Letcher County Culture Hub: Impact on Borrowing and Financing Power

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1 Acknowledgements

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Thank you to the Robertson Scholars Leadership Program, as well as the Hart Leadership Program at Duke University, for generously funding this community-based research project.

This report is owned by the Letcher County Culture Hub. It articulates the voices of its members, of its prospective and past lenders, and of its core contributors. My role is simply to amplify, supplement, and facilitate those voices.

2 Summary

Despite the tight-knit and trust-abundant nature of rural America, traditional financial institutions are largely unable to trust communities with funding, especially without traditional measures like credit score checks, which rural communities are disproportionately excluded from demonstrating.

International efforts under the umbrella of microfinance have attempted to generate alternative solutions to "the trust problem" for rural communities, the most notable of those alternatives being group lending. However, research results on group lending are ambivalent, leaving room for future alternatives.

Examining Appalachian Kentucky affords the opportunity to see what one community is doing to combat the issue. The Letcher County Culture Hub offers a potential model against community disinvestment. Its core purpose is to advance culture in a collaborative manner. However, the hub has found success in garnering lending and grant investments by positioning itself as a group where members are capable and committed to collaborative initiatives. **I utilize several long-form interviews and a simple signaling model to argue that such a strategy aligns with the incentives of both the community, and prospective lenders and grantmakers.** Then, I examine the core tradeoff that could arise with any community looking to position itself similarly, that being the substantive time and effort investment for its members.

I ultimately argue that the Culture Hub can function as a model for communities looking to formalize their trust and signal their credibility, as a step toward relieving rural communities of their empirical disinvestment.

3 Introduction

"The handshake still speaks volumes." — Geoff Marietta, CEO of the Appalchian Impact Fund [28].

One of rural communities' most readily definable features is its constituents' emphasis on trust. Yet, despite intra-community trust, many banks and investors looking in from the outside find it hard to trust rural communities with their money, leading to a crisis of underbanking. Underbanked communities find it difficult to access banking services that would empower them with financing capabilities. The phenomenon disproportionately plagues rural areas such as Appalachia, because many residents do not possess sufficient credit to qualify for traditional loans [34].

Many of these areas suffer from larger economic decline and negligence. In 2017, the unemployment rate in Letcher County (a county in Appalachian Kentucky) reached 15 percent [41], and the county resides in a district where almost a third of residents live below the poverty line [7]. Many cite the decline of the coal industry as chief culprit, where 90 percent of coal jobs have disappeared in a county that had relied heavily on the industry [26].

Payday lenders weaponize the trust of these communities by posing as suitable treatments to the condition of underbanking, often worsening the ailment of poverty for their own gain. The average interest rate of 469 percent (in Kentucky) for a standard 2-week, 300 dollar payday loan is preposterous for most, and consequently, 25 percent of consumers must reborrow at least 9 times; this can cause an expected 520 dollars in additional charges [35].

Ironically, the symptoms of poverty inhibit these communities from access to the financial resources that would ease those symptoms; beyond poor credit, issues with internet access and transportation inequity further complicate access to banks [34].

Rural communities domestic and worldwide suffer from similar symptoms. According to the Federal Reserve, "between 2012 and 2017, there was also a substantial increase in the number of communities that contained no bank headquarters, the majority of which were rural" [14]. Underbanking and underinvestment compound problems of community and economic development in these areas. Worldwide, 1.7 billion adults suffer from lack of banking, in large part due to the same credit issue articulated above [12].

Trust is a latent asset. Traditional banks and financial institutions focus on the credit score as an all-powerful measurable of interest, when it is perhaps just as meaningful that people living in trust-dependent areas do not want to be branded as the "one who didn't pay back their loan" in their town, village, or community.

This report calls to attention those institutions, while also acknowledging the ways in which rural communities can operationalize their trust. I explore the work of one organization in Appalachia, the Letcher County Culture Hub, and their efforts to formalize and project their intra-community trust outward, in an effort to signal their credibility to lenders (and even philanthropists, where the problem of trust persists). I first introduce the methods I utilized. Then, I further specify the aforementioned trust issue. Afterward, I identify past worldwide efforts to solve such an issue, before comparing the Culture Hub to those efforts. Finally, I conclude and articulate areas of further research.

4 Methods

In the following sections, I introduce the methods I utilized in my research.

4.1 Interviews

As part of this study, I conducted 9 long-form, open-ended interviews with members of the community, all centered around the impact of the Culture Hub's collective nature on its ability to function and empower financing for its members. Broadly, I sought to interview community lenders in the Appalachian region, active members in the Culture Hub who had participated in a successful half a million dollar community solar initiative [15], as well as other active members of the Culture Hub. The names and affiliations of my interviewees are listed below.

Lenders in the Appalachian region:

- Geoff Marietta: Geoff is the CEO of Appalachian Impact Fund, a branch of the Foundation of Appalachian Kentucky that specializes in social impact investing [2]. He is also the co-founder of Invest 606, an incubator program for the 606 zip code in Eastern Kentucky [29].

- Betsy Waley: Betsy is the CSO of Mountain Association, formerly known as MACED [33]. The Mountain Association is a community development financial institution (CDFI) that facilitated the 2019 Letcher County Culture Hub solar project through a 500,000 dollar loan [15].

Active members in the Culture Hub solar project:

- Seth Long: Seth is the CEO of HOMES, Inc, a non-profit looking to increase affordable housing opportunity in Southeastern Kentucky, through construction, repairs, and affordable rental units [1].

- Gwen Johnson: Gwen is the Secretary and Treasurer for Hemphill Community Center [5]. The center hosts musical, crafting, and other gathering events [22]. The Black Sheep Brick Oven Bakery, which Gwen co-founded and manages, is housed in the center [5]. Gwen was also appointed as a member of the Culture Hub Board of Directors in June 2022.

Active members in the Culture Hub:

- Annie Jane Cotten: Annie Jane is the lead organizer of the Letcher County Culture Hub.

- Valerie Horn: Valerie is the director of Cowan Community Center, a center that offers family gathering events, reunions, musical events, and more [39]. The center collaborated with the Levitt foundation to host the Levitt Amp concert, which occurred across 10 weeks in Summer 2022 [3]. Valerie was also appointed as the Vice Chair of the Culture Hub Board of Directors in June 2022.

- Kathleen Byrne: Kathleen is the Institutional Development Director of Appalshop [32]. Appalshop is a multimedia shop that seeks to authentically lift up the voices of Appalachia, whether through film, music, or some other medium [31]. Kathleen was also appointed as the Vice Chair of the Culture Hub Board of Directors in June 2022.

- Marcia Caudill: Marcia is the Treasurer of Carcassone Community Center, a center known for its square dance celebrations, among other community events [8]. Marcia was also appointed the Chair of the Culture Hub Board of Directors in June 2022.

Finally, I also interviewed Professor Gladstone "Fluney" Hutchinson of Lafayette College, who was a core contributor to the ideas behind the Culture Hub's formation several years ago.

Interviews were either conducted through Zoom or in-person, and audio recorded with the consent of the interviewees.

4.2 Game Theory

The secondary, supplementary method that I employ in this report is that of game theory. Game theory is a "science of strategy;" it is a field of math that helps determines how one should act in interactions that are interdependent [11]. Such interactions are distinct from decisions made in a vacuum (for instance, deciding how much pizza to consume), as each participant (or player) derives an outcome from the interaction (or game) that relies on every player's action [11]. The classic example of such a game, championed by John Von Neumann, is warfare — each side must act with forethought as to the other side's reaction [11].

Game theory is a useful methodology for the lender-borrower interaction because how the borrower decides to act depends on the lender's propensity to lend to them, and how the lender decides to lend depends on the borrower's actions (for instance, what they put

on their loan application). It also applies to a granter-grantee interaction, with the same characteristic interdependence.

A few basic terms are pertinent in my use of game theory to model the Culture Hub's funding transactions:

- Strategy: a specified set of actions that a player can take in a game [16].
- Dominance: strict dominance of one action over another means that a specified player would rather play that first action than the other in every case [16].
- Payoff: the benefit a player derives from the outcome that the game prompts [16].
- Equilibrium: a Nash equilibrium is a set of strategies such that not a single player in the game can reap a higher payoff by choosing a different strategy [16].

For a more comprehensive explanation of game theory and its mechanism, visit [16]. For examples of simple games, visit [11].

4.2.1 Signaling Games

To model the Culture Hub, I utilize a simple, exploratory signaling game; a brief introduction to signaling games is thus relevant.

Signaling games are games involving two players; they are also what are known as "incomplete information games," which means that one player does not possess knowledge of information that the other does [38]. The recent theoretical development of these models has focused on the instance where the informed player takes actions that are based on their own, private information, which then must be interpreted by the uninformed player [37]. The tension in these games arises when the informed player has an incentive to manipulate their action, or signal, in order to extract a more favorable response from the uniformed player [38]. This can often result in an unfavorable result for the uniformed player, so finding an equilibrium is a nontrivial task in many cases.

Another complication in signaling games is the significance of "beliefs." What the uninformed player believes is crucial to an equilibrium, as their beliefs will inform their actions and can depend on the signals they receive. In sequential games, where the informed player moves first, the uninformed player can then update their beliefs.

Finally, signaling games involve what is known as a "perfect bayesian equilibrium" (PBE), which is a specification of the previously defined equilibrium. A PBE encompasses a set of

strategies, but it also must articulate the belief of each player at each step of the game where they are taking an action [13]. In a sense, beliefs are considered just as important as strategies in this modified equilibrium form [13].

While analyzing the Culture Hub, I simply search for PBE's in the signaling game I will define in a later section — the model itself is simple enough to serve as an introductory example to signaling games.

5 Identifying the "Trust Issue"

The issue of trust starts with a recognition that trust in lender-borrower interactions are double-sided. Professor Hutchinson mentioned that "at any given time, less than 20 percent of money that has been deposited in a bank stays in a bank" as an example of the trust consumers must have in their financial institutions [24].

Conversely, financial institutions, from CDFI's to banks, must trust their consumers in order to transact with them. Geoff [28] and Betsy [40] both articulated as such, sharing their perspectives as leaders in an impact fund and CDFI, respectively, who intend to serve otherwise underserved populations. Both emphasized the reality that these alternative financial institutions, although funded in large part by philanthropy (which widens the range of clients they can work with), are still worried to some extent about repayment [28, 40].

For instance, Geoff speculated in our interview as to the possibility of some metric of community trust in an organization [28]. If it could be determined that the organization is well-trusted in the community, that perhaps signals a level of credibility with a financing institution such that a credit check perhaps isn't necessary. Implicit in the conversation was an acknowledgement that socially-minded finance must act more flexibly and innovate beyond traditional measureables of interest.

Furthermore, Betsy expressed the Mountain Association's efforts to utilize crowdfunding as a screen for borrowers: "one of the things we've done is to allow folks to use their social capital as a source of collateral. In a sense, we see social capital and community support as a good indicator of a business's success" [40]. She mentioned an example of a lady who crowdfunded a bagel initiative and received a match from the Mountain Association, even without a credit check [40]. However, Betsy acknowledged that the Mountain Association has struggled to formulate other alternative measures of interest that would induce the organization, as a major lender in the region, to choose which prospective borrowers to trust [40].

Seth and HOMES also recognized the challenge of helping secure funding for clients left behind by traditional banks, funding that would then be supplemented by HOMES itself in its housing development efforts [27]. As one alternative, Seth described HOMES's rental unit system; those in need of housing, who perhaps do not possess sufficient credit, receive priority for this service [27]. HOMES then offers to write a recommendation letter to potential financial institutions if tenants managed living the rental unit responsibly, acting as a trustworthy liaison for their clients [27].

In all three of these conversations, a central question emerged: what mechanisms can borrowers design to signal their credibility to lenders, thus empowering lenders to trust them, even without traditional measures like credit? Although all three interviewees demonstrated examples of such a struggle within their local context, the challenge not only exists in its converse form, as Professor Hutchinson demonstrated, but is also more universal than just the Appalachian region, as I argued in my introduction.

As the challenge is universal, the well-documented and thoroughly-researched initiative of microfinance has been developed to combat it, which I will describe in the next section.

6 Microfinance and Group Lending: a First Attempt at Operationalizing Trust

"Financing is a kind of economic oxygen for people. If you don't give this oxygen to people, people get sick, people get weak, people get non-functional."

The above statement by Mohammad Yunus encapsulates his motivation in founding microfinance as a poverty alleviation tool [42]. He began by implementing microloans to underbanked low-income folks, starting in Bangladesh [21]. Crucially, instead of requiring credit, the Grameen Bank model that he founded lended to non-familial groups of borrowers that organized themselves — this became known as the group lending model [21]. The goal was to combine "peer pressure and peer support" to maximize repayment for those without access to traditional credit [21]. Many microfinance organizations have adopted similar models [18]. Microfinance has, in large part due to group lending as a mechanism to operationalize trust between lenders and borrwowers, grown into an industry affecting more than 130 million people [12].

Group lending as a model is grounded in a strong, well-developed theoretical foundation, best summarized by Armandáriz and Morduch [4]. In many cases, the microfinance institution (MFI) does not know much about their prospective borrowers, since most do not possess much credit history [4]. MFI's would ideally charge interest rates for their loans depending on how "risky" their borrowers are; riskier borrowers would be asked to compensate for the higher risk by paying a higher interest rate, and vice versa [4]. Prior to group lending, given that MFI's did not have this information, they charged a higher interest rate as a general policy, which led to unsustainble microfinance and priced out a large portion of low-income borrowers [4].

To allow microfinance to be more charitable, Yunus and other MFI's can ask that borrowers form groups and apply as groups, such that if a single person does not pay off their loan, the entire group is prohibited from reborrowing [4]. Thus, borrowers have an incentive to form groups with people they trust, or people who will not be substantially riskier than themselves; this is a process known as "assortative matching" [4]. MFI's can then lower their interest rates, knowing that riskier borrowers are more likely to have been filtered out of the applicant pool, and safer, more credible borrowers can reliably utilize this service [4]. In this sense, MFI's use group lending to pass on the job of enforcement and filtering applicants to the borrowers themselves [4]. Based on this theoretical foundation, group lending solves the trust problem; it allows lenders a credible avenue to trust their borrowers, even without a

credit check.

Buoyed by the theory of group lending as the principle innovation of microfinance, research on the practice swelled. Gómez and Santor use a probit model to compare individual loans and group loans offered by the Calmeadow MFI [20]. They find that the repayment rate increases 23 percent under the group lending scheme versus the individual lending counterpart, a statistically significant difference that demonstrates the impact of joint liability [20].

Other research produces more mixed results. Dhami, et al explore the theoretical and empirical differences between joint liability and individual liability contracts, under both public and private repayment settings [10]. They agree with Gómez and Santor in that the guilt of hurting the peers in your group by not repaying does drive up repayment rates under joint liability [10]. However, they qualify this argument in their observation that the form of liability does not matter in a public repayment scheme, suggesting that the feeling of public shame matters more to borrowers than the feeling of guilty uniquely found in a group lending scheme [10]. Giné, et al further present limitations to the theory of group lending, applying a game-theoretical model to a lab field experiment setting [18]. They observe that assortative matching does occur under a group lending scheme [18]. However, when safe borrowers end up with riskier borrowers, the safe borrowers often shift toward riskier projects than they would otherwise in an individual lending scheme [18]. The authors assert that this is because borrowers in group lending often insure each other instead of allowing any one borrower to default, meaning that safer borrowers face disproportionate costs as they bear the weight of other borrowers' risky decisions [18].

Schurmann and Johnston present more limitations to group lending; unlike the others, they examine microfinance from its potential impact on the physical and social health of the borrowers [36]. Their conclusion is that the inherent characteristic of including some members in a group and excluding others can be a double-edged sword [36]. Despite the group health benefits for some, microfinance in some sense simply "replaces the economic exclusions of the market with exclusion through social processes" [36].

Overall, sentiment around group lending has grown to be ambivalent. Giné and Karlan conducted a large-scale, randomized evaluation (considered a gold standard in social science research) of a bank in the Philippines with a few hundred branches, in order to determine differences between group and individual lending [19]. The authors found no significant difference between the two schemes, confirming that group lending does not provide a substantive empirical benefit over its individual counterpart, despite theoretical backing for such

a distinction [19].

Empirical ambivalence is exactly why although group lending remains present in microfinance, it has become less prominent and less widely regarded [30]. In the next section, I posit that the Culture Hub allows an alternative notion of "group lending" that can potentially solve the trust problem more efficiently.

7 The Culture Hub as a Potential Improvement

Given ambivalent empirical results tied to the overall mechanism of group lending, the trust problem between lenders and borrowers in Appalachian Kentucky continues to persist.

However, the premise of microfinance as a prescription for underbanking relies on the ability for lenders to "screen" for borrowers in a more sustainable fashion than credit checks. Alternatives or improvements to group lending are therefore relevant to the optimization of community development finance, and the ability of individuals and organizations to access more funding.

The Letcher County Culture Hub has emerged as a potential model for such an improvement. The Letcher County Culture Hub is a collective of several community-based organizations, all dedicated toward taking ownership of the county's economic and cultural development. Located in Appalachia, the county has suffered from exploitation of natural resources, which has deprived residents of generational wealth and health [15]. As a result, the hub seeks to re-empower residents with the county's resources and culture in order to achieve economic freedom and mobility.

The Culture Hub is premised on the building and formalizing of trust amongst its members, a characteristic that Professor Hutchinson stressed in our interview: "The whole purpose of the Culture Hub . . is to build trust, as the first foundation condition for social exchange and economic exchange . . that is the single driving purpose of it" [24].

The creation of the hub further reflects the belief that culture building and production can accomplish this goal of formalizing trust [26]. Professor Hutchinson emphasizes the same realization, that culture as a latent asset and trust as a latent asset are inextricably connected: "[Trust] is absolutely a cultural product, in the sense that it's about people's behvaior" [24].

As such, the hub's collective mechanism implicates the same lender-borrower interaction studied in the field of microfinance for half a century. The Culture Hub has the potential to formalize the trust already existing within the Letcher County community, and project credibility toward its lenders. My interview with Geoff, whose speciality is in lending in the region, reflects such a phenomenon: "There was already a level of trust between some of these organizations . . . [the Culture Hub can] arm the trust, and make it powerful . . . force multiply the trust" [28].

The next sections will explore the Culture Hub's tendency to promote joint initiatives as its primary mechanism for "force multiplying" community trust, enabling them to appeal to

both lenders and grant-givers.

7.1 Joint Initiatives

The Culture Hub's main success is related to its ability to garner cross-sectional support for joint initiatives. Most tellingly, such a mindset has resulted in a 500,000 dollar loan investment from the Mountain Association for a community solar project [15].

Crucially, collaboration requires a certain level of trust and coordination not usually found in group lending, where individuals form a group only for the purpose of taking out separate microloans. Said collaboration is bottom-up and is not imposed from the outside in. In fact, when I talked to Annie Jane, the hub's lead organizer and only paid worker, she stressed facilitation, not imposition, of collaborative efforts as a crucial component of her job: "When I hear an idea from one member, I always try to connect it to the others. That space of connection, around a shared vision or goal, is where the creative magic and the spark for concrete projects and improvements often comes from. The collective vision for what has been, what is needed, and how to get where we are trying to go is a core component of what makes the Culture Hub so effective" [9].

In my interview with Marcia, she talked about the power of the Culture Hub in facilitating collaborating sharing: "We met regularly every month, and we shared good things, bad things, future ideas, past successes, and even our failures sometimes . . . things that helped us as individuals to grow and become better" [8].

Such discussions inevitably lead to ideas for collaborative initiatives. I argue in the following subsections that these initiatives function as effective signals of credibility for both prospective lenders and, as an addendum, prospective granters. The two actors have different goals; lenders tend to prioritze repayment as their goal, whereas granters tilt toward maximizing community impact. In either case, joint initiatives are advantageous.

7.1.1 Lending

The bulk of my interviews and research centers around the utility of joint initiatives as a signal of credibility to lenders. The Culture Hub cites amongst its greatest accomplishments the facilitation of the 2019 community solar project, which involved the Mountain Association as a lender and Appalshop, Hemphill Community Center, and HOMES as borrowers.

When I interviewed Gwen, she acknowledged that "being a part of the collective that was trying to get funding for solar" allowed Hemphill to receive funding attention that they

"wouldn't have gotten as an individual organization" [25]. The very act of forming a group and circulating the idea of a joint initiative conferred credibility, as a contrast to an individual organization's potential initiative.

Seth also talked candidly about the differences between an individual effort and a joint initiative: "If we were flying solo . . we might have discounted it because honestly, my view on solar at the time, I was a skeptic" [27]. Seth had believed that in the mountains, there wouldn't be enough sunlight for solar to be cost-efficient form of energy [27]. However, when the Mountain Association, facilitated through the Culture Hub, did their inspection of HOMES, they marked HOMES as a suitable candidate for solar [27]. As Seth puts it, "the bottom line started speaking to me . . . from day one, we had a positive cash flow" [27]. In this sense, the Culture Hub first and foremost represents a way to formalize trust amongst members, facilitating a process of project-ideation that involves all members and empowers them with the chance to get involved when they otherwise might not choose to.

These members then have the capacity to implement change within their own respective initiatives, creating a ripple effect. Seth was so enthused about the success of the solar project that he personally replicated its instrumentation for his farm [27]. He then opened a new solar initiative in HOMES, sending an employee to receive solar technician certification [27]. The organization has since then put solar panels on 16 commercial and residential buildings [27].

I also talked to Betsy, who runs strategy for the Mountain Association, about the lender's perspective in this project. She mentioned that she had already "built a lot of trust" with Culture Hub leadership, who then mentioned that energy bills had become a common problem between many of the members [40]. Thus became the impetus for the auditing of 11 members of the hub who all expressed interest in a community solar project [40]. These audits turned into a project with 3 of the members [40].

Beyond the presence of lender-borrower trust, Betsy also cited practical reasons for lenders to invest in joint initiatives, the most notable of which is the economics of scale [40]. Mountain Association bids out contracts to different companies to assist with the project, and they received more favorable pricing due to the fact that they bid "as a group — this isn't just one job . . here we're bidding out three jobs" [40].

At its core, Mountain Association needed to receive some signal of credibility from the Culture Hub in order to feel comfortable proceeding. This signal began as a pre-existing level of trust between the two organizations, and compounded with the audits that the hub facilitated.

7.1.2 Grant-giving

The process of grant-giving also implicates the trust problem. Lenders may find it more their priority to receive repayment (although many CDFI's, like the Appalachian Impact Fund and the Mountain Assocation, balance this with social impact). Grantmakers are generally solely concerned with maximizing social impact. They must trust their grantees with the responsibility of using their funding in such a manner, and just as for borrowers, grantees must signal their credibility in order to do so.

I argue that the joint initiatives that the Culture Hub promotes are just as, if not more effective, in drumming up credibility for grants, versus their loan counterparts.

I talked to Kathleen, who directs Institutional Development at Appalshop (which mainly concerns institutional funding), about the trust problem in granting [6]. She argued that without a collective, smaller organizations must compete with each other for the same grants [6]. In contrast, applying as a collective allows a group to pitch for a higher money sum [6]. Counterintuitvely, it is also in the grantmaker's interest to approve such an application: "You can say to that funder: look, we're applying as a collective. So you granting us this money means that you're benefiting all these different aspects of this community instead of just one . . . you're giving the funder an opportunity to to help a wider geographic region and a wider set of initiatives" [6].

Kathleen further acknowledged that different organizations have different levels of experience; developing organizations can benefit greatly by being associated with more developed ones as it relates to grants [6]. She cited the example of Black Sheep Bakery, which received money from a grantmaker in part due to their affiliation with Appalshop (Black Sheep Bakery is part of Hemphill Community, with Hemphill and Appalshop both active members of the Culture Hub) [6]. In fact, Annie Jane mentioned that some organizations involved in joint grant efforts do not individually have 501c(3) status, which would otherwise easily rule them out of individual grant applications [9].

In my interview with Valerie, she agreed with Kathleen, and even took the argument a step further, stating that in the case of individual applications, "it's real likely none of us would be funded, because [grantmakers] might look at us and think there's three community centers who are not working together and not communicating" [23]. She articulated the example of a cotton candy machine: "Maybe we can [apply for] one cotton candy machine and have a system in place so when you need it, you can get it . . . identifying ourselves as a unified front has to be more appealing to a funder, who recognizes that it's a community working outside of a silo" [23].

However, to share resources in such a fashion and apply as a group for a joint initiative (even when the intended use is literally as simple as a cotton candy machine) requires a level of trust. It is this trust exactly that grantmakers screen for when they identify their preference to help multiple parts of the same community, to fund an integrated community effort. Again, trust is already present in many rural communities, and organizations like the Culture Hub simply facilitate and project that trust.

7.2 A Game Theoretical Model of Lending and Joint Initiatives

To model the Culture Hub's capacity to induce lending, I introduce a simple signaling game.

7.2.1 Model Introduction, Description, and Assumptions

Variable/Term	Meaning
t_1	Type 1: capacity to collaborate on initiatives
t_2	Type 2: cost (c) to collaborate on initiatives
$P1$	Player 1: group of borrowers applying for loan
$P2$	Player 2: lender
J	Pitch joint initiative to prospective lender
S	Pitch separate initiatives to prospective lender
L	Lend to prospective borrower group
NL	Do not lend to prospective borrower group

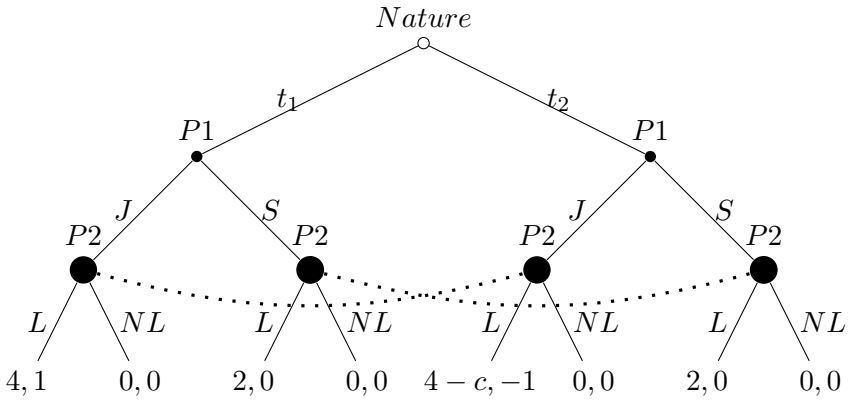

Figure 1: Signaling Game Model

The sequential game works as follows:

1. P1 is first randomly (with equal chance) endowed with a "type," which determines their capacity to collaborate. Type 1 represents the situation where members are, in this case, capable of collaborating to a reasonable degree, such that collaborating makes more sense than pitching separate initiatives. In the case of type 2, there is punishment quantity c for collaborating, perhaps due to lack of availability of group members at that specific time, or other community-specific inhibitions. These inhibitions may or may not render collaboration better or worse for P1 than separate initiatives, depending on the value of c. However, they invariably mean that the project is not "worth it" for the lender.

2. Player 1 then selects whether they want to pitch a joint initiative or separate initiatives to Player 2. Doing so acts as a signal for their type, which is private information and not available to Player 2. The dashed lines visualize that Player 2 cannot distinguish between those two positions on the tree (eg. P2 cannot tell the different between a type 1 P1 who chooses J, and a type 2 P1 who chooses J).

3. Player 2, based on this signal, decides whether to lend or not lend, producing the payoffs for both players. P1 payoffs are on the left and P2 payoffs are on the right. For instance, if P1 draws Type 1 and plays J, and P2 responds with L, P1 receives a utility of 4 and P2 receives a utility of 1.

Thus, the game models the capacity of borrowers to credibly signal their capacity to collaborate - is it in the lender's interest to lend to a collaborative initiative anyway, even if they are not certain whether their borrowers can collaborate? How is the attempt by a group of borrowers to collaborate perceived by the lender? In this sense, a signaling game is ideal for approximating the trust problem and the potential for collaborative initiatives as a solution. It can viewed as a game that can be repeated for the same group, who at certain times might have higher costs to collaborate than other times. This will affect their strategy.

I make a series of comparative assumptions, primarily informed by my interviews, about the relative strengths of the various payoffs.

Lenders' payoffs are determined by the success of the project and corresponding capability of borrowers to pay back their loan. Thus, lenders who decide not to lend receive a payoff of 0, as the status quo remains entirely unchanged. For those who do, I assume a positive payoff for lenders who lend to a type 1 group of borrowers (capable of collaborating), as my

interviews with Appalachian lenders reflected the relative potential of those initiatives (from economies of scale to the force multiplying of trust). I input a negative payoff for lenders who lend to a type 2 group of borrowers who nonetheless decide to pitch collaboration; this is due to their relative inefficiency and potential breakdowns in collaboration that could have been avoided by conducting separate initiatives. Notably, this is constant regardless of c, as I assume c is large enough always for breakdowns in collaboration to result in a net negative project result from the lender perspective. Finally, under both types, lenders receive payoff 0 for lending to separate initiatives, as these are considered neutral investments (speaking to the ambivalent conclusions of group lending literature).

It is important to note that the "0" payoff in this case is different than the "0" payoff in the case of lender inaction. The first is roughly an expected value, where successes in repayment are canceled out by failures, whereas the second is a concrete value — every time a lender decides not to lend their situation is guarenteed to be unchanged. In future sections, I explore the impact of this assumption, while also exposing it to slight sensitivity changes to explore its impact on the result.

On the other hand, borrowers' payoffs are determined partly by their capability to pay back their loan, but more important by the larger impact of the project. Borrowers who do not receive money receive a payoff of 0. Type 1 borrowers who pitch a joint initiative and receive money yield a higher payoff than those who pitch separate initiatives, reflecting my interviews' emphasis the exponential effect of collaborative initiatives on community well-being. Regardless of type, borrowers who pitch separate initiatives receive the same payoff. I assume this payoff to be positive; even in ambivalent group lending, borrowers who receive money for ambivalent projects are in a better position than lenders who lend money for ambivalent projects. Finally, type 2 borrowers who pitch a joint initiative yield a payoff 4-c, which can be positive or negative depending on the value of c.

Finally, I assume that P1 has an equal chance of drawing type 1 and type 2, for the simplicity of equilibrium calculations.

In order to solve this game, it is important to recognize the possibility of three different types of PBE: separating equilibrium, pooling equilibrium, or semi-separating equilibrium [38]. In each case, I follow the method outlined in [17] for finding an equilibrium. If you wish to follow along, it is handy to refer back often to the game tree. If you do not wish to go through the details, I have bolded each equilibrium at the end of each equilibrium section.

7.2.2 Separating Equilibrium

The first potential PBE of this game is a separating equilibrium, where P1 must send a different signal depending on their type [38]. I briefly explain the reasoning used to arrive at this equilibrium; for more detail on the method, refer to [17]:

By strict dominance, the only possible separating equilibrium would consist of a type 1 P1 choosing J, and type 2 P2 choosing S, and only if $c \geq 2$. This is because for a type 1 P1, J dominates S, and for type 2 P1, J also strictly dominates S unless $4 - c \leq 2$.

Possible strategy set for P1:

$$\sigma_1(t) : \begin{cases} J & \text{if } t = t_1 \\ S & \text{if } t = t_2 \end{cases}$$

Under this hypothetical separating equilibrium, P2's corresponding beliefs are

$$\mu(t_1|J) = \mu(t_2|S) = 1$$

These terms express a conditional probability: P2 knows for sure (with probability 1) that P1 is type 1 if P1 chooses J, and P2 also knows with probability 1 that P1 is type 2 is they choose S.

At this point, P2's best response given these beliefs is L if P1 chooses J ($1 > 0$), and indifferent (meaning any response produces the same payoff) if P1 chooses S ($0 = 0$).

Finally, I check that P1 would not deviate from this arrangement given P2's best response framework. If P1 draws type 1, they will never deviate to S instead of J due to strict dominance. If P1 draws type 2, they will yield utility $\frac{1}{2} * (2) + \frac{1}{2} * (0) = 1$ by adhering to the equilibrium. This is because P2 is indifferent between L and NL in response to S, so they will opt for each action half of the time, hence the expression above. If P1 draws type 2 and defects from the equilibrium, they will yield utility $4 - c$ because P2 will opt for L, thinking P1 is type 1.

Thus, P1 will deviate from the equilibrium if $4 - c > 1$, or if $c < 3$. This means we must expand our initial condition of $c \geq 2$ to $c \geq 3$ in order to assert the existence of a separating equilibrium.

Thus, our equilibrium is as follows: **As long as $c \geq 3$, P1 chooses a joint initiative if endowed with type 1, at which point P2 believes for sure P1 is type 1 and responds by lending. Conversely, P1 chooses separate initiatives if given type 2,**

at which point P2 believes for sure P1 is type 2 and responds with indifference between lending and not lending.

7.2.3 Pooling Equilibrium

In a pooling equilibrium, P1 sends the same signal regardless of type [38]. This equilibrium models the possibility of P1 "manipulating" P2 by pitching a joint initiative even when they draw type 2. I derive one below:

The only possible pooling equilibrium would consist of the following strategy set by P1.

$$\sigma_1(t) : \begin{cases} J & \text{if } t = t_1 \\ J & \text{if } t = t_2 \end{cases}$$

This is again due to strict dominance of J over S for type 1, P1. Again, such a pooling equilibrium can also only be possible when $c \leq 2$, or else S dominates J for type 2, P1. With this hypothetical pooling equilibrium, P2's beliefs are as follows:

$$\mu(t_1|J) = \mu(t_2|J) = 0.5, \mu(t_1|S) = \lambda \in [0,1], \mu(t_2|S) = 1 - \lambda$$

(In this notation, λ is a variable between 0 and 1)

Calculating P2's best responses indicates that regardless of what P1 does, P2 is indifferent. Against J, P2 derives utility $\frac{1}{2} * 1 + \frac{1}{2} * (-1) = \frac{1}{2} * 0 + \frac{1}{2} * 0 = 0$ no matter their choice of L or NL. Against S, all payoffs are 0 so P2 is again indifferent.

Finally, using the same check as for separating equilibrium, P1 would not deviate if drawing type 1. If P1 draws type 2, they can adhere to the equilibrium, which will yield utility $\frac{1}{2} * (4-c) + \frac{1}{2} * 0$. Alternatively, they can defect, which will yield utility $\frac{1}{2} * (2) + \frac{1}{2} * (0) = 1$. Because our initial presumption is that $c \leq 2$, or $4 - c \geq 2$, P1 would never deviate.

It's important to note that even if one tweaks the payoffs such that P2 is not indifferent between lending and not lending (imagine, for instance, P2 is a more compassionate lender), a pooling equilibrium still exists, as P1 would not deviate regardless. To see this, I observe that regardless of the probability (p, 1-p) with which P2 opts for (L, NL), respectively, $2p + 0(1-p) \geq (4-c)p + 0(1-p)$, meaning P1 would never deviate from the strategy J.

Therefore, our pooling equilibrium is the following: **Assuming $c \leq 2$, P1 chooses a joint initiative regardless of type. P2 believes P1 is type 1 with probability $\frac{1}{2}$ and type 2 with probability $\frac{1}{2}$. P2 thus responds indifferently.**

7.2.4 Semi-separating Equilibrium

I finally consider the possibility of a semi-separating equilibrium, in which one type induces one signal, but another type induces a random choice between the two signals [38].

In our case, this would involve the following strategy set by P1:

$$\sigma_1(t) : \begin{cases} J & \text{if} t = t_1 \\ pS + (1-p)J & \text{if} t = t_2, p \in [0,1] \end{cases}$$

In other words, P1 chooses J if given type 1, and mixes between J and S if given type 2. Due to strict dominance, type 1 P1 can never choose S. In addition, the above is only possible as a semi-separating equilibrium of $c = 2$, as type 2 P1 would never choose to mix between J and S if one strategy strictly dominated the other; instead they must be indifferent between their payoffs ($4 - c = 2$, $0 = 0$).

P2's beliefs are as follows:

$$\mu(t_1|S) = 0, \mu(t_2|S) = 1, \mu(t_2|J) = \frac{1-p}{2-p}, \mu(t_1|J) = \frac{1}{2-p}$$

The last two beliefs are calculated using Bayes' rule of probability:

$$\mu(t_2|J) = \frac{\mu(J|t_2) * \mu(t_2)}{\mu(J|t_2) * \mu(t_2) + \mu(J|t_1) * \mu(t_1)}$$

As a gut check, if P2 sees the action J by P1, P1 can either be type 1 or type 2, so $\mu(t_1|J) + \mu(t_2|J) = 1$, and this does hold.

I first examine P2's best response to J. P2 gains an expected utility of $\frac{1}{2-p} * 1 + \frac{1-p}{2-p} * (-1) = \frac{p}{2-p}$ by responding with L. Conversely, P2 gains an expected utility 0 by responding with NL. Given that p is a probability between 0 and 1, $\frac{p}{2-p} > 0$ besides the trivial case $p = 0$ (in which case we are no longer dealing with a semi-separating equilibrium); thus, P2's best response to J is L.

I next examine P2's best response to S. P2 gains utility -1 if they lend and 0 if they do not lend. Therefore, P2's best response to S is NL.

Finally, I check if P1 would deviate from this arrangement. For the same reason as the other two equilibria, P1 would not deviate if endowed with type 1. If given type 2, P1 would gain utility $4 - c = 2$ from opting for J (as P2's best response to J is L), but just utility 0 from S (as P2 responds with NL). Since one strategy is clearly better than the other, P1

would defect from this arrangement if given type 2, preferring to always choose J instead of mixing between J and S.

Therefore, a semi-separating equilibrium does not exist for this game.

7.2.5 Discussion

The above derived equilibria demonstrate that groups must have a strong grasp of when they are capable of collaborating, and when there is some extraneous cost to doing so, as this most directly affects their equilibria strategies. If the cost is "high enough" (in our model, $c \geq 3$), it makes sense for the group not to present themselves as capable of completing a joint initiative. Instead, they should wait until they are more capable of collaborating (in other words, endowed with type 1) before pitching a joint initiative. Such a strategy maximizes their social return, as well as their capacity to pay back any loan, and lenders will respond appropriately by lending to those joint initiatives. Such an equilibrium represents a trustworthy interaction; in good faith to both sides, borrowers only ask for larger investments for joint projects if they can actually complete them reliably, and lenders reward those asks with the money necessary to carry out said projects.

On the other hand, if the cost is "low enough" (in our model, $c \leq 2$), the group of borrowers can pitch a joint initiative regardless. Even if they happen to be endowed with type 2, their cost is not high enough to make the project a net negative for either them or the lender. However, as opposed to the previous situation, in this situation lenders optimally would not approve every project, perhaps deciding which projects to approve based on other, self-determined criteria. The benefit of this equilibrium is that it represents the "learning curve" of a group just formed; it is optimal for this group to pitch joint initiatives even if they have some collaborative costs, as long as they are low enough. The group learns through feedback from the lender, and as they complete more projects, can perhaps become more efficient and run a future project without those initial collaborative costs.

Finally, it is never in the incentive of the group to attempt to "dupe" the lender by choosing randomly between a joint initiative and separate initiatives, in an attempt to earn money for a joint initiative even when not necessarily capable of doing so. This ultimately simplifies the interaction greatly.

The three findings together mean in the case of groups like the Culture Hub interested in joint initiatives, both lender and borrower are empowered both sides to approach the interaction in good faith. Borrowers only ask for a bigger, joint investment if they have the capacity to do so, or if the costs are low enough

such that the return can be positive for both parties.

7.3 Limitation: Time and Effort Commitment

Motivated by my interviews, I present in this section the main, inherent tradeoff with the Culture Hub's emphasis on collaborative initiative generation: time and effort commitment.

Microfinance literature on group lending has already foreshadowed such a trade-off. Armendáriz and Morduch assert that an important limitation of group lending versus individual lending is the effort, time, and cost required for the group to conduct meetings and hold each other accountable [4]. Such an issue is inherent to the group lending model, because the entire point of group lending is that it allows lenders to pass on these costs to borrowers, who know each other better than lenders otherwise would.

Throughout my web of interviews and conversations, the slow pace of change (which to a certain extent, is a necessary cost of collaboration) remained a common thread. Below is an anonymized list of interviewee concerns related to efficiency and the tradeoff that inclusivity and collaboration can present:

- "The culture hub is one place that forces, that holds that [inclusive] space and it can be exhausting at times, and I just want to do something . . but it helps us learn to be more intentional, thoughtful."
- "That solar project did not come about quickly. It came about very slowly. Because first there was research about what would be the benefit of it. And who could do it. What companies could do the work. And what organizations wanted to be involved and not all did, and so there was all that and then there was how are we going to fund this project? And who is going to lend money to these high risk organizations?"
- "I feel like it takes a lot of time. That was just my perspective and my involvement, a whole lot of time, especially meetings or in the evenings."
- "[Members of the Culture Hub have] their own businesses that they're running. So to have somebody take the charge in leading the Culture Hub has some difficulties to it, because you know, they're all volunteering time. Aside from Annie Jane who is the coordinator . . not the leader or the executive director of the Culture Hub. . . . so it's great that it's collective, everybody has a say, but sometimes that slows things down."

Again, I emphasize that to a large extent, slow pace of change is an inherent bug in a collaborative environment, and might even masquerade as a feature; lenders and grantmakers

interpret collectivization as a signal that individual organizations are willing to commit to the time and effort needed to work together and produce a greater good. Hence my designation of said limitation as a tradeoff with the Culture Hub's core collaborative characteristic. Each community must make their own determination as to where they find such a balance.

Slow pace of change can unfortunately increase the exclusivity of groups like the Culture Hub. Accommodating slower and deeper community work is both a privilege and a reflection of drive and hard work; however, many who do not have the time or capacity to do so cannot reap the benefits of increased social capital, as echoed by Schurmann and Johnston earlier in this report [36].

Such exclusivity is arguably an inevitable and inherent feature of groups like Culture Hub. The very nature of assortative matching is that organizations in these group prefer that each member is able and willing to commit to joint initiative; at the very least, they must trust that each member can do so, and trust is built by reputation. The necessary side effect of such a process is that organizations and individuals without the capability to do so are sidelined and unable to access the funding that groups like the Culture Hub can collectively solicit.

This is where minimalist intervention can be of use. Each founding member of the Culture Hub received a stipend, in some sense a proactive form of compensation for people's incoming time commitment [8]. Such efforts could be expanded in order to include a wider range of individuals and organizations.

8 Conclusion and Future Research

Despite its potential tradeoff with efficiency, the Culture Hub's approach of collaborative initiatives can inspire a different approach to the trust problem between lenders and borrowers. Based on my several interviews with lenders, Culture Hub partners, and core contributors to the organization, I argue that joint-initiative generation has helped the Culture Hub and its members from both a lending and grant-giving perspective. I supplement those interviews on the lending side by introducing a simple signaling model, from which I conclude that borrowers and lenders can treat the interaction with good faith, ultimately working together to maximize benefits for both parties.

As this is an exploratory report, much more research is to be done about this model of encouraging rural investment. For instance, one could add complexity to the game theory model by analyzing the comparative values of the payoffs, instead of substituting these properties with discrete, concrete, but ultimately, hypothetical payoffs.

In addition, the joint initiatives model I study does not apply to groups of individuals who are more so looking for financing in order to smooth their consumption, which is a more direct alternative to malicious payday lending. This has become an important use case of microfinance, despite microfinance's original intentions of primarily funding entrepreneurial efforts; it is untouched by this research [30].

Finally, the crowdfunding model that Betsy mentioned during interview is a empirically accessible alternative to traditional credit that deserves theoretical modeling and additional analysis. It can be more efficient than a joint initiatives model, as supporters need only donate to a crowdfunding campaign to formalize their support.

The ethos of the Culture Hub, and community-based development at large, is to focus on the assets communities already possess and operationalize those further, instead of simply focusing on what communities lack. Trust is one of those assets. Just as the handshake ensures the functioning of our traditional economic systems, it sustains the Culture Hub and Letcher County and rural communities across America. These communities can, and should, be a thriving part of that system.

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