need to surrender to entrepreneurs, but also the competition they face from other financiers. This is the counterpart to results in the prior literature on how competition among financiers can affect entrepreneurs' incentive problems (see Boyd and De Nicolò (2005) and Martinez-Miera and Repullo (2010)). Our insight is that, if, unlike in these papers, competition among financiers is nonexclusive—different financiers can fund the same entrepreneur at the same time—then the mechanism can also work in the other direction. Specifically, mitigating agency problems (via the termination threat) can effectively decrease competition among financiers because it allows them to charge entrepreneurs such high rates initially that no one else wants to fund them subsequently.

Our third main result is that entrepreneurs choose their projects based on the kind of finance they have access to. Because they enjoy agency rents, entrepreneurs prefer HAC projects. But they do not want to choose projects that they will be unable to finance. Thus, knowing that only nonbanks, with their use of hard budget constraints, will finance HAC projects, entrepreneurs choose HAC projects when they have access to nonbank finance and LAC projects when they do not (fact (vii)).

Like some other papers in the literature (discussed below), there is sorting between financiers and projects—in equilibrium, banks and nonbanks finance different types of projects. Unlike in this literature, however, entrepreneurs in our model are ex ante identical. Thus, the mix of financiers in the market determines the mix of projects, not the other way around.

Our fourth main result is that nonbanks become more important as competition among financiers increases. Nonbanks enter only competitive markets and provide an increasing proportion of financing as competition increases. However, they do not take over the entire market, possibly remaining scarce for all levels of competition (facts (v) and (vi)). To understand this result, first note that competition does not affect nonbanks, which can hold entrepreneurs captive—they are always effective monopolists—but does affect banks, which cannot. If competition is low, this benefit of monopoly power for nonbanks is not enough to outweigh the direct disadvantage of their high cost of capital, and all financiers specialize in traditional banking. As competition increases, nonbanking becomes attractive, and some financiers specialize in it to exploit the high rates they can charge to captive entrepreneurs. Not all financiers do this, however—some always specialize in banking. The reason is that if all financiers were to specialize in nonbanking, there would be a scarcity of banks and we would be back in the case of low competition among banks, and thus banking would become attractive again. Banks therefore coexist with nonbanks, even for very high levels of competition.

In summary, for low competition, there are only banks, and entrepreneurs choose LAC projects. For higher competition, banks continue to finance only LAC projects, and nonbanks emerge to fund HAC projects, providing an increasing share of finance as competition increases but possibly remaining scarce, even in the perfect-competition limit. Figure 1 provides a summary of the financing regimes as a function of the levels of competition among financiers.

This connection between competition and the mix of financiers in the market is new to the literature. It arises through the externality that one bank's entry imposes on other banks but not on nonbanks: by increasing competition for continuation financing, bank entry makes soft-budget-constraint problems worse. This harms banks, but not nonbanks because only banks suffer from soft-budget-constraint problems.

Low competition	Higher competition	As competition increases
All financiers specialize in banking.	Most financiers specialize in banking.	Some financiers continue to specialize in banking.
No financiers specialize in nonbanking.	A few financiers specialize in nonbanking.	More and more financiers, but never all, specialize in nonbanking.
All entrepreneurs are bank-financed and choose LAC projects.	Bank-financed entrepreneurs choose LAC projects.	Bank-financed entrepreneurs still choose LAC projects.
There are no nonbank-financed entrepreneurs.	Nonbank-financed entrepreneurs choose HAC projects.	Nonbanked financed entrepreneurs still choose HAC projects.

Figure 1. Financing regimes as a function of competition among financiers

Further results. We explore three extensions. In the first, we relax the assumption that financing HAC projects is prohibitively costly for banks. Thus, entrepreneurs can choose HAC projects, regardless of the type of finance they have access to. We show, however, that they may still choose the LAC project when they have access to banks. Specifically, for high competition, the observed behavior of entrepreneurs is qualitatively unchanged from our baseline results: entrepreneurs who meet banks choose LAC projects and entrepreneurs who meet nonbanks choose HAC projects. In the second extension, we suppose that there is congestion among similar financiers, for example, because they look for similar entrepreneurs. In this case, the more nonbanks enter, the harder it is for other nonbanks to find entrepreneurs to finance, and likewise for banks. Whether this makes nonbanking or banking more attractive depends on which financiers are most affected by the congestion and thus congestion can increase or decrease the proportion of nonbanks that operate in equilibrium. Either way, it does not qualitatively change our results. In the third extension, we suppose that there is a limited supply of HAC projects. In this case, the more nonbanks enter and fund HAC projects, the fewer HAC projects are left for other nonbanks to fund. This makes nonbanking less attractive and hence decreases the proportion of nonbanks that operate in equilibrium. However, it does not qualitatively change our results.

Related literature. Our paper contributes to the literature on how borrowers choose between competing sources of finance, most of which focuses on the trade-off between bank and market finance.[5] In this literature, borrowers are typically endowed with heterogeneous projects that determine whether it is advantageous for them to seek bank or market finance. Banks typically have an informational advantage over markets by assumption, as in Diamond (1991), Holmström and Tirole (1997), and Rajan (1992). Information-sensitive borrowers thus choose banks to benefit from bank monitoring or flexibility, whereas borrowers less in need of monitoring choose markets to avoid compensating banks for monitoring or giving them information rents. In Boot and Thakor (1997), the trade-off is between the market's ability to aggregate information and banks' ability to resolve moral hazard. Thus, again, borrowers' exogenous characteristics determine their choice of financing source. Unlike this literature, we assume that borrowers are ex ante identical. Differences among them arise ex post based on their source of finance. Also unlike this literature, we focus on the trade-off between bank and nonbank finance, rather than between bank and market finance. This is likely to be the most relevant trade-off for the kinds of innovative/entrepreneurial borrowers we model.

There are a few other papers in which banks coexist with other types of financiers. In Ueda (2004), they coexist with VCs, which can screen entrepreneurs' projects better but cannot commit not to expropriate them.[6] In Begenau and Landvoigt (2017) and Chrétien and Lyonnet (2019), banks coexist with shadow banks, which are less regulated but do not benefit from cheap funding due to moneyness or deposit insurance. In Hanson et al. (2015), banks also coexist with shadow banks, which, in line with the other papers cited, are less regulated. However, in contrast with the other papers, these shadow banks also enjoy a low cost of capital from creating money-like liabilities. Thus, they do not resemble the nonbanks in our model, but instead are closer to our banks, whose defining feature is their low cost of capital. Indeed, their nonbanks are closest to money market mutual funds, which invest in marketable securities, whereas ours are closest to VCs or finance companies, which finance early-stage entrepreneurs. Unlike this literature, which focuses on different specialist financiers, Bond (2004) develops a model in which finance is provided not only by specialist financiers, but

[5] See Allen and Gale (2004), Besanko and Kanatas (1993), Bolton and Freixas (2000), Chemmanur and Fulghieri (1994), Gersbach and Uhlig (2007), Hoshi, Kashyap, and Scharfstein (1993), Rajan (1992), Repullo and Suarez (2000), Song and Thakor (2010), and von Thadden (1999). Many papers study competition among banks rather than between banks and other sources of finance. See, for example, Boot and Thakor (2000), Boyd and De Nicolò (2005), Cao and Shi (2000), Cetorelli (2004), Dell'Ariccia (2000), Dell'Ariccia and Marquez (2004), Guzman (2000), Hellmann, Murdock, and Stiglitz (2000), Keeley (1990), Marquez (2002), Martinez-Miera and Repullo (2017), Matutes and Vives (2000), Petersen and Rajan (1995), Repullo (2004), Sharpe (1990), and Wagner (2009).

[6] See also Chan, Siegel, and Thakor (1990). In that paper, banks, VCs, and markets all coexist, and a borrower's financing choice depends on his experience and reputation.

also by "regular" firms (for example, conglomerates) that provide trade credit.

Our model is also related to models of the VC market, which also stress staged financing. Like us, Inderst and Mueller (2004), Jovanovic and Szentes (2013), Khanna and Mathews (2017), and Nanda and Rhodes-Kropf (2013) use models of bilateral meetings to embed dynamic VC-entrepreneur relationships in a wider market.[7] Many of these papers include search-and-matching frictions, which are likely to be first order for early-stage entrepreneurs with projects that are difficult to assess.[8] We can do so too, but such frictions are unnecessary for our results. What matters is that we can capture scarcity, not search frictions—some entrepreneurs can go unfunded just because capital is scarce, even if matching is frictionless. This is certainly first order for potential entrepreneurs, who report that raising capital is their principal problem (Blanchflower and Oswald (1998)).

Layout. Section I presents the model. Section II analyzes the bilateral contracting problem between entrepreneurs and financiers. Section III solves for the equilibrium and presents our main result on intermediation variety. Section IV discusses our assumptions, empirical evidence (including evidence for the facts listed at the beginning), and policy implications. Section V concludes. Extensions are provided in Appendix Appendix A and proofs in Appendix Appendix B.

I. Model

Time is discrete and the horizon is infinite. Overlapping generations of entrepreneurs seek financiers to provide capital to two-stage projects. The projects suffer from a soft-budget-constraint problem, requiring additional capital if they do not pay off at the initial stage. Incumbent financiers compete with the next generation of financiers, but have an advantage in providing capital: they reduce entrepreneurs' private benefits due to what we call an "oversight advantage." This competition is the only link between generations. (We omit time indices since we focus on stationary equilibria.)

[7]Some other papers, for example, Boualam (2018), Payne (2018), Donaldson, Piacentino, and Thakor (2019), Herkenhoff (2019), and Wasmer and Weil (2004), use related models to study the market for bank credit.

[8]Indeed, in one survey, 20% of aspiring entrepreneurs say that the question of *where* to get finance is their biggest concern (Blanchflower and Oswald (1998)).

A. *Entrepreneurs and Projects*

At each date, a unit continuum of identical, penniless, risk-neutral entrepreneurs is born. Each entrepreneur meets a financier with probability Q, which reflects the supply of financiers relative to entrepreneurs. We take Q as our measure of competition among financiers. If an entrepreneur meets a financier, he may raise capital to invest in one of two projects. Each is associated with agency problems, but one has higher agency costs than the other. We therefore index the projects by the level of agency costs, with $\alpha = A$ denoting the high-agency-cost (HAC) project and $\alpha = a$ denoting the low-agency-cost (LAC) project. If an entrepreneur does not meet a financier, he gets a reservation payoff normalized to zero.

The projects resemble those in Crémer (1995). Each project lasts two stages with moral hazard at each stage and a soft budget constraint. Specifically, each project requires first-stage financing K_0 at the initial date and continuation financing K_1^α at the interim date if it does not succeed at the first stage. If the project succeeds (at either stage), it pays off y^α; otherwise, it pays off nothing. The probability of success, denoted by π_1 at the first stage and π_2 at the second, depends on the entrepreneur's effort. If he works, the project succeeds with probability p; if he shirks, it succeeds with probability $p - \Delta$. Although working increases the expected payoff of the project, it is costly for the entrepreneur, because it entails forgoing (non-pecuniary) private benefits β^α at each stage, where $\beta^\alpha = B^\alpha$ unless the financier monitors the project, in which case it is reduced to $\beta^\alpha = b^\alpha$ in the second stage, as discussed below.

A project $\alpha \in \{a, A\}$ is thus characterized by seven parameters: K_0, K_1^α, y^α, p, Δ, B^α, and b^α. Observe, however, that only the payoff, second-stage financing cost, and private benefits depend on the project's type α (although below we often omit the superscript α even from these parameters). Limiting the parameters that vary across the projects imposes discipline (limiting our free parameters) and simplifies the equations. It also means that we abstract from some important ways in which projects can differ, for example, in their riskiness. However, as we discuss in Section IV.A, the model can be easily adapted to capture such differences.

Below, we make parametric assumptions that specify how LAC and HAC projects differ (Section II.C). For now, we simply assume that the payoff y is sufficiently large for both types.

Assumption 1: *Projects' payoffs are sufficiently high:*

$$y \geq \frac{1}{\Delta^2} \max \left\{ \frac{p(1+p)B - \Delta pb - \Delta^2 K_1}{(1-p)}, pB \right\}. \tag{1}$$

As we show in Appendix Appendix C, this assumption ensures that it is always better for financiers to offer repayments so that the entrepreneur works at both stages. Roughly speaking, working makes it more likely to get y and hence working is optimal as long as y is large enough (relative to the agency and financing costs captured by the right-hand-side (RHS) of inequality (1)).

B. Financiers

At each date, a continuum of identical risk-neutral financiers is born. Each chooses to become either a bank or a nonbank and meets an entrepreneur with probability q, which is a decreasing function of the number of entrepreneurs, $q'(Q) < 0$. We denote by φ the (endogenous) proportion of nonbanks.

The only difference between financiers is their cost of capital ρ. Banks have a low cost of capital, which we normalize to zero ($\rho = 0$), relative to nonbanks, which have a higher cost of capital ($\rho = r > 0$). This cost of capital defines the hurdle rate that financiers use to discount their own investments.

Both types of financiers want to invest in entrepreneurs' projects. If a financier does not meet an entrepreneur, it exits, getting a reservation payoff normalized to zero. If a financier meets an entrepreneur, it can make the entrepreneur a take-it-or-leave-it offer of initial financing K_0 in exchange for repayment R_1 in the event that the project succeeds at the first stage. If the entrepreneur does not succeed at the first stage, the financier can make a take-it-or-leave-it offer of continuation financing K_1 in exchange for the additional repayment R_2 in the event that the project succeeds in the second stage, that is, the financier retains its claim to R_1, which we assume has priority ahead of R_2.[9] If the entrepreneur rejects this offer, he can try to find continuation financing from a rival financier in a market populated by the next generation of financiers. We denote by $\hat{Q}$ the probability that the entrepreneur meets a rival that offers continuation financing and by $\hat{R}_2$ the repayment the rival offers. If

[9] This priority does not matter for the qualitative results. The reason is that, as long as it is optimal to incentivize the entrepreneur to work at both stages (Assumption 1), repayments are determined by the entrepreneur's incentive constraint, which depends on only the total stock of debt, and hence not on the relative priority of the debts that make it up. See equation (7) below.

the entrepreneur does not get financing, the project is scrapped, and pays off zero.

We assume that incumbent financiers have an "oversight advantage" over entrepreneurs, due to, say, proprietary information that they acquire about the entrepreneur, as in Rajan (1992).[10] Following Holmström and Tirole (1997), we assume that if an entrepreneur receives continuation financing from the incumbent financier, his second-stage private benefits are reduced from B to b, whereas if he gets continuation financing from a rival, his private benefits are B (see Section IV.A for a discussion of this assumption).

C. *Timeline*

At each date, for a given level of competition among financiers Q, each financier chooses to be a bank or a nonbank. It then meets an entrepreneur with probability q, which is a decreasing function of Q. Symmetrically, each entrepreneur meets a financier with a probability that is proportional to the number of financiers of that type (banks and nonbanks), meeting a bank with probability $(1-\varphi)Q$ and a nonbank with probability φQ. After meeting a financier, the entrepreneur chooses a project to seek financing for.[11] The financier then offers the entrepreneur financing terms.

After receiving financing, the entrepreneur works or shirks, and the project either succeeds or fails. If it succeeds, the entrepreneur makes the agreed repayment. If it fails, the entrepreneur does not make the repayment and the sequence repeats: the financier makes an offer to fund the continuation of the project, the entrepreneur works or shirks, and the project succeeds or fails. If it succeeds, the entrepreneur makes the agreed repayment; otherwise, he repays nothing. Entrepreneurs and financiers exit if they do not meet anyone.[12] (See Figure 2.)

Importantly, a financier that offers continuation financing takes into account the fact that an entrepreneur who rejects the offer can try to find continuation financing from a rival

[10] Botsch and Vanasco (2019) find empirical evidence of banks' "learning by lending," which gives incumbent financiers an informational advantage over competitors, and Nakamura and Roszbach (2018) find evidence of their monitoring.

[11] In practice, this choice would typically be accompanied by informal financing, from credit cards, family and friends, and personal loans (Robb et al. (2020)), which we do not model, so as to focus on "break-out" financing at the next stage.

[12] The assumption that everyone gets only one chance to match keeps the model stationary, so that competition is the same each period. We intentionally abstract from dynamics, using the overlapping generations setup just to capture the effect of competition on multi-stage financing in a simple way. See Biais and Landier (2020) for a model in which a similar link between overlapping generations of entrepreneurs does matter for aggregate dynamics.

financier with probability $\hat{Q}$. Recall that the entrepreneur's private benefits are lower with the incumbent financier, given its monitoring advantage.

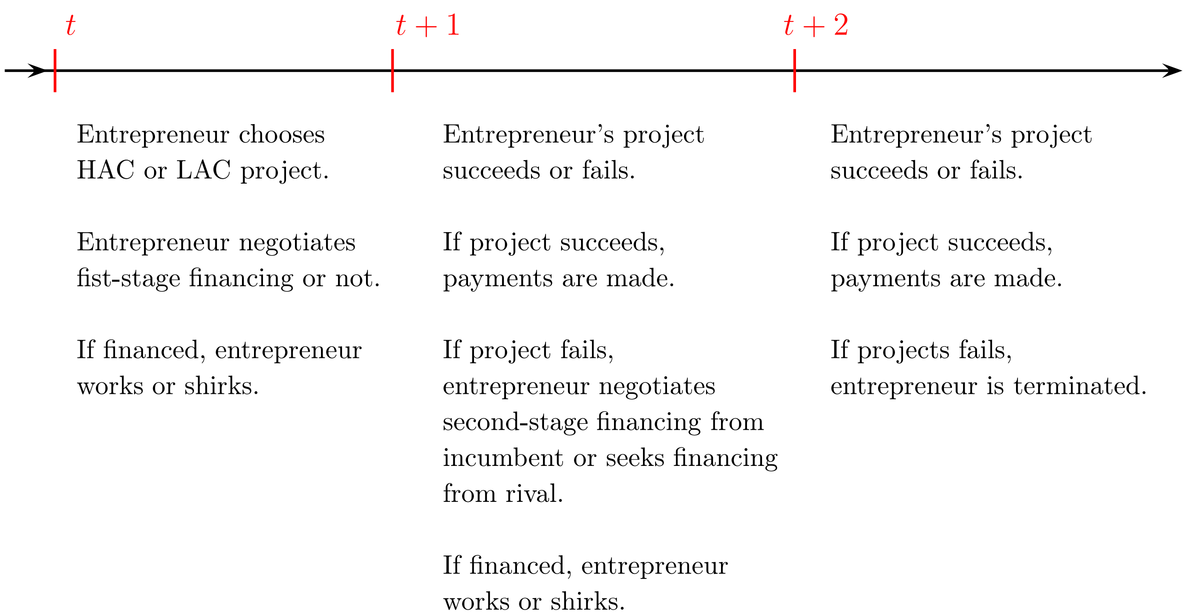

Figure 2. Timeline given a match between a financier and an entrepreneur.

II. Contracting Problem

In this section, we analyze the two-stage bilateral contracting problem between a financier and an entrepreneur. First, we set up the contracting problem in terms of participation constraints (PCs) and incentive constraints (ICs).

Next, we combine the PCs and the ICs above to derive four results: (i) a condition for the entrepreneur to face a soft budget constraint, (ii) a condition for him to be captive to his incumbent financier, (iii) a condition under which an entrepreneur who faces a hard budget constraint is captive, and (iv) an expression for his continuation payoff (i.e., his payoff given failure at the first stage).

Finally, in light of these results, we impose parametric assumptions that ensure that the types of projects/financiers are sufficiently different and that whether an entrepreneur faces a soft budget constraint and/or is captive depends on his project/financier.

A. Participation and Incentive Constraints

Here we analyze the two-stage contracting problem implied by the setup above. We first specify a financier's PCs to provide finance at each stage. We then turn to an entrepreneur's ICs to work at each stage.

A.1 Financiers' Participation Constraints

We start with the second-stage PCs. The entrepreneur arrives at the second stage only if his project fails at the first. The incumbent financier can offer him continuation financing in exchange for an additional repayment, but the entrepreneur can reject it and look for a rival. Financiers offer contracts only if they satisfy their PCs. The PCs are different for the incumbent financier and the rival because for the incumbent, (i) providing continuation financing increases the likelihood that it will recoup the initial repayment and (ii) incentivizing effort is relatively cheap given its ability to monitor. We describe these PCs in turn.

The incumbent financier is willing to provide continuation financing if its cost K_1 is lower than the discounted expected value of its total repayment $R_1 + R_2$,

$$K_1 \leq \pi_2 \frac{R_1 + R_2}{1+\rho}. \tag{2}$$

If this is satisfied for some feasible repayment $R_1 + R_2$, equilibrium success probability π_2, and the incumbent's cost of capital ρ, then we say there is a *soft budget constraint (SBC)*, which we denote by $\mathbb{1}_{\{\text{SBC}\}} = 1$; otherwise, we say there is a *hard budget constraint (HBC)*, which we denote by $\mathbb{1}_{\{\text{SBC}\}} = 0$. In words, a financier has a SBC if it is willing to provide continuation financing K_1 at some rate; otherwise, it has a HBC.

A rival financier is willing to provide continuation financing if its cost K_1 is lower than the discounted expected value of its repayment $\hat{R}_2$,

$$K_1 \leq \pi_2 \frac{\hat{R}_2}{1+\rho}. \tag{3}$$

If this is satisfied for some feasible repayment $\hat{R}_2$, equilibrium π_2, and a rival's cost of capital ρ, then we say the entrepreneur is *not captive*, so the probability of getting continuation finance from a rival is positive, $\hat{Q} > 0$; otherwise, we say that he is *captive*, so $\hat{Q} = 0$.

We now turn to the first-stage PC. We streamline the exposition here by restricting attention to the case in which the entrepreneur gets continuation financing from the incumbent financier if he gets it at all, which turns out to be the only relevant case (see Corollary 1).[13] However, the possibility of getting continuation financing from a rival financier can be a relevant outside option for the entrepreneur, and thus it affects the terms that the incumbent offers.

At the first stage, a financier takes into account the fact that it could refinance the entrepreneur at the second stage, that is, that it could have a SBC. The financier's PC reads

$$\pi_1 \frac{R_1}{1+\rho} + (1-\pi_1)\mathbb{1}_{\{\text{SBC}\}}\, \pi_2 \frac{R_1 + R_2}{(1+\rho)^2} \geq K_0 + (1-\pi_1)\mathbb{1}_{\{\text{SBC}\}} \frac{K_1}{1+\rho}, \tag{4}$$

where, given the financier's cost of capital ρ, the left-hand side (LHS) is the present value of the entrepreneur's repayments and the RHS is the present value of the financier's capital outlay.

A.2 Entrepreneurs' Incentive Constraints

We start with the second-stage IC. An entrepreneur who owes his financier(s) $R_1 + R_2$ prefers to work than to shirk if

$$p\big(y - R_1 - R_2\big) \geq (p - \Delta)\big(y - R_1 - R_2\big) + \beta. \tag{5}$$

The LHS is his expected payoff if he works—his success probability is $\pi_2 = p$. The RHS is his expected payoff if he shirks—his success probability is only $\pi_2 = p - \Delta$—but he gets private benefits β, where $\beta = b$ if he gets continuation financing from his incumbent and hence is monitored, while $\beta = B$ if he gets continuation financing from a rival financier. This IC can be rewritten as an upper bound on his total repayment $R_1 + R_2$,

$$R_1 + R_2 \leq y - \frac{\beta}{\Delta}. \tag{6}$$

We now turn to the first-stage IC, which depends on his continuation value given failure, denoted by u_1. Specifically, the entrepreneur prefers to work than to shirk if and only if

$$p\big(y - R_1\big) + (1-p)u_1 \geq (p - \Delta)\big(y - R_1\big) + (1 - p + \Delta)u_1 + B. \tag{7}$$

[13] Basically, if a rival financier, which gets only $\hat{R}_2$ and cannot monitor, is willing to provide finance, so is the incumbent, which gets $R_1 + R_2$ and can monitor.

The LHS is his expected payoff if he works—his success probability is $\pi_1 = p$. The RHS is his expected payoff if he shirks—his success probability is only $\pi_1 = p - \Delta$, but he gets private benefits $\beta = B$. This IC can be rewritten as an upper bound on his repayment R_1,

$$R_1 \leq y - \frac{B}{\Delta} - u_1. \tag{8}$$

Note that increasing the entrepreneur's continuation value u_1 decreases the repayment the financier can extract, because the financier must surrender more rent to him to incentivize him to work. In turn, u_1, depends on whether the entrepreneur can fund continuation at the second stage, and at what terms.

B. *Soft Budget Constraint (SBC), Captivity, and Continuation Value*

We now use the preceding analysis to derive results on the outcome at the interim date.

Combining the incumbent financier's second-stage PC and the entrepreneur's second-stage IC gives a condition for the entrepreneur to face a SBC.

PROPOSITION 1 (SOFT BUDGET CONSTRAINT): *An incumbent financier provides continuation financing if and only if*

$$p\left(y - \frac{b}{\Delta}\right) \geq (1+\rho)K_1, \tag{9}$$

that is, if and only if its cost of capital ρ is sufficiently low.

The condition of the proposition (inequality (9)) says that the maximum that incumbent financiers can extract at the second stage—here, the total expected payoff py minus the agency rent pb/Δ—needs to exceed the cost of continuation compounded for one period at the incumbent's cost of capital ρ. Hence, increasing ρ makes it harder to satisfy inequality (9). Intuitively, because a financier's cost of capital defines the hurdle rate that it applies to its own investments, increasing it enough leads the financier to deny financing to entrepreneurs at the continuation stage.

Combining the incumbent financier's second-stage PC and the entrepreneur's second-stage IC for a given the first-stage repayment, R_1, yields a condition for the entrepreneur to be captive to his incumbent financier.

PROPOSITION 2 (ENDOGENOUS CAPTIVITY): *An entrepreneur cannot obtain continuation financing from a competing financier, that is, he is captive to his incumbent financier, if and* *only if*

$$(1+\rho)K_1 > \max\left\{p\left(y - \frac{B}{\Delta} - R_1\right), (p-\Delta)(y-R_1)\right\}, \tag{10}$$

for $\rho \in \{0, r\}$, that is, if and only if his initial repayment R_1 is sufficiently high.

The condition in the proposition (inequality (10)) says that a rival financier is unwilling to provide continuation financing if the maximum that it can extract from the entrepreneur (the RHS of inequality (10)) is lower than the cost of continuation, which is its capital outlay compounded for one period at the rival's cost of capital ρ (the LHS of inequality (10)). Corollary 1 follows from combining the results above (Proposition 1 and Proposition 2).

Corollary 1: *Suppose*

$$K_1 > (p-\Delta)\frac{B}{\Delta}. \tag{11}$$

Then the entrepreneur is captive to his incumbent financier and faces a HBC.

The results so far suggest that a high cost of capital, which seems like a disadvantage, could actually be an advantage:[14] it allows the financier to impose a HBC (Proposition 1), and an entrepreneur who faces a hard budget constraint is endogenously captive to his incumbent. To see why, first observe that if the incumbent can require a high R_1, then he can keep the entrepreneur captive (Proposition 2). The reason is that the more the entrepreneur owes to his incumbent from the first stage, the less he can promise to a rival at the second stage. Next, observe that an incumbent financier that imposes a HBC can credibly require a high initial repayment. The reason is that the entrepreneur faces a credible termination threat, since he cannot get continuation from his incumbent (given the HBC) or from a rival (given he already owes too much to the incumbent). Thus, the entrepreneur has an incentive to work even if a lot of his output goes to his financier if his project succeeds, because he wants to avoid termination when the project does not succeed.

These results highlight the link between the entrepreneur's continuation value u_1 and his first-stage repayment R_1. In particular, Proposition 2 shows that whether the entrepreneur is captive depends on R_1 (inequality (10)). But note that R_1 depends on the entrepreneur's continuation value u_1 via his first-stage IC (inequality (8)), and u_1 depends in turn on

[14] The idea that financiers can use a high cost of capital as a commitment device to withhold capital complements the intuition that financiers use their own leverage as a commitment device to prevent borrower opportunism. For example, in Diamond and Rajan (2001), the risk of depositor runs ensures that a bank collects repayment from its borrowers, and in Axelson, Strömberg, and Weisbach (2009) intermediary leverage mitigates the conflict of interest between a private equity fund and its investors. Another literature, represented by Arping (2014), shows that banks could hold derivatives positions to make their liquidation incentive compatible.

whether he is captive in the first place. Hence, finding u_1 is a fixed point problem. Solving it gives the following result.

LEMMA 1: *Suppose*

$$K_1 > (p - \Delta)\frac{B}{\Delta}. \tag{12}$$

If an entrepreneur faces a HBC (inequality (9) is violated), then his continuation value is $u_1 = 0$.

If he faces a SBC (inequality (9) is satisfied), his continuation value is

$$u_1 = \begin{cases} \max\left\{p\dfrac{b}{\Delta}, \hat{Q}B\right\} & \textit{if } \dfrac{b}{B} \leq \dfrac{1}{\Delta} - \dfrac{1}{p} \textit{ and } \hat{Q} \leq \dfrac{p}{\Delta}\left(\dfrac{1}{\Delta} - \dfrac{1}{p}\right), \\ \hat{Q}p\dfrac{B}{\Delta} & \textit{if } \dfrac{b}{B} \leq \dfrac{1}{\Delta} - \dfrac{1}{p} \textit{ and } \hat{Q} > \dfrac{p}{\Delta}\left(\dfrac{1}{\Delta} - \dfrac{1}{p}\right), \\ \dfrac{p}{\Delta}\max\left\{b, \hat{Q}B\right\} & \textit{otherwise.} \end{cases} \tag{13}$$

The relevant takeaway from the expression for u_1 above is that it is increasing in $\hat{Q}$: the entrepreneur's continuation value is higher when it is easier to get financing from a rival.

C. Assumptions

We now impose assumptions on the deep parameters.

We make two assumptions on parameters to distinguish the projects from each other.

ASSUMPTION 2: *Private benefits are high for HAC projects:*

$$B^A > 2B^a. \tag{14}$$

An entrepreneur's private benefits from shirking are higher under the HAC project. The specific restriction—that they are at least twice as high—implies that an entrepreneur gets more agency rent from the HAC project than from the LAC project, even if the LAC lasts twice as long (i.e., two periods instead of one). As a result, he always prefers HAC projects. (See Lemma Appendix B.1.)

ASSUMPTION 3: *The initial investment cost is not too small or too large:*

$$(2-p)py^a - (1-p)K_1^a - 2p\frac{B^a}{\Delta} > K_0 > (2-p)py^A - (1-p)K_1^A - p\frac{B^A + b^A}{\Delta}. \tag{15}$$

This assumption says that the SBC problem is significantly more costly ex interim for the HAC project than the LAC project, because K_1^A is high relative to K_1^a. This makes it relatively unattractive to finance ex ante. The specific assumption ensures that a bank (which has cost of capital $\rho = 0$) will provide initial financing to an LAC entrepreneur but not to an HAC entrepreneur. (See Lemma Appendix B.3.)

We make the following assumption on nonbanks' cost of capital.

ASSUMPTION 4: *Nonbanks' cost of capital is not too small or too large:*

$$\frac{p\left(y^A - B^A/\Delta\right)}{K_0^A} \geq 1 + r > \frac{p\left(y^A - b^A/\Delta\right)}{K_1^A}. \tag{16}$$

This ensures that nonbanks will provide financing to an HAC entrepreneur at the first stage but not the second. (See Lemma Appendix B.2.)

We make the following assumption on the cost continuation financing.

ASSUMPTION 5: *The cost of continuation financing is not too small or too large: for HAC projects,*

$$p\left(y - \frac{b^A}{\Delta}\right) > K_1^A > (p - \Delta)\frac{B^A}{\Delta}, \tag{17}$$

and for LAC projects,

$$\max\left\{p^2\frac{b^a}{\Delta}, (p-\Delta)\left(\frac{B^a}{\Delta} + p\frac{b^a}{\Delta}\right)\right\} \geq K_1^a > \frac{B^a}{(1+r)\Delta}\max\left\{p^2, (p-\Delta)(1+p)\right\}. \tag{18}$$

Condition (17) ensures that incumbent banks provide continuation financing to HAC entrepreneurs (see Lemma Appendix B.3), but rivals do not (see Lemma Appendix B.2). Condition (18) ensures that rival banks finance continuation of LAC entrepreneurs (see Lemma Appendix B.3), but nonbanks do not (see Lemma Appendix B.4).

One example of a set of parameters satisfying all of these assumptions, as well as Assumption 1 and the hypothesis of Proposition 4 below, is as follows: $p = 0.6, \Delta = 0.4, r = 5\%, K_0 = 60, y^A = 175, K_1^A = 80, B^A = 22, b^A = 15, y^a = 110, K_1^a = 7.5, B^a = 9$, and $b^a = 8.5$.

III. Equilibrium and Intermediation Variety

In this section, we first characterize the subgame perfect equilibrium as a function of the level of competition Q and the mix of nonbanks and banks φ and $1-\varphi$. We then derive our main results on how this mix depends on the level of competition.

A. Equilibrium Characterization

The preliminary results and assumptions in the previous section allow us to characterize the equilibrium behavior of entrepreneurs, banks, and nonbanks.

PROPOSITION 3 (EQUILIBRIUM): *For any level of competition Q among financiers and proportion φ of nonbanks, the unique best responses are as follows:*

- *Entrepreneurs who meet nonbanks choose HAC projects, face HBC, and are captive.*
- *Entrepreneurs who meet banks choose LAC projects, face SBC and are not captive.*

This result says that the projects entrepreneurs choose depend on the kind of finance they have access to. All prefer HAC projects over LAC projects, because the former provide them higher agency rents (see Assumption 2). However, they can only invest in projects that they can finance, and different types of financiers are willing to finance different types of projects. In fact, only nonbanks are willing to finance HAC projects. Anticipating this, entrepreneurs, who prefer HAC projects, which generate high agency rents, choose them when they meet nonbanks and choose LAC projects when they meet banks.

The reason that nonbanks are willing to finance HAC projects is that they use their high cost of capital as a disciplining device, which allows them to commit not to refinance entrepreneurs and thus to impose HBCs (Proposition 1). This in turn allows nonbanks to extract high initial repayments, which keeps entrepreneurs captive (Corollary 1) and hence disciplines entrepreneurs, who anticipate termination following failure and therefore provide effort in the first stage. Although this discipline decreases entrepreneurs' agency rents after projects are undertaken, they still welcome it, because it allows them to finance HAC projects in the first place.

The reason that banks, unlike nonbanks, are unwilling to finance HAC projects is that, due to their low cost of capital, they cannot credibly commit not to refinance entrepreneurs (Proposition 1). Since entrepreneurs will always be able to refinance their projects, they have high continuation values u_1, making them costly to incentivize, especially with HAC projects. Indeed, this is so costly that a bank will not fund an HAC entrepreneur in the first place.

In our model only failure-intolerant financiers (nonbanks) are willing to finance HAC projects. To the extent that HAC projects are likely to be innovative, this contrasts with the idea that failure tolerance fosters innovation (for example, Manso (2011) and March (1991)). The reason is that even if failure tolerance is optimal for an individual entrepreneur, it could be prohibitively expensive for an external financier.[15]

The difference between financiers' cost of capital affects investment not only at the initial stage, but also at the continuation stage, when an entrepreneur could seek financing from a financier other than his incumbent. Rival banks are willing to provide continuation financing to LAC entrepreneurs, but rival nonbanks are not. This leads to the following corollary.

COROLLARY 2: *The probability that an LAC entrepreneur finds continuation financing from a rival is the probability that he meets a bank:* $\hat{Q} = (1 - \varphi)Q$.

B. Intermediation Variety

We have established that entrepreneurs with access to nonbanks choose HAC projects while those with access to banks choose LAC projects. But this does not address the question of whether there will be a *mix* of banks and nonbank financiers in equilibrium, whether financiers will all prefer to be banks (benefiting from their lower cost of capital), or whether financiers will all prefer to be nonbanks (benefiting from their HBCs). Also and open question is wheter the mix of financiers in the market depends on the level of competition Q among them.

To address these questions, we start by comparing the expected payoffs of banks and nonbanks. Since financiers offer the contracts, they get the total surplus from a project less the agency rents they must surrender to incentivize entrepreneurs. In a meeting between an entrepreneur and a nonbank, the total surplus is the value of the HAC project, which can succeed in its first stage or not at all (given the HBC). We denote this value by Σ^A. Noting that we need to discount the payoff by nonbanks' cost of capital $1 + \rho = 1 + r$, we have

$$\Sigma^A := \frac{py^A}{1+r} - K_0. \tag{19}$$

[15] Further, the agency problem in Manso (2011) is different from ours—he focuses on how to incentivize exploratory learning, not just effort.

Hence, since the nonbank meets an entrepreneur with probability q, the nonbank's expected payoff is

$$\text{nonbank's payoff } = q\left(\Sigma^A - p\frac{B^A}{\Delta}\right), \tag{20}$$

where the second term is the entrepreneur's expected rent $p(y - R_1)$.

In a meeting between an entrepreneur and a bank, the total surplus is the value of the LAC project. The project could succeed at either its first or its second stage (given the SBC). We denote this value by Σ^a. Noting that we do not need to discount the payoff since the bank's cost of capital is $1 + \rho = 1$, we have

$$\Sigma^a := py^a - K_0 + (1-p)\big(py^a - K_1^a\big). \tag{21}$$

Recalling that a bank meets an entrepreneur with probability q, a bank's expected payoff is

$$\text{bank's payoff } = q\left(\Sigma^a - \frac{p}{\Delta}B^a - u_1(\hat{Q})\right), \tag{22}$$

where the second term is the entrepreneur's expected rent $p(y-R_1)+(1-p)p(y-R_1-R_2)$. We write the continuation value as $u_1(\hat{Q})$ to emphasize that u_1 depends on the probability that the entrepreneur can get continuation financing from a rival financier.

Different types of financiers coexist if and only if their payoffs are equal in equilibrium, so a financier is indifferent between becoming a nonbank and a bank, or if

$$q\left(\Sigma^A - p\frac{B^A}{\Delta}\right) = q\left(\Sigma^a - p\frac{B^a}{\Delta} - u_1(\hat{Q})\right). \tag{23}$$

This expression captures a key force in our model: an increase in competition among rival financiers, captured by an increase in $\hat{Q}$, increases the entrepreneur's continuation utility u_1 (Lemma 1) and thereby exacerbates the bank's SBC problem. As a result, the bank must leave the entrepreneur a higher agency rent at the first stage (see the IC in equation (8)). This reduces the bank's profit on the RHS of equation (23). Thus, the more competitive the market is, the greater is the benefit to financiers from keeping entrepreneurs captive, making it more attractive to be a nonbank than a bank.

Rewriting, nonbanks and banks coexist if and only if the entrepreneur's continuation value is

$$u_1(\hat{Q}) = \frac{p}{\Delta}\left(B^A - B^a\right) - \left(\Sigma^A - \Sigma^a\right) =: u^*. \tag{24}$$

Given that, by Corollary 2, we know that the level of competition among rivals is $\hat{Q} =$

$(1-\varphi)Q$. This expression for u^* (equation (24)) allows us to solve for the equilibrium mix of nonbanks φ and banks $1-\varphi$ in the market as a function of the level of competition Q among all financiers. Indeed, rearranging, we see that if there is an interior mix of banks and nonbanks in equilibrium, the proportion of nonbanks is given by

$$\varphi = 1 - \frac{u_1^{-1}(u^*)}{Q} \tag{25}$$

(assuming that the inverse of u_1 is well defined). Moreover, there is indeed an interior mix of financiers as long as this expression is between zero and one. Since it can be less than zero but never greater than one, we have

$$\varphi = \max\left\{ 0\,,\, 1 - \frac{u_1^{-1}(u^*)}{Q} \right\}. \tag{26}$$

Equation (26) implies that φ is an increasing function of Q, the level of competition among financiers. If Q is very low, φ is zero, indicating that no nonbank operates—the benefits of cheap capital (low ρ) outweigh the costs of SBC problems. As competition increases, banks' SBC problems become more severe, and some financiers become nonbanks, helping to keep these problems at bay. But φ never reaches one, so nonbanks never take over the entire market, and banks provide some finance for all levels of competition Q. The proportion of nonbanks approaches $1-u_1^{-1}(u^*)$ in the perfect competition limit ($Q \to 1$), as depicted in Figure 3 and formalized in the next proposition.

Proposition 4 (Intermediation variety): *Suppose that*

$$\Sigma^a - \frac{p}{\Delta}\left(B^a + b^a\right) > \Sigma^A - p\frac{B^A}{\Delta}. \tag{27}$$

1. *Nonbanks are present only if competition among financiers Q is sufficiently high.*
2. *The proportion of nonbanks is increasing in competition Q.*
3. *Nonbanks never take over the entire market. Rather, banks provide a positive fraction of finance for all Q.*

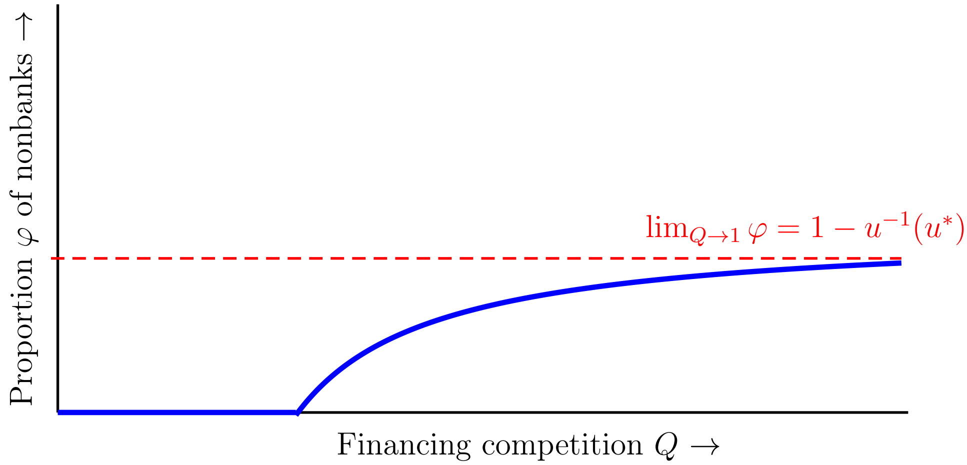

Figure 3. The proportion φ of nonbanks in the market as a function of competition Q.

For low Q, all financiers become banks to take advantage of their funding cost advantage. But as competition increases, and there are more banks in the market, it becomes easier for entrepreneurs to find banks to finance their second-stage investments, that is, $\hat{Q}$ goes up. As a result, entrepreneurs can extract more rents from their incumbent banks. Nonbanks emerge in response, as the rents entrepreneurs can extract from them are limited. They keep entrepreneurs captive, and hence are effectively monopolists, unaffected by competition. Still, nonbanks do not provide all the finance for high competition. The reason is that nonbank entry attenuates the effect of competition on banks, because the higher φ is, the less sensitive $\hat{Q} = (1-\varphi)Q$ is to Q. Thus, if $\varphi \rightarrow 1$, then $\hat{Q} \rightarrow 0$: if no bank were to operate, then the probability an entrepreneur could find refinancing from a rival financier would go to zero. In this case, entrepreneurs would in effect be captive to banks. This would make banking desirable and induce banks to enter.

IV. Discussion, Empirical Evidence, and Policy

In this section, we discuss our model's assumptions, empirical evidence, and policy implications.

A. Discussion

Banks' and nonbanks' cost of capital. Underlying all of our results is the assumption that banks have a lower cost of capital than nonbanks. This difference generates the high hurdle rate that nonbanks apply to investments,[16] which in turn disciplines entrepreneurs, hardening their budget constraints.[17]

We stress the role of banks' low cost of debt, stemming from government guarantees and money-like deposits. However, due to capital regulation, banks' marginal source of funds is not debt, but rather a mixture of debt and equity. Likewise, the relevant cost of capital is not the cost of debt, but the weighted-average cost of capital (WACC). Of course, theoretically, the WACC should still reflect the debt subsidies the banks enjoy. And so it is empirically: the WACC is lower for banks than for nonbanks, and sometimes it is even lowered by regulation (Kovner and Van Tassel (2020)).

But banks' low cost of capital relative to nonbanks need not necessarily stem from their role as depositories. For example, unlike banks, nonbanks such as VCs and private equity funds (PEs) take on relatively few investments, so their undiversified positions and exposure to idiosyncratic risk could drive up their cost of capital.[18] Moreover, nonbanks are likely to care more about upside payoffs, given that leverage and incentive distortions make their payoffs convex.[19] As a result, they may finance only entrepreneurs that still have high upside potential, which would also have the effect of hardening a SBC.[20] Finally, they are also likely to finance riskier investments and hence have a higher probability of default themselves. This would drive up the rate they have to pay on their own financing to compensate their investors endogenously.

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[16] A few other papers show that VCs may impose high hurdle rates because the opportunity cost of their capital is high, even if their cost of capital is not; see Inderst, Mueller, and Münnich (2006), Jovanovic and Szentes (2013), and Khanna and Mathews (2017).

[17] Our model thus explains why some finance must be intermediated: nonbanks' high cost of capital on the RHS of their balance sheets gives them the commitment power they need to make profitable investments on the LHS. See, for example, Kashyap, Rajan, and Stein (2002) and Donaldson, Piacentino, and Thakor (2018) for other theories connecting intermediary assets and liabilities.

[18] For example, Metrick and Yasuda (2010) find that the median VC fund expects to make only 20 investments over its lifetime and argue that "the expected number of investments plays an important role in driving the overall volatility of the fund portfolio, which in turn has a significant effect on the expected present value of revenue" (p. 2309).

[19] For example, finance companies lever up with bank and market debt, limiting their downside risk (Carey, Post, and Sharpe (1998)), VCs want high upside payoffs to attract investor capital (Piacentino (2019)), and the general partners in PEs have contracts that reward them more on the upside (Axelson, Strömberg, and Weisbach (2009)).

[20] To capture this within our model, we need only make the (reasonable) assumption that entrepreneurs' upside potential is higher at the first stage than at the second. We abstract from this in the baseline for simplicity: it would amplify, but is not necessary for, our results.

High- and low-agency-cost projects. For our results, the key distinction between the two types of projects is the severity of the SBC problem: compared to entrepreneurs with LAC projects, those with HAC projects are costly to incentivize and expensive to refinance, that is, they have projects that have lower private benefits at each stage (B and b) and costs of continuation financing (K_1). We assume, however, that all projects have the same start-up costs (K_0), the same payoff given failure (zero), and the same success probabilities (p if entrepreneurs work and $p - \Delta$ otherwise). This simplifies the exposition, but it also means that we have to rely on a few parameters to generate meaningful differences across projects.

In particular, Assumption 4 and Assumption 5 suggest that K_1^a should be "a lot" smaller than K_1^A. This could be reasonable, even taken literally. For example, refinancing innovative (HAC) projects could amount to starting over, whereas refinancing traditional (LAC) projects could be closer to minor upkeep. But it can also be taken as a stand-in for differences in other parameters. Most notably, to the extent that high agency costs capture innovative projects, it is likely that they actually do pay off zero in the event of failure (Hall and Woodward (2010)), whereas traditional projects are likely to have positive recovery value. Thus, the cost of continuation should be interpreted as only the new capital needed for an entrepreneur to continue a traditional project, which, net of the first-period payoff, is likely to be relatively small for traditional projects compared to innovative ones.

In reality, HAC projects are likely to be riskier in the sense of having a lower success probability too. Our framework accommodates such heterogeneity without becoming intractable (although the equations do become significantly more complicated). We omit it only for simplicity.

Bilateral matching/Competition. We use a model of random bilateral meetings to embed a staged financing problem in market equilibrium. This is a useful setup with precedent in the literature. It also allows us to conduct comparative statics on the level of competition, which is captured by an entrepreneur's probability of meeting a financier Q.

Financier's bargaining power. Throughout, we assume that financiers have the bargaining power when they negotiate contracts with entrepreneurs. This is useful from a modeling perspective, because it generates a division of surplus within a relatively classical principal-agent framework: entrepreneurs get agency rents and financiers get the remaining surplus (see equations (20) and (22)). However, it leaves open the question of how our results would change if entrepreneurs had some bargaining power, allowing them to propose lower repayments R_1. Here, we briefly discuss how this affects (or does not affect) each of our main results and explain why our main takeaways continue to hold.

- Decreasing R_1 does not affect our SBC result (Proposition 1). The reason is that an incumbent financier's willingness to provide continuation financing at the interim date does not depend on the amount the entrepreneur owes from the initial date, but only on the most he can promise to repay at the terminal date. As per the second-stage IC (equation (6)) no matter what R_1 is, the most he can promise to repay is $R_1 + R_2 = y - b/\Delta$.

- Decreasing R_1 could affect our endogenous captivity result (Proposition 2). The reason is that the entrepreneur is captive if and only if R_1 is sufficiently high (by equation (10)).

  However, the takeaway that HAC entrepreneurs are more likely to be captive will continue to hold as long as the repayment R_1 is sufficiently high with an HAC project relative to with an LAC project, which will be the case whenever agency rents tilt the division of surplus toward the entrepreneur. There are other realistic reasons that financiers would likely require high repayments R_1 from HAC entrepreneurs, which we do not include in the baseline for simplicity; notably, HAC projects could be relatively risky ($p^A < p^a$) or require relatively large initial capital ($K_0^A > K_0^a$).

- Decreasing R_1 could affect our project choice result (Proposition 3). The reason is that, with no bargaining power, entrepreneurs do not take the total surplus into account and prefer the project that maximizes their agency rent. Thus, they choose the HAC project whenever financing it is feasible.

  However, the takeaway that entrepreneurs choose HAC projects whenever they are feasible will continue to hold whenever they also have higher surplus, which is the case we have in mind to the extent that, for example, HAC projects are more innovative (we do not make this assumption in the baseline analysis because it is not necessary for our results).

- Decreasing R_1 could affect our intermediation variety result (Proposition 4) to the extent that it affects our captivity result (described above). The reason is that the result relies on nonbanks being monopolists over captive entrepreneurs and hence is not affected by competition.

  However, the takeaway that the proportion of nonbanks is increasing in competition will continue to hold as long as the endogenous captivity result holds, which is likely to be the case for the reasons described above.

Incumbent's oversight advantage. In our baseline model, we rely on the assumption that if an entrepreneur is refinanced by his incumbent financier, his private benefits are reduced from B to b, whereas if he is refinanced by a rival, they are not. This helps us model imperfect competition. Even though financiers offer the contracts, the option to seek financing from a rival financier helps the entrepreneur to extract more surplus from his incumbent, because he can get higher private benefits/agency rents with the rival.

The assumption is intended to capture incumbent financiers' oversight advantage, due, for example, to any propriety informational advantages they obtain in the course of their relationship with the entrepreneur (see, for example, Rajan (1992)). We should stress, however, that when the entrepreneur gets financing from a rival at the second stage, his private benefits are not reduced, even if he has repayments to make to his incumbent from the first stage. This could be because information acquired during second-stage financing is complementary to that acquired during the first-stage relationship. Alternatively, it could be because the financier itself must have incentives to monitor, and does so only if it has a sufficiently large stake in the entrepreneur, as in Holmström and Tirole (1997).[21] In particular, a financier must prefer to engage in oversight at cost c, ensuring the entrepreneur works, and get its total repayment R_{tot} with probability p than not to, inducing the entrepreneur to shirk, and getting R_{tot} with probability $p - \Delta$:

$$pR_{\text{tot}} - c \geq (p - \Delta)R_{\text{tot}} \tag{28}$$

or $R_{\text{tot}} \geq c/\Delta$ (which is IC_m on p. 672 of Holmström and Tirole (1997)). Thus, as long as $\max\{R_1, R_2\} < c/\Delta < R_1 + R_2$, a financier engages in oversight if and only if it has provided finance at both the first and the second stages (i.e., only if $R_{\text{tot}} = R_1 + R_2$).

B. *Empirical Evidence*

Banks in our model represent institutions that take deposits and as a result have a low cost of capital. Nonbanks could represent a variety of institutions that do not take deposits but still compete with traditional banks to finance entrepreneurs. Salient examples are finance companies and VC firms. Others are PE firms,[22] asset managers, and commercial mortgage

[21] Using data on credit lines, Acharya et al. (2014) find empirical support for the predictions of this model of monitoring.

[22] Our model might not apply to leveraged buyouts, in which PEs often target low-risk firms. But it could apply to other branches of the PE business. Indeed, anecdotally, it seems that PEs are increasingly competing with banks in the lending market. See, for example, "The New Business Banker: A Private Equity Firm," *Wall Street Journal*, August 12, 2018 and "How the Biggest Private Equity Firms Became the New Banks," *Financial Times*, September 19, 2018.

banks. Given this, we now cite evidence for the facts listed at the start of the paper. We then discuss other evidence consistent with our model. Some of the nonbank evidence we cite corresponds to VCs and some corresponds to a broader class of nonbanks.

Motivating facts.

(i) *Compared to banks, nonbanks finance relatively HAC entrepreneurs.*

This follows from Proposition 3, which says that only the entrepreneurs who meet nonbanks choose HAC projects.

- Evidence on this prediction requires proxies for HAC firms/entrepreneurs. Possible proxies include firms with low asset tangibility, high growth options, and high asset specificity (see Gompers (1995)) as well as those that are young, are risky/have low credit quality, are innovative/R&D-intensive/high-tech, or have low current profitability.
- Given these proxies, see Chernenko, Erel, and Prilmeier (2018), Carey, Post, and Sharpe (1998), and Denis and Mihov (2003) on finance companies, Gompers (1995), Kortum and Lerner (2000), and Hellmann and Puri (2000) on VCs, and Lerner, Sorensen, and S (2011) on PEs.

(ii) *Compared to banks, nonbanks charge entrepreneurs relatively high rates.*

This follows from Proposition 3, given that entrepreneurs who face HBCs (have low u_1) pay higher rates (equation (8)).

- See Chernenko, Erel, and Prilmeier (2018), who document that nonbank-loans carry 190 basis points higher interest rates than bank loans.
- See Cochrane (2005), Hall and Woodward (2007), Korteweg and Sorensen (2010), and Korteweg and Nagel (2016), who document abnormal returns on VCs' portfolio investments.

(iii) and (iv) *Compared to banks, nonbanks have relatively short-term relationships and are relatively intolerant of failure.*

This follows from Proposition 3, which says that nonbanks impose HBCs, withholding capital after one period in the case of failure, whereas banks do not.

- See Kerr, Nanda, and Rhodes-Kropf (2014), who find that VC-backed firms are likely to be shut down relatively early, despite high upside potential. Indeed, Gompers and Lerner (2001) note that "[s]taged capital infusion may be the most potent control mechanism a VC can employ" (p. 155). Further, Guler (2018) identifies VCs' ability to terminate failing investments as a primary driver of their success, suggesting it could be on par with picking winning entrepreneurs in the first place.[23] Chernenko, Erel, and Prilmeier (2018) find that many nonbank lenders, including hedge funds and other asset managers, use relatively short-maturity loans, which they suggest discipline borrowers.[24] By contrast, banks are more likely to provide continuation financing to their relationship borrowers, even during crises (see Banerjee, Gambacorta, and Sette (2021)).

- See Sahlman (1990), who describes how VCs, unlike banks, finance firms with the intent to exit, likely in an IPO, and to terminate otherwise.
- See Gompers (1995), who finds that HAC entrepreneurs are associated with shorter financing duration.

(v) *Compared to banks, nonbanks exist in relatively competitive financial markets.*

This follows from Proposition 4.

- See, for example, Boyd and Gertler (1994), who attribute the decline in the share of commercial and industrial loans provided by banks partly to increases in competition following the deregulation of the 1980s. Neuhann and Saidi (2016) also find that "[b]ank deregulation thus facilitated the entry of nonbank intermediaries into the market for corporate credit" (p. 1).
- To the extent that increasing competition decreases market value, our prediction implies a greater entry of nonbanks when bank market values are low. See Irani et al. (2020) for evidence that low bank capitalization leads to nonbank entry. Similarly, the International Monetary Fund (2016) attributes the rise in nonbank finance in part to weak bank balance sheets. It also underscores that nonbanks are less prevalent in less developed credit markets, which likely have the highest impediments to competition.

[23]As there are many differences between nonbanks and both banks and other types of nonbanks that are not captured by our model—for example, they offer different types of contracts—we do not intend to claim that our model provides the unique explanation for any of these facts. Rather, we mean to underscore that a single force—the difference in banks' and nonbanks' cost of capital—can provide one possible explanation for all of them.

[24]They find that insurance companies are an exemption; they lend long-term. To the extent that insurance companies benefit from a low cost of capital (since their liabilities are their insurance policies), this is arguably consistent with our theory.

(vi) *Compared to banks, nonbanks are relatively scarce.*

This follows from Proposition 4, Figure 3, and the related discussion.

- See, for example, Puri and Zarutskie (2012), who find that only a fraction of a percent of new companies are VC-funded in U.S. Census data.
- See also Chernenko, Erel, and Prilmeier (2018), who find that nonbank finance constitutes less than one-third of the loans in their sample of mid-market firms.

(vii) *Compared to bank-financed entrepreneurs, nonbank-financed entrepreneurs pursue relatively HAC projects.*

This follows from Proposition 3.

- This is the counterpart of (i) above. See the evidence cited there.
- See also the anecdotal evidence below that HAC entrepreneurs actively seek out nonbank finance.

Other evidence. One feature that distinguishes our model from other theories of entrepreneurial finance is that in our model entrepreneurs choose their projects in response to the kind of finance they have access to, not the other way around (see Proposition 3). In the model, this happens in an extreme way: an entrepreneur is matched with one financier that it can get finance from. However, it could reflect something milder, such as a choice made before matching with financiers, but in anticipation of the pool of available financiers—for example, entrepreneurs located in Silicon Valley may have more access to VC finance than those elsewhere—or a choice to "tilt" the project in some direction made during negotiations with a financier. Direct evidence on this prediction is lacking, probably because it requires information about the set of projects available to entrepreneurs that are not undertaken. However, it resonates with indirect evidence as discussed next.

(viii) *Access to (nonbank) finance determines project choice for HAC entrepreneurs.*[25]

- See Sorenson and Stuart (2001), who find that entrepreneurs further from VCs are more likely to be denied financing; see Blanchflower and Oswald (1998), who find that one of the main reasons people choose not to pursue entrepreneurship is that they have limited access to financing; and see Samila and Sorenson (2011), who find that an increase in the supply of VC makes people more likely to engage in entrepreneurship.

[25] It is critical for our results that project choices happen after entrepreneurs and financiers meet.

- Anecdotally, access not only to financing but to the right *type* of financing is a first-order consideration for entrepreneurs. For example, access to VC financing is among the most-cited reasons why entrepreneurs decide to headquarter in the Bay Area (for example, Cohan (2013) and Wessel (2013)). Similarly, Chen et al. (2010) find that location is related to VC outcomes.
- See the Kauffman survey (Robb et al. (2020)) for evidence that HAC entrepreneurs (proxied by "insufficient collateral," as discussed above) must "'take what they can get' rather than the financing that would be the best fit for their needs." The survey also stresses that entrepreneurs do not apply for financing when they fear being denied. This is in line with our model, in which entrepreneurs alter their project choices to avoid being denied finance.
- More generally, see Hellmann and Puri (2000), Kerr, Lerner, and Schoar (2011), and Lerner et al. (2018), who find that access to finance is a driver of innovation.

In our baseline setup, an increase in competition among financiers leads to more nonbank entry and therefore more entrepreneurs choosing HAC projects in anticipation of nonbank finance. However, as we show in an extension (Appendix Appendix A.A), this specific prediction of our model actually depends on our parametric assumptions. The reason is that, in general, when entrepreneurs choose projects, they face a trade-off. With the HAC project, they get high agency rents, but are captive. With the LAC project, they get low agency rents, but are not captive. So far, we have focused on the case in which the HAC project offers a significant increase in rents, and thus is preferred by entrepreneurs. However, if the HAC project offered only a modest increase in rents, then entrepreneurs could prefer the LAC project, even if the HAC project is efficient, in the sense that the payoff y^A is sufficiently high relative to y^a. Thus, our model suggests that the effect of competition on project choice is ambiguous. To the extent that innovative projects proxy for HAC projects, the empirical evidence is mixed as well, as we discuss next.

(x) *Real-sector innovation can be increasing or decreasing in banking competition.*

- See Chava et al. (2013) and Mao and Wang (2018).[26]
- Hombert and Matray (2016), Cornaggia et al. (2015), and (under the assumption that innovation is relatively risky) Kaviani and Maleki (2018) provide evidence that real-sector innovation declines with banking competition.

[26]To the extent that banks finance with debt and nonbanks with equity, see also Hsu, Tian, and Xu (2014), who find that equity market development increases innovation, whereas debt market development seems to decrease it. Keep in mind, however, that debt and equity are theoretically equivalent in our setup.

In addition to suggesting that banks provide entrepreneurs longer-term financing than nonbanks, our model could potentially illuminate other details of contracts.

(xi) *Contract terms.*

- In our model, banks, with their SBCs, provide refinancing at favorable terms. See Degryse and Cayseele (2000) for evidence that contract terms deteriorate with the duration of financing relationships.
- To the extant that banks, unable to rely on a credible termination threat, could substitute with contractual terms, our model suggests that banks should use more covenants in their contracts. See Chernenko, Erel, and Prilmeier (2018) for evidence consistent with this view.

Although our banks and nonbanks are identical in every way except for their cost of capital, our results are consistent with classic findings about the unique value of banking relationships stressed in the relationship-banking literature. In particular, ex interim, entrepreneurs value their relationships with banks, which provide them continuation finance after failure, but not with nonbanks, which terminate. Unlike in the literature, however, this difference does not depend on assumed differences in information, monitoring ability, or horizon (i.e., myopia or lack thereof).

(xii) *Value of banking relationships.*

- See, for example, Degryse and Ongena (2005) and Nguyen (2019), who find that bank branch closings harm local borrowers. See also Bord, Ivashina, and Taliaferro (2021) who find that the presence of local branch networks helps to cushion the impact of macroeconomic shocks on the supply of credit to small businesses.

C. Policy

Our model stresses that the projects and technologies developed by entrepreneurs depend on the availability of financiers to fund them. This could have implications for policy.[27]

[27] Although we comment on specific policy objectives, we refrain from giving a formal definition of efficiency. There are two main reasons for this. (i) With imperfect markets (bilateral matching) and heterogeneous agents (different costs of capital), there is not a clear way to define the discount rate that determines whether one project is better than another in a net present value sense. (ii) With financiers' funding cost difference

For example, more innovative or productive projects may also be HAC projects, and therefore require nonbank financing. In this case, a policy maker could want to foster nonbank entry to encourage entrepreneurs to develop efficient technologies. As such, he could consider subsidizing nonbank funding, in an effort to level the playing field with banks, which already benefit from government guarantees. Our model suggests, however, that such policies could backfire. The reason is that decreasing nonbanks' cost of capital could undermine the credibility of their termination threat, making them unable to finance HAC entrepreneurs.

An alternative way to encourage nonbank entry could be to tax banks, making nonbanking relatively attractive. Tightening bank regulation could also have a similar effect and lead to an increase in nonbanking, as Buchak et al. (2018) and Irani et al. (2020) document. Our analysis suggests that such regulatory arbitrage, typically cast in a negative light, could have a bright side.

Finally, our model speaks to the unintended consequences of deposit insurance, in so far as the deposit insurance subsidies reduce banks' cost of capital and undermine their threat to withhold capital from entrepreneurs. Our analysis suggests that banks' contributions to deposit insurance schemes should be designed to minimize this distortion.

V. Conclusion

We develop an equilibrium model in which banks and nonbanks coexist even though banks have a lower funding cost than nonbanks. This apparent disadvantage that nonbanks face becomes an advantage in dealing with the SBC problem vis-à-vis borrowers. Because of their higher funding cost, nonbanks are able to more credibly threaten not to continue financing the entrepreneur, thereby enabling them to deal with borrowers more effectively than banks when agency costs are high. Unlike previous theories, entrepreneurs' project choices depend on the type of financiers they have access to. Entrepreneurs with access to banks choose LAC projects and those with access to nonbanks choose HAC projects, thus providing market segmentation with intermediation variety. The theory is consistent with a number of stylized facts about bank and nonbank financing and gives a new perspective on

taken in reduced form, there is not a clear way to define aggregate welfare. To do so, we would have to take a stand on where the difference comes from, and close the model more fully. We choose not to do this given that the cost of capital difference could reflect a variety factors (Section IV.A). For example, banks' low cost of capital could reflect a social purpose played by safe deposits, and these deposits could be safe in part because they are backed by LAC projects. In this case, investing in LAC projects need not be inefficient. In contrast, the low cost of capital could reflect fiscal backing by the government. In this case, investing in LAC projects likely would be inefficient.

some policies.

Appendix A. Extensions

In this section, we describe three extensions. First, we relax the assumption that banks do not fund HAC projects. Second, we allow for so-called “congestion externalities.” Finally, we allow for the possibility that HAC projects are scarce.

A. Entrepreneurs Choose Not to Innovate

So far, entrepreneurs who meet banks choose LAC projects because they know they cannot not get funding for HAC projects. We now turn to another reason they might not choose HAC projects: to avoid being captive. Specifically, if they anticipate being captive if they pursue HAC projects but not LAC projects, they could prefer to pursue LAC projects, which allow them to refinance at better terms. This cannot happen given the parameter assumptions of the baseline model, because we assume that HAC projects are viable only if financiers can impose HBCs. However, it can happen for other parameters.

Proposition Appendix A.1 (Entrepreneurs choose not to innovate): *Suppose the assumptions in the baseline model hold, except that condition (B.26) for banks ($\rho = 0$) holds for HAC but not LAC entrepreneurs (which implies that HAC but not LAC entrepreneurs are captive to banks) and*

$$K_0^A < py^A + \big(1-p\big)\Big(py^A - K_1^A\Big) - 2p\frac{B^A}{\Delta} \tag{A.1}$$

(which implies that HAC projects are viable for banks).

Entrepreneurs matched with banks choose LAC projects (possibly inefficiently) if and only if interbank competition $\hat{Q}$ is sufficiently high.

Intuitively, when entrepreneurs choose projects, they face a trade-off. With the HAC project, they get high private benefits but are captive; with the LAC project, they get low private benefits but are not captive. Thus, they may choose the LAC project, even if the HAC project is efficient, in the sense that the payoff y^A is sufficiently high relative to y^a. This points to another way that nonbanks' high cost of capital can discipline entrepreneurs. Not only does it allow nonbanks to commit to deny second-stage financing, and hardening entrepreneurs' SBCs, but it also allows them to commit to deny financing to LAC projects, which forces entrepreneurs to choose HAC projects. Consequently, entrepreneurs with access to banks choose LAC projects, and those with access to nonbanks choose HAC projects.

B. *Congestion*

Here we show that our results are robust to, and sometimes amplified by, the possibility that similar financiers compete for the same entrepreneurs, in the sense that the probability that a bank meets an entrepreneur is decreasing in the number of other banks operating and the probability that a nonbank meets an entrepreneur is decreasing in the number of other nonbanks. This captures so-called congestion externalities, which are a hallmark of models of markets in which trading/search frictions can make it hard to find a counterparty, for example, the Mortensen and Pissarides (1994) model of labor markets, the Duffie, Gârleanu, and Pedersen (2005) model of over-the-counter asset markets, and the Inderst and Mueller (2004) model of VC markets.[28] To include congestion externalities, we suppose that banks and nonbanks meet entrepreneurs with the "telephone" probabilities (Stevens (2007)):[29]

$$q_{\text{nb}} := \frac{1}{1+\frac{\varphi}{1-Q}} \quad \text{and} \quad q_b := \frac{1}{1+\frac{1-\varphi}{1-Q}}. \tag{A.2}$$

Now, financiers' indifference condition reads

$$q_{\text{nb}}\left(\Sigma^A - p\frac{B^A}{\Delta}\right) = q_b\left(\Sigma^a - p\frac{B^a}{\Delta} - u_1(\hat{Q})\right). \tag{A.3}$$

which is just equation (23) with nonbanks' and banks' matching probability q replaced by q_{nb} and q_b. Following the analysis in Section III.B , we can rearrange equation (A.3) to write

$$u_1(\hat{Q}) = \Sigma^a - p\frac{B^a}{\Delta} - \frac{q_{\text{nb}}}{q_b}\left(\Sigma^A - p\frac{B^A}{\Delta}\right) \tag{A.4}$$

$$= u^* + \left(1 - \frac{q_{\text{nb}}}{q_b}\right)\left(\Sigma^A - p\frac{B^A}{\Delta}\right). \tag{A.5}$$

Solving for φ and comparing the perfect-competition limit ($Q \to 1$) to that in the baseline model gives the next result.

Proposition Appendix A.2 (Intermediation variety with congestion): *Suppose*

[28] Such congestion externalities can also be present in our baseline setup (although they need not be). However, unlike in this extension, they affect all financiers the same way. That is, when a nonbank enters, it imposes the same externalities on banks as on other nonbanks.

[29] These probabilities would more commonly be written as a function of the number of financiers that enter. To economize on notation, we write everything in terms of the probability Q that an entrepreneur meets a financier, rather than introducing notation for this number (which, given telephone matching probabilities with parameters equal to one, is just $\frac{1}{1-Q}$).

that the conditions of Proposition 4 hold, that there is congestion within banks and nonbanks as specified in equation (A.2), and that $\frac{b}{B} \leq \frac{1}{\Delta} - \frac{1}{p}$. In the perfect-competition limit ($Q \to 1$), the proportion of nonbanks is given by

$$\varphi_c \to \frac{1}{2}\left(1 - \frac{u^*}{pB^a/\Delta} - 2\beta + \sqrt{\left(1 - \frac{u^*}{pB^a/\Delta} - 2\beta\right)^2 + 4\beta}\right), \tag{A.6}$$

where

$$\beta := \frac{\Sigma^A - p\frac{B^A}{\Delta}}{pB^a/\Delta} \tag{A.7}$$

(and the expression in equation (A.6) is well defined between zero and one).

The limiting proportion of nonbanks is higher than in the baseline model if and only if it is less than half in the baseline model.

The result above says that congestion in each market works as an additional equilibrating force, bringing the limiting proportion of nonbanks closer to one-half. The reason is that congestion pulls against the thin market, be it the market of banks or of nonbanks.

C. *Scarcity of Innovative Projects*

Here we show that our results are robust to, and indeed amplified by, the possibility that there could be relatively few truly innovative ideas available. Assuming that HAC projects correspond to innovation, we capture this with the assumption that the total supply of innovative projects is at most $S^A < 1$. We maintain the assumption that entrepreneurs are ex ante identical, but we suppose that if there are $E^A > S^A$ innovative entrepreneurs, each gets a viable project with probability S^A/E^A, and otherwise gets zero. If $E^A \leq S^A$, they all get viable projects, as in the baseline setup. Thus, if there are only a few financiers in the market (low Q), our assumption here that innovative projects are limited does not affect our analysis above, since few innovative projects are funded anyway. For high Q, however, becoming a nonbank becomes less attractive, so there are fewer nonbanks. This strengthens our result.

To see why, observe that financiers' indifference condition now reads

$$\min\left\{1, \frac{S^A}{E^A}\right\}\left(\Sigma^A - p\frac{B^A}{\Delta}\right) = \Sigma^a - p\frac{B^a}{\Delta} - u_1(\hat{Q}), \tag{A.8}$$

which is just the baseline indifference condition in equation (23) with nonbanks' payoff multiplied by the probability of successful innovation, that is, by $\min\left\{1, S^A/E^A\right\}$.[30] Following the analysis in Section III.B, we can rearrange equation (A.3) to write

$$u_1(\hat{Q}) = \Sigma^a - p\frac{B^a}{\Delta} - \min\left\{1, \frac{S^A}{E^A}\right\}\left(\Sigma^A - p\frac{B^A}{\Delta}\right) \tag{A.9}$$

$$= u^* + \left(1 - \min\left\{1, \frac{S^A}{E^A}\right\}\right)\left(\Sigma^A - p\frac{B^A}{\Delta}\right). \tag{A.10}$$

Comparing the perfect competition limit ($Q \to 1$) to that in the baseline model gives the next result.

PROPOSITION Appendix A.3 (INTERMEDIATION VARIETY WITH SCARCE INNOVATIVE PROJECTS): *Suppose that the conditions of Proposition 4 hold and that there is a limited supply* S^A *of innovative projects, assumed not to be too small. The proportion of nonbanks* φ_s *is smaller than it is in the baseline model with elastic supply.*

Intuitively, a scarce supply of innovative projects makes it less attractive to become a nonbank, since a nonbank may end up with an entrepreneur lacking a viable idea. Hence, fewer financiers become nonbanks.

[30] We should point out that the number of innovative entrepreneurs, E^A, is itself endogenous. In fact, it is just equal to the probability an entrepreneur meets a nonbank, $E^A = \varphi Q$, given entrepreneurs innovate if and only if they meet nonbanks. We do not substitute it here, however, because it is not necessary for our result below.

Appendix B. Proofs

A. Proof of Proposition 1

An entrepreneur's budget constraint is soft if and only if his incumbent financier is willing to finance continuation. We derive a necessary condition for the incumbent to finance continuation. We then show that this condition is also sufficient.

There are two cases, either (i) the financier offers the maximum R_2 that satisfies the entrepreneur's second-stage IC and the entrepreneur works; or (ii) the financier offers the maximum R_2 that the entrepreneur can feasibly repay, that is, that satisfies the "feasibility constraint,"

$$R_1 + R_2 \leq y, \tag{B.1}$$

and the entrepreneur shirks. The incumbent imposes an SBC if and only if his second-stage PC is satisfied in either of these cases. We consider the two cases in turn.

- *Case (i): Entrepreneur works.* The maximum repayment R_2 that satisfies the entrepreneur's second-stage IC (inequality (6)) with $\beta = b$ solves

$$R_1 + R_2 = y - \frac{b}{\Delta}. \tag{B.2}$$

  The incumbent financier's expected payoff is

$$\begin{aligned} \Pi_2^{\text{work}} &:= p(R_1 + R_2) \\ &= p\left(y - \frac{b}{\Delta}\right). \end{aligned} \tag{B.3}$$

- *Case (ii): Entrepreneur shirks.* The maximum repayment that the entrepreneur can make that satisfies his feasibility constraint solves

$$R_1 + R_2 = y, \tag{B.4}$$

  and he does not work. Hence, in this case, the financier's expected payoff is

$$\begin{aligned} \Pi_2^{\text{shirk}} &:= (p - \Delta)(R_1 + R_2) \\ &= (p - \Delta)y. \end{aligned} \tag{B.5}$$

Observe from the expressions above that it is always the case that the financier prefers to incentivize work,

$$\Pi_2^{\text{work}} \geq \Pi_2^{\text{shirk}} \iff \Delta^2 y \geq pb, \tag{B.6}$$

which is implied by Assumption 1 (since $B > b$). Hence, a necessary condition for the creditor to provide continuation financing is that $\Pi_2^{\text{work}} \geq (1+\rho)K_1$, which is condition (9) in the proposition.

This condition need not be sufficient. Although it holds for the maximum repayments (the incumbent can extract these if the entrepreneur is captive) it need not hold for lower repayments, which the incumbent could potentially have to offer compete with a rival financier with a lower discount rate. However, it is indeed sufficient. The reason is that the only way that an entrepreneur is not captive is if a rival is willing to finance him. But, in this case, the incumbent is willing to finance too (this follows from Corollary 1). □

B. Proof of Proposition 2

An entrepreneur is not captive if and only if a rival financier is willing to provide continuation financing.

As in the proof of Proposition 1, there are two cases: either (i) the financier offers the maximum R_2 that satisfies the entrepreneur's second-stage IC constraint and the entrepreneur works, or (ii) the financier offers the maximum R_2 that satisfies the entrepreneur's feasibility constraint and the entrepreneur shirks. The entrepreneur is captive if and only if the rival financier's second-stage PC is satisfied in neither of these cases. We consider the two cases in turn.

- *Case (i): Entrepreneur works.* If the rival financier incentivizes the entrepreneur to work, it offers the repayment $\hat{R}_2$ so that his second-stage IC binds (inequality (6)) with $\beta = B$:

$$R_1 + \hat{R}_2 = y - \frac{B}{\Delta}. \tag{B.7}$$

  The rival financier's payoff in this case is

$$\hat{\Pi}_2^{\text{work}} := p\hat{R}_2 \tag{B.8}$$

$$= p\left(y - \frac{B}{\Delta} - R_1\right). \tag{B.9}$$

- *Case (ii): Entrepreneur shirks.* If the rival financier extracts the highest repayment ex post, it offers $\hat{R}_2$ so that the entrepreneur's feasibility constraint binds (inequality (B.1)):

$$R_1 + \hat{R}_2 = y. \tag{B.10}$$

The rival financier's payoff in this case is

$$\begin{aligned} \hat{\Pi}_2^{\text{shirk}} &:= (p-\Delta)\hat{R}_2 \\ &= (p-\Delta)\left(y - R_1\right). \end{aligned} \tag{B.11}$$

Substituting from the above into into the rival's PC (inequality (3)), we see that the entrepreneur is captive if and only if

$$\begin{aligned} (1+\rho)K_1 &> \max\left\{\hat{\Pi}_2^{\text{work}}, \hat{\Pi}_2^{\text{shirk}}\right\} \\ &= \max\left\{p\left(y - \frac{B}{\Delta} - R_1\right), (p-\Delta)\left(y - R_1\right)\right\}. \end{aligned} \tag{B.12}$$

This is gives the condition in the proposition, which holds if and only if R_1 is sufficiently high.

Finally, we make a side note that will be useful later. Specifically, we note that by comparing the cases above, we get a condition for the rival to prefer to incentivize work:

$$\hat{\Pi}_2^{\text{work}} \geq \hat{\Pi}_2^{\text{shirk}} \iff \Delta^2(y - R_1) \geq pB. \tag{B.13}$$

□

C. Proof of Corollary 1

The initial financier wants to set the highest possible R_1, subject to the entrepreneur's first-stage IC (which is satisfied by Assumption 1; see Appendix Appendix C). The maximum R_1 he can set is $R_1^{\max} := y - B/\Delta$, which comes from the binding IC with $u_1 = 0$. The entrepreneur is captive (and hence $u_1 = 0$ is consistent with the equilibrium) if inequality (10) is satisfied given $R_1 = R_1^{\max}$, or

$$K_1 > \max\left\{0, (p-\Delta)\frac{B}{\Delta}\right\}, \tag{B.14}$$

which is the condition in the corollary. □

D. Proof of Lemma 1

Solving for u_1 involves considering a number of cases, corresponding to whether the entrepreneur faces an HBC/SBC, is captive/not, and whether he works/shirks. The proof involves going through these cases.

If the entrepreneur faces an HBC, then under the condition in the lemma, we know that he is also captive (by Corollary 1). Hence, his continuation value is zero.

If he faces an SBC, there are two cases, each with two subcases, as follows: he can be captive to his incumbent financier or not, and, in each case, his IC can be binding (if the financier incentivizes him to work) or not (if it does not).

1. *Case (i): Entrepreneur captive.* In this case, the entrepreneur's incumbent financier will finance him but a rival will not. Given Assumption 1, the incumbent will always make the entrepreneur's second-stage IC bind, that is, $R_1 + R_2 = y - b/\Delta$ (see the proof of Proposition 1). This leaves the entrepreneur an agency rent of:

$$\begin{aligned} u_1 &= p(y - R_1 - R_2) \\ &= p\frac{b}{\Delta}. \end{aligned} \tag{B.15}$$

2. *Case (ii): Entrepreneur not captive.* If the entrepreneur is not captive, then the incumbent offers R_2 so that the entrepreneur prefers not to look for a rival. Hence, the entrepreneur's payoff is the greater of (i) the payoff he gets from his incumbent with a binding IC (as in the case of captivity; see equation (B.15)) and (ii) the expected payoff he would get from looking for a rival (recall that he gets higher private benefits with a rival, which cannot monitor).

   Thus, to find his continuation value, we need to compute his payoff if he meets a rival and then multiply it by the probability that the rival funds him, $\hat{Q}$. As in the previous results, there are two subcases: either (a) the rival offers the maximum $\hat{R}_2$ that satisfies the entrepreneur's second-stage IC (and the entrepreneur works) or (b) the rival offers the maximum $\hat{R}_2$ that satisfies the entrepreneur's feasibility constraint (and the entrepreneur shirks). We know from the proof of Proposition 2 that we are in subcase (a) if inequality (B.13) is satisfied and subcase (b) otherwise. We now compute u_1 in each subcase.

   - *Subcase (a): Entrepreneur works.* In this case, the entrepreneur's total repayment

$R_1 + \hat{R}_2$ is given by equation (B.7). His expected payoff from looking for a rival financier is

$$u_1 = \hat{Q}p\left(y - R_1 - \hat{R}_2\right) \\ = \hat{Q}p\frac{B}{\Delta}. \tag{B.16}$$

- *Subcase (b): Entrepreneur shirks.* In this case, the entrepreneur's repayment is such that his feasibility constraint (inequality (B.1)) binds and he gets only his private benefits. His expected payoff from looking for a rival is

$$u_1 = \hat{Q}B. \tag{B.17}$$

Using the above and the condition for the rival to incentivize work (inequality (B.13)), we can write u_1 for the not-captive entrepreneur as:

$$u_1 = \begin{cases} \max\left\{p\frac{b}{\Delta}, \hat{Q}B\right\} & \text{if } \Delta^2(y - R_1) < pB, \\ \max\left\{p\frac{b}{\Delta}, \hat{Q}p\frac{B}{\Delta}\right\} & \text{otherwise.} \end{cases} \tag{B.18}$$

Note that u_1 (on the LHS) depends on R_1 (on the RHS), which depends in turn on u_1, so this equation embeds a fixed-point problem, which could have multiple solutions. In the case that u_1 above is multi-valued, it takes the smallest value. The reason is that the initial financier offers the highest R_1 it credibly can and in so doing "chooses" the lowest possible u_1.

Recall that the first-stage IC (inequality (8)) is satisfied by Assumption 1 (see Appendix Appendix C). Given the initial financier offers the highest possible R_1, the IC will bind (inequality (8)). This gives an expression for R_1 in terms of u_1:

$$R_1 = y - \frac{B}{\Delta} - u_1. \tag{B.19}$$

Substituting this into the expression for u_1 above, we have

$$u_1 = \begin{cases} \max\left\{p\frac{b}{\Delta}, \hat{Q}B\right\} & \text{if } \max\left\{p\frac{b}{\Delta}, \hat{Q}B\right\} \leq \frac{B}{\Delta}\left(\frac{p}{\Delta} - 1\right), \\ \max\left\{p\frac{b}{\Delta}, \hat{Q}p\frac{B}{\Delta}\right\} & \text{if } \max\left\{p\frac{b}{\Delta}, \hat{Q}p\frac{B}{\Delta}\right\} \geq \frac{B}{\Delta}\left(\frac{p}{\Delta} - 1\right). \end{cases} \tag{B.20}$$

The remainder of the proof consists of simplifying the expression above case by case. There are three cases, which we write as (i) low, (ii) medium, and (iii) high pb/Δ.

- *Case (i): $pb/\Delta \le \hat{Q}B$.* This corresponds to $\hat{Q} \ge \dfrac{p}{\Delta}\dfrac{b}{B}$. In this case,

$$u_1 = \begin{cases} \hat{Q}B & \text{if } \hat{Q} \le \dfrac{p}{\Delta}\left(\dfrac{1}{\Delta} - \dfrac{1}{p}\right), \\ \hat{Q}p\dfrac{B}{\Delta} & \text{if } \hat{Q} \ge \dfrac{1}{\Delta} - \dfrac{1}{p}. \end{cases} \tag{B.21}$$

  Comparing the thresholds above, we see that given $\frac{1}{\Delta} - \frac{1}{p} < \frac{p}{\Delta}\left(\frac{1}{\Delta} - \frac{1}{p}\right)$ (because $p > \Delta$), there is a nonempty interval in which the above is multi-valued. In this case, it takes the smaller value, namely, $\hat{Q}B$. Hence,

$$u_1 = \begin{cases} \hat{Q}B & \text{if } \hat{Q} \le \dfrac{p}{\Delta}\left(\dfrac{1}{\Delta} - \dfrac{1}{p}\right), \\ \hat{Q}p\dfrac{B}{\Delta} & \text{if } \hat{Q} > \dfrac{p}{\Delta}\left(\dfrac{1}{\Delta} - \dfrac{1}{p}\right). \end{cases} \tag{B.22}$$

- *Case (ii): $\hat{Q}B < pb/\Delta \le \hat{Q}pB/\Delta$.* This corresponds to $b/B \le \hat{Q} < pb/(\Delta B)$. In this case,

$$u_1 = \begin{cases} p\dfrac{b}{\Delta} & \text{if } \dfrac{b}{B} \le \dfrac{1}{\Delta} - \dfrac{1}{p}, \\ \hat{Q}\,p\dfrac{B}{\Delta} & \text{if } \hat{Q} \ge \dfrac{1}{\Delta} - \dfrac{1}{p}. \end{cases} \tag{B.23}$$

  Comparing the thresholds above, we see that it always has at least one well-defined value (given the conditions of Case (ii)), but it can be multi-valued. In this case, it takes the smaller value, namely, pb/Δ:

$$u_1 = \begin{cases} p\dfrac{b}{\Delta} & \text{if } \dfrac{b}{B} \le \dfrac{1}{\Delta} - \dfrac{1}{p}, \\ \hat{Q}p\dfrac{B}{\Delta} & \text{if } \dfrac{b}{B} > \dfrac{1}{\Delta} - \dfrac{1}{p}. \end{cases} \tag{B.24}$$

- *Case (iii): $pb/\Delta > \hat{Q}pB/\Delta$.* This corresponds to $\hat{Q} < b/B$. In this case,

$$u_1 = p\frac{b}{\Delta}. \tag{B.25}$$

Collecting the cases above gives the expression in the lemma.[31]

Finally, as an aside, we prove a corollary that will be useful later.

COROLLARY Appendix B.1: *Suppose that an entrepreneur has a SBC. He is not captive if and only if*

$$(1+\rho)K_1 \leq \max\left\{p^2\frac{b}{\Delta}, (p-\Delta)\left(\frac{B}{\Delta}+p\frac{b}{\Delta}\right)\right\}. \tag{B.26}$$

Proof. To prove the result, we make use of the fact that increasing R_1 makes it easier to keep an entrepreneur captive (Proposition 2). Hence, an entrepreneur is captive if and only if a rival will not finance him given the maximum possible R_1 that satisfies his first-stage IC with the lowest continuation value consistent with an SBC, or with $u_1 = pb/\Delta$ and hence $R_1 = y - B/\Delta - pb/\Delta$. (Recall that Assumption 1 implies he works at the first stage, so the IC is satisfied.) To recover the condition in the corollary, we substitute this into the necessary and sufficient condition for the entrepreneur to be captive (inequality (10)).

□

E. Proof of Proposition 3

We divide the proof into a number of smaller results:

- Lemma Appendix B.1 characterizes an entrepreneur's project choice, given their access to finance.
- Lemma Appendix B.2 characterizes nonbank finance for HAC projects (which turns out to be the only relevant case).
- Lemma Appendix B.3 characterizes bank finance for HAC and LAC projects. There, we show that rival banks provide continuation financing to LAC entrepreneurs and, in Lemma Appendix B.4, we show that rival nonbanks do not provide such financing to LAC entrepreneurs.

Uniqueness follows from these results, because we show how each player best responds to any rationalizable action of others (i.e., we do not rely on players knowing the equilibrium behavior of others).

[31]The expression in the lemma can easily be verified case by case. To do so, it is useful to note that the conditions $\frac{b}{B} \leq \frac{1}{\Delta} - \frac{1}{p}$ and $\hat{Q} > \frac{p}{\Delta}\left(\frac{1}{\Delta} - \frac{1}{p}\right)$ imply that $\hat{Q}B > p\frac{b}{\Delta}$, and therefore we are in Case (i) above.

Lemma Appendix B.1: *If an entrepreneur can finance either the HAC project or the LAC project, he chooses the HAC project.*

Proof: An entrepreneur gets at least his first-stage agency rent, pB^A/Δ, if he pursues the HAC project. He gets at most the sum of his first- and second-stage agency rents, which is at most $2pB^a/\Delta$, if he pursues the LAC project.[32] Since $B^A > 2B^a$ by Assumption 2, he always prefers the HAC project. □

Lemma Appendix B.2: *Nonbanks (i) impose HBCs on HAC entrepreneurs, (ii) keep them captive, and (iii) are willing to provide finance at the initial stage.*

Proof: We prove the three statements in turn.

- *Statement (i).* This follows from Proposition 1: inequality (9) is violated for $\alpha = A$ and $\rho = r$ by Assumption 4.
- *Statement (ii).* This follows from Statement (i) and Corollary 1, given Assumption 5.
- *Statement (iii).* The nonbank's expected payoff is $p\left(y - B/\Delta\right)$, which is just the project's expected payoff py minus the entrepreneur's agency rent pB/Δ at the first stage (and nothing at the second stage, given he has an HBC and he is captive). This exceeds $(1+r)K_0$ (i.e., the nonbank's first-stage PC is satisfied) by Assumption 4.

□

Lemma Appendix B.3: *Banks (i) have SBCs with both types of entrepreneurs, (ii) do not keep LAC entrepreneurs captive, and (iii) are willing to provide finance at the initial stage to LAC but not HAC entrepreneurs.*

Proof: We prove the three statements in turn.

[32] To see this upper bound, observe that the entrepreneur's ex ante utility is lower if he shirks (and gets private benefits) than if he works (and gets agency rents which more than compensate for forgone private benefits). In this case, he gets $u_0 = p(y - R_1) + (1-p)p(y - R_1 - R_2)$. From the first- and second-stage ICs (inequalities (8) and (6)), we have that $R_1 + R_2 \leq y - B/\Delta$, so $u_1 \leq pB/\Delta$, and $R_1 \leq y - B/\Delta - u_1$. Substituting into the expression for u_0 gives the upper bound in the text.

- *Statement (i).* This follows from Proposition 1: inequality (9) is satisfied for $\alpha \in \{A, a\}$ and $\rho = 0$ by Assumption 1 and Assumption 5.[33]

- *Statement (ii).* This follows from Corollary Appendix B.1: given their SBCs, entrepreneurs are not captive to banks as long as inequality (B.26) is satisfied with $\rho = 0$, which it is by Assumption 5.

- *Statement (iii).* Here we compute the bank's expected payoff and show that it is positive for an LAC entrepreneur but negative for an HAC entrepreneur.

  Given the bank has an SBC and $\rho = 0$, the bank's payoff is

$$\begin{aligned} \text{bank's payoff } &= py + (1-p)py - K_0 - (1-p)K_1 - u_0 \\ &= (2-p)py - K_0 - (1-p)K_1 - u_0, \end{aligned} \tag{B.29}$$

  where $py + (1-p)py$ is the total surplus (given the entrepreneur works at both stages), $K_0 + pK_1$ is the total expected capital outlay, and u_0 is the entrepreneur's payoff. We can find upper and lower bounds on u_0. To do so, observe that from his first-stage IC (inequality (7)) the entrepreneur gets agency rent $p(B/\Delta + u_1)$ at stage one. Adding his continuation value gives $u_0 = pB/\Delta + u_1$. Now, from Lemma 1, observe that his continuation value u_1 is at least pb/Δ and at most pB/Δ. Hence,

$$\frac{p}{\Delta}(B+b) \leq u_0 \leq \frac{2pB}{\Delta}. \tag{B.30}$$

  Thus, substituting into the equation for the bank's payoff, we have

$$(2-p)py - K_0 - (1-p)K_1 - \frac{2pB}{\Delta} \leq \text{ bank's payoff } \leq (2-p)py - K_0 - (1-p)K_1 - \frac{p(B+b)}{\Delta}. \tag{B.31}$$

  By Assumption 3, the LHS is always positive for LAC projects (so a bank always finances them) and the RHS is always negative for HAC projects (so a bank never finances them).

[33] To see this, observe after that substituting $p^2 b > \Delta K_1$ from Assumption 5 and $B > b$, Assumption 1 implies that

$$y \geq \frac{1-\Delta}{(1-p)\Delta}\Big(p\frac{b}{\Delta} + K_1\Big). \tag{B.27}$$

Given $\Delta < p$, this implies that

$$y \geq \frac{1}{p}\left(p\frac{b}{\Delta} - K_1\right). \tag{B.28}$$

Rearranging gives the desired inequality.

□

Lemma Appendix B.4: *Nonbanks do not finance continuation of LAC entrepreneurs.*

Proof: The rival nonbank finances continuation if and only inequality (10) is satisfied with $\rho = r$.

A sufficient condition for this is that inequality (10) is satisfied with the lowest possible value of R_1, which is the value at which the first-stage IC binds with the largest possible value of u_1 ($\hat{Q} = 1$). This value is $u_1 = pB/\Delta$, which corresponds to the case in which the entrepreneur meets a rival that incentivizes him to work for sure.

From here, the binding first-stage IC (inequality (8)) gives $R_1 = y - (1+p)B/\Delta$. Substituting into the condition for captivity in inequality (10), we find that nonbanks do not provide continuation financing if

$$(1+r)K_1 > \max\left\{p^2\frac{B}{\Delta}, (p-\Delta)(1+p)\frac{B}{\Delta}\right\}. \tag{B.32}$$

This is satisfied for the LAC entrepreneur by Assumption 5. □

F. *Proof of Corollary 2*

The result follows from Lemma Appendix B.4. □

G. *Proof of Proposition 4*

We prove each statement in turn.

- *Statement 1.* We must show that for sufficiently low Q, all financiers prefer to become banks. Substituting $Q = 0$ into the continuation value u_1 in Lemma 1 ($u_1(0) = pb/\Delta$), we see that banks' payoff is greater than nonbanks' (the expression in equation (22) with $Q = 0$ is greater than that in equation (20)) exactly when the condition in the proposition is satisfied (inequality (27)).
- *Statements 2.* This follows almost immediately from the analysis in the text given the expression in equation (26) for φ.

- *Statement 3.* Using the expression for φ in equation (26) and rewriting, we see that $\varphi < 1$ for all Q if and only if $u^* > u_1(0) = pb/\Delta$, where the last equality follows from the expression in Lemma 1. This is always satisfied given the definition of u^* in equation (24) and the condition in Proposition (27). $\square$

H. *Proof of Proposition Appendix A.1*

As above, an entrepreneur's budget constraint is soft with a bank. Thus, his payoff is

$$u_0 = p(y - R_1) + (1 - p)u_1 \tag{B.33}$$

$$= p\frac{B}{\Delta} + u_1, \tag{B.34}$$

having substituted for R_1 from the entrepreneur's IC (equation (8)).

Now, by the hypothesis of the proposition, he is captive with an HAC project but not with an LAC one. Hence, $u_1\big|_{\text{HAC}} = p\frac{b^A}{\Delta}$ and $u_1\big|_{\text{LAC}}$ is a function of $\hat{Q}$ given by Lemma 1. Thus $u_0|_{\text{HAC}}$ is constant, whereas $u_0|_{\text{LAC}}$ is increasing in $\hat{Q}$. Hence, the entrepreneur chooses the LAC project if $\hat{Q}$ is sufficiently high. $\square$

I. *Proof of Proposition Appendix A.2*

The argument follows from taking the limit as $Q \to 1$ of the financiers' indifference condition. We have that $\hat{Q} = (1 - \varphi_c)Q \to 1 - \varphi_c$ and

$$\lim_{Q\to 1} \frac{q_{\text{nb}}}{q_b} = \lim_{Q\to 1} \frac{\frac{1}{1+\frac{\varphi_c}{1-Q}}}{\frac{1}{1+\frac{1-\varphi_c}{1-Q}}} \tag{B.35}$$

$$= \frac{1 - \varphi_c}{\varphi_c}. \tag{B.36}$$

By Lemma 1 and the hypothesis that $\dfrac{b}{B} \leq \dfrac{1}{\Delta} - \dfrac{1}{p}$, we have $u_1(\hat{Q}) \to pB^a(1 - \varphi_c)/\Delta$. Thus, equation (A.5) can be written as

$$p\frac{B^a}{\Delta}(1 - \varphi_c) = u^* + \left(1 - \frac{1 - \varphi_c}{\varphi_c}\right)\left(\Sigma^A - p\frac{B^A}{\Delta}\right), \tag{B.37}$$

or defining

$$\beta := \frac{\Sigma^A - p\frac{B^A}{\Delta}}{pB^a/\Delta}, \tag{B.38}$$

as

$$\varphi_c^2 - \left(1 - \frac{u^*}{pB^a/\Delta} - 2\beta\right)\varphi_c - \beta = 0. \tag{B.39}$$

The expression for φ_c in the proposition follows from solving the quadratic equation for φ_c and realizing that the smaller root is negative and hence can be discarded.

To compare the above to the fraction of nonbanks in the baseline model, observe from equation (24) that, for $u_1 \to pB^a(1-\varphi)/\Delta$, the limit of φ in the baseline model is

$$1 - \frac{u^*}{pB^a/\Delta} =: \varphi^\infty. \tag{B.40}$$

Comparing this to the expression for φ_c (equation (A.6)) and manipulating reveals that the limiting φ_c exceeds φ^∞ if and only if $\varphi^\infty < 1/2$. □

J. Proof of Proposition Appendix A.3

From equation (A.10), we have that $u_1(\hat{Q}) > u^*$ and, therefore, using $\hat{Q} = (1-\varphi_s)Q$ from Lemma 1, $\varphi_s < 1 - u^{-1}(u^*)/Q$. The RHS is the expression for $\varphi > 0$ in the baseline model (equation (26)). Hence, $\varphi_s < \varphi$.

It remains only to check that entrepreneurs still choose innovative projects when they meet nonbanks, despite the risk that the projects are not viable. Given that entrepreneurs strictly prefer innovative projects in the baseline model by Lemma Appendix B.1, this is the case as long as the probability of getting a viable project S^A/E^A is high enough, which it is given our assumption that S^A is not too small. □

Appendix C. Assumption 1 Implies No Equilibrium Shirking

Here, we explain that financiers always offer contracts that incentivize work at both stages, that is, that it is most profitable to offer repayments R_1 and R_2 that satisfy the entrepreneur's ICs (inequalities (5) and (7)). Note, however, that at the second stage the entrepreneur's outside option is to get finance from a rival, which might not offer a contract satisfying his

IC.

HBC. If the entrepreneur faces an HBC, there is only one stage, and we need show only that the financier's surplus is higher from working than from shirking,

$$p\left(y - \frac{B}{\Delta}\right) \geq (p - \Delta)y, \tag{B.41}$$

where the LHS is the financier's payoff if the entrepreneur's first-stage IC binds and the RHS is its payoff if the feasibility constraint ($R_1 = y$) binds. Rewriting, this says that

$$\Delta^2 y \geq pB. \tag{B.42}$$

This is the (second part of the) condition in Assumption 1.

SBC. Now we compare the financier's payoff from incentivizing work or not at each stage. There are four possible outcomes, for each first- and second-stage action: work-work, work-shirk, shirk-work, and shirk-shirk. We focus on the case of a bank, which turns out to be the only relevant case here (since, by Lemma Appendix B.2, the nonbank imposes an HBC).

We already know from the proof of Proposition 1 that work-work $\succeq$ work-shirk. Here, we compute the financier's payoff from the other outcomes and show that work-work is necessarily preferred (no matter whether the entrepreneur has access to a rival).

- *Work-work.* Here, we use the superscript ww to indicate the repayments the financier offers such that the entrepreneur works at each stage, that is, that satisfy the entrepreneur's ICs. In this case, a financier gets

$$\Pi_1^{\text{work,work}} = -K_0 + pR_1^{ww} + (1-p)\Big(-K_1 + p(R_1^{ww} + R_2^{ww})\Big). \tag{B.43}$$

  The terms can be understood as follows. The financier provides the initial capital K_0 and the entrepreneur works. Hence, the entrepreneur succeeds and repays with probability $\pi_1 = p$. He fails with probability $1-p$, in which case his budget constraint is soft: the financier provides continuation capital K_1, the entrepreneur works, and, hence, succeeds and repays with probability $\pi_2 = p$.

- *Shirk-work.* Here, we use the superscript sw to indicate the repayments the financier offers such that the entrepreneur shirks at the first stage and works at the second, that is, that satisfy the entrepreneur's resource constraint at the first stage ($R_1^{sw} = y$) and its IC at the second (inequality (5)). In this case, a financier gets

$$\Pi_1^{\text{shirk,work}} = -K_0 + (p - \Delta)y + (1 - p + \Delta)\Big(- K_1 + p(R_1^{sw} + R_2^{sw})\Big). \tag{B.44}$$

The terms can be understood as follows. The financier provides the initial capital K_0 and the entrepreneur shirks. Hence, the entrepreneur succeeds and repays with probability $\pi_1 = p - \Delta$. He fails with probability $1 - p + \Delta$, in which case his budget constraint is soft: the financier provides continuation capital K_1, the entrepreneur works and, hence, succeeds and repays with probability $\pi_2 = p$.

- *Shirk-shirk.* In this case, a financier gets

$$\Pi_1^{\text{shirk,shirk}} = -K_0 + (p - \Delta)y + (1 - p + \Delta)\Big(- K_1 + (p - \Delta)y\Big). \tag{B.45}$$

The terms can be understood as follows. The financier provides the initial capital K_0, the entrepreneur shirks, and, hence, he succeeds and repays with probability $\pi_1 = p - \Delta$. He fails with probability $1 - p + \Delta$, in which case, his budget constraint is soft: the financier provides continuation capital K_1, the entrepreneur shirks and, hence, succeeds and repays with probability $\pi_2 = p - \Delta$.

We first point out that shirk-work $\succeq$ shirk-shirk: the first-stage payoff to the financier is the same, and we know from the proof of Proposition 1 that, given Assumption 1, financiers always prefer to induce working at the second stage.

It remains to show that work-work $\succeq$ shirk-work. To compare the expressions above, first observe that the total repayment at the second stage does not depend on what happened in the first stage, so $R_1^{ww} + R_2^{ww} = R_1^{sw} + R_2^{sw}$. Now, given the expressions above, we have

$$\Pi_1^{\text{work,work}} \geq \Pi_1^{\text{shirk,work}} \implies p\Big(y - R_1^{ww}\Big) < \Delta\Big(y + K_1 - p(R_1^{sw} + R_2^{sw})\Big). \tag{B.46}$$

This inequality is satisfied if it is satisfied for the lowest possible R_1^{ww} and the largest possible $R_1^{sw} + R_2^{sw}$.

- The lowest possible R_1^{ww} comes from, first, making the first-stage IC (inequality (8)) bind, so $R_1^{ww} = y - B/\Delta - u_1$, and, second, making u_1 as large as possible, so pB/Δ (which is an upper bound on the entrepreneur's second-stage payoff). Thus, we set $R_1^{ww} = y - B/\Delta - pB/\Delta$.

- The largest possible $R_1^{sw} + R_2^{sw}$ comes from making the second-stage IC (inequality (6)) bind, so $R_1^{sw} + R_2^{sw} = y - b/\Delta$.

Substituting R_1^{ww} and $R_1^{sw} + R_2^{sw}$ into inequality (B.46), we get a sufficient condition for there not to be shirking at the first stage. This is the (first part of the) condition in Assumption 1. $\square$

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