The Cooperative Financial Institution and Bank Market Power[*]

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Cooperative financial institutions arose in response to the perceived failure of the conventional banking system to serve marginal communities. Such institutions now enjoy a widespread and growing presence in banking markets across the world. Yet, the costs and benefits of this organizational form remain a theoretical puzzle. We show that the cooperative organizational form overcomes a classic friction associated with bank market power but that whether overcoming this friction is welfare enhancing or not depends critically on the structure of the local economy. We also show how "redlining" may arise in equilibrium. These results lead to a rich set of implications for empirical and policy research.

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Academics and policymakers have long been concerned that the financial system may not properly serve marginal communities. Banks are variously accused of refusing to lend to the poor and disadvantaged minorities and also of taking advantage of their market power when they do lend by charging usurious interest rates (Ladd, 1998; Taylor, 1974; Immergluck, 2004). These concerns have a theoretical foundation. Marginal communities may not have the economic potential to support multiple competing banks. Moreover, a lack of well-documented credit and work histories may give rise to high information asymmetry among lenders, creating a barrier to competition (Marquez, 2002), and widespread financial illiteracy may lead banks to compete using deceptive practices rather than on price (Squires, 2004; Carlin, 2009).

It was to provide banking services to these poorer, less educated communities that one of the world's largest social movements arose to create the cooperative financial institution (CFI) (Akerlof, 1970; Moody and Fite, 1971; Taylor, 1974; Haveman and Rao, 1997; MacPherson, 1999). CFIs like mutual savings and loans, community savings banks, and credit unions count over 43% of the economically-active US population as members and had 177 million members and \$1.2 trillion of assets worldwide in 2007 (versus 157 million members and \$0.9 trillion in assets in 2005) (World Council of Credit Unions, 2005, 2007, 2009).

From the early 19th century to the present, proponents have argued that the benefits of introducing a CFI to a neglected or exploited community are profound, for the "inter-dependency of human interests" gives an efficient financial system the character of a public good (Keyes, 1870: 130). When individuals have access to fairly-priced credit, they have greater incentive to invest in their own betterment, which in turn leads to greater economic activity and higher social welfare for the whole community; conversely, when the financial system does not adequately serve a community, decay and poverty persist (Keyes, 1870; Dexter, 1894; Bodfish, 1931).

Yet, CFIs are notably not charities (Clark and Chase, 1925; MacPherson, 1999), operate like a business in allocating scarce capital (Moody and Fite, 1971), and may even favor net savers rather than net borrowers in loan pricing, depending on the governance structure; indeed, the CFI form emerged in the 19th century to operate successfully in areas where charitable lending intuitions had floundered (Bodfish, 1931; Moody and Fite, 1971). Why do CFIs succeed in communities where charitable lending institutions and conventional shareholder-owned banks have failed or chosen not to operate? Under what circumstances is the CFI form more efficient than a shareholder-owned bank?

In this paper, we provide what we believe is the first specific theoretical treatment of these questions. Our analysis yields a novel insight: The CFI form overcomes a classic friction associated with bank market power, but whether overcoming this friction improves social welfare or not depends critically on the nature of an area's economy. Our results lead to a rich set of implications for empirical research and policy.

The classic friction is as follows. Investigating the viability of, and laying the groundwork for, an entrepreneurial project requires costly effort. A would-be entrepreneur will not incur this cost without the prospect of capturing a sufficient portion of the project's future surplus (Schumpeter, 1912). Likewise, an individual will not incur the cost of developing economically relevant skills and human capital without expecting to capture the surplus to be so derived (Fogel, Hawk, Morck, and Yeung, 2006). A bank with market power extracts a portion of the surplus individuals create with their entrepreneurial projects and human capital, disincentivizing individuals from incurring costly effort toward these ends (Rajan, 1992). As a result, bank market power acts like a friction, impeding economic activity.

Our analysis shows, however, that the implications of this friction for social welfare are not as straightforward as intuition might suggest. On the one hand, by engaging in economic activity, individuals generate savings, which are used to fund the entrepreneurial projects of others. This is a positive externality in accordance with the notion of the financial system as a public good. Economic activity may also generate other positive externalities, for the value of one trade is made more valuable by developments in another trade in the same value chain. Rosenberg (1982) documents many examples, including how innovations in agriculture yield greater benefits because of innovations in rail transportation, which in turn yield greater benefits because of innovations in refrigeration and oceanic shipping. Individuals, who do not internalize these externalities, tend to underinvest in effort toward economic activity, reflecting an inherent coordination problem. In addition, a bank with market power captures some of the surplus that an individual generates from borrowing, disincentivizing individual effort toward economic activity; individuals anticipate these disincentivizing effects on each other and rationally reduce their own effort. The friction associated with bank market power thereby *reinforces* the coordination problem, and its impact is more severe, the greater are the positive externalities from economic activity.

On the other hand, economic activities may also create negative externalities, including congestion, pollution, duplicative innovation, advertising expenditure that serves primarily to capture the attention of consumers, and competition that mostly benefits parties outside the community, for example, foreign suppliers and buyers. Importantly, even in this case, the optimal level of effort toward economic activity is not zero. There are always first-order positive welfare effects from economic activity and a functioning financial system. Yet, because individuals do not internalize negative externalities, individuals may overprovide effort. We show that if and only if externalities are negative and above a threshold level of intensity, the rent extraction associated with bank market power acts like a socially beneficial tax, increasing social welfare by reducing effort provision toward the social optimum.

Now, consider the CFI form. While the details vary, a CFI typically provides intermediation services only to its members, who acquire their membership through a common occupational or communal bond or by receiving permission from existing members (Kendall, 1962; Ferguson and McKillop, 1997). Although members often have equal voting rights, financial claims are accorded to members in proportion to their share of intermediation activity (Cuevas and Fischer, 2006). We show that the CFI form can eliminate the disincentivizing friction associated with bank market power, even if the CFI prices loans and deposits to maximize profits, as is customary. The reason is that in deciding how much effort to exert toward economic activity, an individual rationally anticipates *both* (a) that a monopoly CFI may capture some of the surplus the individual may generate as a borrower *and* (b) that the claim the individual has on the surplus generated by *other* individuals is increasing in the individual's effort and thus in the individual's financial claim on the CFI as either a net saver or borrower. These two effects offset each other exactly. Thus, unlike a monopoly bank, a monopoly CFI does not disincentivize effort. It follows that the CFI form is welfare-enhancing *if and only if* the externalities from economic activity are positive or not too negative and the actual or potential financial intermediation sector exhibits rent extraction.

Our base model considers effort toward economic activity in terms of *quantity*, for example, how many years of schooling to acquire or how many hours a week to devote to an entrepreneurial idea. For many important, life-altering decisions in marginal economies, however, effort is a question of *quality*, that is, it has a discrete character. A villager in a developing nation *either* stays in the village to pursue subsistence farming and cottage industries *or* migrates to the city to pursue a career in the formal economy. A teenager in a disadvantaged inner-city neighborhood may have to decide under intense social pressure *whether* to pursue a conventional career in the formal economy *or* join the underclass in a life of crime or dependence on the welfare system.

In an extension to our model, we consider such discrete choices. Based on their own expectation of the potential for economic activity and their logical inferences about the behavior of others, individuals decide to "opt in" or "opt out" of the formal economy. In equilibrium, there is a *unique* threshold level of economic potential above which enough individuals are optimistic and opt in to give rise to a healthy formal economy and financial system, and below which they do not exist.[1] If individuals anticipate that the formal economy will be monopolized by a shareholder-owned bank rather than a CFI, the friction associated with its market power raises this threshold by dissuading relatively pessimistic individuals from opting in, thereby dissuading slightly less pessimistic individuals from opting in, and so on. Bank market power may thus choke off a healthy economy and financial system even without a bank to exercise that power.

The model of discrete choices also sheds light on "redlining," whereby banks refuse to lend in marginal communities, especially those with primarily minority inhabitants, despite the presence of creditworthy borrowers. Aalbers (2005) provides an extended example in the form of the "coloured map of Rotterdam," which was used to screen mortgage loans.[2] Advocates claim these communities fall into decay in large part because banks refuse to lend even to creditworthy borrowers, while banks respond that they cannot operate profitably in such communities (Aalbers, 2006: 1074).

We find that both parties to the debate on redlining may be right. In marginal economic areas, a proper loan market and formal economy might arise in the absence of a coordination problem. But pessimistic individuals demur at exerting effort toward economic activity. These individuals pollute the future pool of borrowers by lowering the percentage of creditworthy loan applicants, making it impossible for banks to operate profitably. Although many individuals anticipate that the loan market will not exist, some optimistic individuals develop what would be viable entrepreneurial projects if only banks would provide capital.

In addition to the literature cited above, our work is related to Da Rin and Hellmann (2002), who use a model with positive externalities to show that a bank with market power may use subsidized lending to mobilize a critical mass of firms to invest and thereby avoid a self-fulfilling "pessimistic" equilibrium, where firms do not invest on the assumption that other firms will not invest either.[3] We develop a model incorporating both positive and negative externalities and use it to show how the CFI form eliminates the friction associated with bank market power and when this is welfare enhancing.

Our paper is related to work on entrepreneurial incentives, which has studied strategic focus (Rotemberg and Saloner, 1994) and the competitiveness of a firm's industry (Fulghieri and

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[1] Formally, our model of discrete choices is a global game. Well-known applications of global games to finance include Morris and Shin (1998), who study foreign currency crises, and Goldstein and Pauzner (2005), who determine the optimal bank contract given the potential for bank runs.

[2] In Aalbers's (2005: 573) words, "Exclusion took place solely on the basis of neighborhood.... Low-income people had a chance of getting a mortgage in another neighborhood, but middle and high-income people – just like low-income people – were barred from obtaining mortgages in excluded zip codes."

[3] Such models have been used in macroeconomics to study the role of complementarities in economic growth, with a focus on equilibrium selection and trickle down effects. See the survey by Matsuyama (1995).

Sevilir, 2011), as well as the allocation of effort between exploratory innovation and assigned tasks (Hellmann, 2007; Hellmann and Thiele, 2011).

Prior work on CFIs has argued informally that the common bond of membership may reduce information costs (Black and Dugger, 1981), that common ownership and control may avoid agency conflicts (Masulis, 1987), that the liquidation of claims disciplines managers (Fama and Jensen, 1983), and that CFIs may confer a private benefit of control that incentivizes managers to avoid risk (Rasmusen, 1988). In formal work, Smith, Cargill, and Meyer (1981) and Smith (1984) analyze conflicts between savers and borrowers, and Smith and Stutzer (1990) show that CFIs can arise endogenously to cope with adverse selection.

In the next section, we separately consider positive and negative externalities when banks have a conventional shareholder ownership structure before turning to the CFI form. We then extend the model to analyze discrete effort choices. The remaining sections present empirical predictions and policy implications and conclude. The Appendix contains formal proofs not included in the text.

1 Model

1.1 Setup

Let there be an economy composed of a set A of identical risk-neutral agents of measure 1. In period $t=0$, an agent exerts effort $e \geq 0$ at cost $e^2/2$. Then, in period $t=1$, the agent obtains the following. With probability p, the agent obtains a lump sum of a numéraire good, which may be deposited in a bank (as described below) or stored without loss until $t=2$, when consumption occurs. In this case, the agent is a "saver." With probability $(1-p)$, the agent obtains a project requiring investment at $t=1$ and generating a return at $t=2$. In this case, the agent is a "borrower."[4] With probability γ, the project is "viable," yielding $(1+r)$ per unit of the numéraire good invested; with probability $(1-\gamma)$, the project is not viable, yielding 0.[5]

The quantity of the numéraire good received by each saver s at $t=1$ is a function of the effort e_s exerted by the saver at $t=0$:

[4] While individuals in our model only borrow to fund entrepreneurial projects, bank market power in the mortgage and personal loan market would have qualitatively similar effects.

[5] *e* encompasses entrepreneurial efforts *per se* as well as the effort to do well in school and generate savings as a wage earner. *p* may be interpreted as the resolution of personal characteristics that determine the choice between a career as an entrepreneur or an employee as in Kihlstrom and Laffont (1979) or as a lottery as in Rampini (2003).

$$e_s\left(\theta+\delta\int_{j\in A} e_j dj\right) \tag{1}$$

where θ is a state variable for economic conditions at $t=1$. Higher values of θ represent better economic conditions. The integral is the total effort exerted by other agents in the economy and thereby captures the positive externalities from economic activity. The magnitude of the externalities are parameterized by δ. We restrict δ to be positive (as we consider negative externalities later) and less than $\left(2\left(p+(1-p)\gamma\left(r-c/\gamma\right)\right)\right)^{-1}$, so the socially optimal level of agent effort is finite. (The need for the latter restriction will be apparent later.)

Likewise, the scale of the risky project of each borrower b is a function of the effort e_b exerted by the borrower at $t=0$:

$$e_b\left(\theta+\delta\int_{j\in A} e_j dj\right) \tag{2}$$

Therefore, a risky project produces the following payoff at $t=2$:

$$\begin{array}{ll} \textit{With probability } \gamma: & (1+r)e_b\left(\theta+\delta\int_{j\in A} e_j dj\right) \\ \textit{With probability } (1-\gamma): & 0 \end{array} \tag{3}$$

We assume that $\gamma \le \frac{p}{1-p}$ so that savers generate enough of the numéraire good to fully fund all viable projects. This assumption does not qualitatively affect our results but does simplify the exposition of how surplus is divided among savers, borrowers, and banks in the loan market.

There is a number $N\in\{1,2\}$ of profit-maximizing banks that collect funds from savers and use these funds to make loans to borrowers. A bank must incur a screening cost c per unit of loan principal at $t=1$ to determine whether a borrower has a viable project. In other words, screening a project costs c multiplied by the quantity in Equation (2). Borrowers, for their part, do not know whether their projects are viable. Thus, there is no separating mechanism to prevent borrowers without viable projects from soliciting a loan for their project, and we assume all borrowers do so. This assumption can be motivated by positing that borrowers receive a private benefit from borrowing regardless of the viability of their project.

We restrict our analysis to the region of the parameter space where there is a role for bank screening in the economy. This region is defined by two conditions. Only for values of γ, $\gamma > c/r$ does the loan market generate a positive surplus from screening; this defines $\underline{\gamma}$, the minimum value of γ for which it is worthwhile to screen and make a loan. Similarly, if $\gamma > 1-c$, it is worthwhile to lend without screening; this defines $\overline{\gamma}$, the maximum value of γ such that it is more profitable to lend with screening than without. Our analysis henceforth assumes that $\gamma \in \left(\underline{\gamma}, \overline{\gamma}\right)$. Clearly, for this interval to be non-empty, $r > c/(1-c)$.

Competition in the loan market works as follows. First, savers compete à la Bertrand to offer deposits to banks. Because there is always an excess of savers vis-à-vis banks and borrowers, savers only receive the opportunity cost of 0 on their deposits. Modeling competition in this way avoids the multiplicity of equilibria that might arise if banks could corner the market for deposits in anticipation of monopolizing the loan market later. However, allowing banks to corner the market for deposits would not qualitatively affect our results, as it would only increase the range of parameters where bank market power could impede economic activity.

Second, the market interest rate for loans is determined. If there are two banks $(N = 2)$, banks compete à la Bertrand to lend, leading to a market interest rate of c/γ, which is the lowest interest rate consistent with non-negative profits and the need to screen borrowers. So each bank earns profits of $\pi_2 = 0$. If there is a monopoly bank $(N = 1)$, then the bank bargains with each borrower over the interest rate. For simplicity, we posit Nash bargaining, such that the surplus from the loan (i.e., the return on the project minus the cost of screening) is split evenly. Thus, the interest rate is $\left(r - c/\gamma\right)/2$, leaving the bank a margin of $\pi_1 = \left(r - c/\gamma\right)/2$ per unit of loan principal. [6] Neither the definition of the surplus nor the magnitude of the split is important for our results, provided that the bank captures at least some of the surplus generated by borrowers' projects. For example, Cournot competition, where bank profits decline more gradually in N, yields qualitatively the same results. We use Bertrand competition merely to simplify the exposition.

Another appealing feature of this model of competition is that bank market power does not give rise to a "deadweight loss," wherein a monopoly bank charges a higher interest rate than some borrowers are willing to pay. While incorporating deadweight loss would not qualitatively affect our results, we want to demonstrate that by reducing agents' incentive to exert costly effort toward entrepreneurial and other economic activity, bank market power can impose a very different kind of friction on the economy.

[6] These results can be derived using cooperative game theory and unrestricted bargaining among savers, borrowers, and banks over the division of surplus in the loan and deposit markets. For details, see Brandenburger and Stuart (1996, 2007).

1.2 Bank Market Power with Positive Externalities

Define $e_k^{W,N}$ as the *socially optimal* level of effort per agent and define $e_k^{u,N}$ as the *equilibrium* level of effort per agent, in each case if the economy has N banks. Define $E^{W,N}$ as the optimal level of social welfare and $E^{u,N}$ as equilibrium social welfare, in each case if the economy has N banks.

Proposition 1.1 *With positive externalities, equilibrium effort* $\left(e_k^{u,N}\right)$ *is less than the socially optimal level* $\left(e_k^{W,N}\right)$ *and equilibrium social welfare* $\left(E^{u,N}\right)$ *is lower than the socially optimal level* $\left(E^{W,N}\right)$. $e_k^{W,N}-e_k^{u,N}$ *and* $E^{W,N}-E^{u,N}$ *are increasing in bank market power (i.e., decreasing in* N *) and these differences are increasing in the magnitude of the positive externalities* (δ). *In particular,*

$$e_k^{W,1}=\frac{\theta\left(p+(1-p)\gamma\left(r-c/\gamma\right)\right)}{1-2\delta\left(p+(1-p)\gamma\left(r-c/\gamma\right)\right)}=e_k^{W,2}$$
$$e_k^{u,2}=\frac{\theta\left(p+(1-p)\gamma\left(r-c/\gamma\right)\right)}{1-\delta\left(p+(1-p)\gamma\left(r-c/\gamma\right)\right)}>e_k^{u,1}=\frac{\theta\left(p+(1-p)\gamma\frac{\left(r-c/\gamma\right)}{2}\right)}{1-\delta\left(p+(1-p)\gamma\frac{\left(r-c/\gamma\right)}{2}\right)} \tag{4}$$

Let us first assume that the loan market is competitive ($N=2$), so all surplus from the loan market accrues to borrowers. Consider a benign social planner with the power to coordinate agent effort. The social planner's problem is the following:

$$\max_{e_{k,\forall k\in A}} E^{W,2}=e_k\left(\theta+\delta\int_{j\in A,\,j\neq k}e_j\,dj\right)\left(p+(1-p)\gamma\left(r-c/\gamma\right)\right)-\frac{e_k^2}{2} \tag{5}$$

Since the integral in the parentheses in Equation (5) integrates to e_k, the solution to the social planner's problem is readily obtained by differentiation:

$$\frac{dE^{W,2}}{de_k}=\left(p+(1-p)\gamma\left(r-c/\gamma\right)\right)\left(\theta+2\delta e_k\right)-e_k=0 \tag{6}$$

This yields the optimal $e_k^{W,2}$ in Proposition 1.

In the absence of the social planner, however, each agent maximizes her own welfare in the presence of two banks (u_2), taking the actions of other agents as given. Specifically, each agent k faces the following problem:

$$\max_{e_k} u_2 = e_k\left(\theta + \delta \int_{j\in A, j\neq k} e_j dj\right)\left(p + (1-p)\gamma\right)\left(r - c/\gamma\right) - \frac{e_k^2}{2} \tag{7}$$

The integral in the parentheses in Equation (7) integrates to e_j, because the agent k takes the efforts of other agents as given. Differentiating yields:

$$\frac{du_2}{de_k} = \left(p + (1-p)\gamma\left(r - c/\gamma\right)\right)\left(\theta + \delta e_j\right) - e_k = 0 \tag{8}$$

Applying symmetry such that $e_j = e_k$ yields the equilibrium effort $e_k^{u,2}$ in Proposition 1.

We thus have $e_k^{W,2} > e_k^{u,2}$. The intuition is that, in equilibrium, agents rationally anticipate each other's effort toward economic activity but cannot coordinate their efforts, that is, they cannot agree to internalize the positive externalities of their efforts on each other. This lack of coordination creates a friction, resulting in underprovision of effort in equilibrium. Thus, equilibrium social welfare does not attain the optimum ($E^{W,2} > E^{u,2}$), even with a competitive banking sector.

Now assume that the banking sector is monopolistic, i.e., that $N = 1$. The solution to the social planner's problem does not change, because the bank's market power only shifts surplus from the pockets of borrowers to the pockets of the bank without affecting the productivity of agents' efforts. Therefore, $e_k^{W,1} = e_k^{W,2}$.

In contrast, the problem of maximizing utility with a monopoly bank (u_1) reflects the fact that borrowers only capture a portion of the surplus generated by their projects:

$$\max_{e_k} u_1 = e_k\left(\theta + \delta \int_{j\in A, j\neq k} e_j dj\right)\left(p + (1-p)\gamma\right)\frac{\left(r - c/\gamma\right)}{2} - \frac{e_k^2}{2} \tag{9}$$

Again, the solution is obtained from differentiation:

$$\frac{du_1}{de_k} = \left(p + (1-p)\gamma\frac{\left(r - c/\gamma\right)}{2}\right)\left(\theta + \delta e_j\right) - e_k = 0 \tag{10}$$

Applying symmetry yields the equilibrium effort $e_k^{u,1}$ in Proposition 1.

We have $e_k^{u,2} > e_k^{u,1}$. Thus, as bank market power increases, the difference between the socially optimal level of agent effort ($e_k^{W,N}$) and the equilibrium level of effort ($e_k^{u,N}$) grows, and equilibrium social welfare falls further from the social optimum. The intuition is that the monopoly bank extracts some of the rent that would otherwise be captured by borrowers with viable projects. Agents anticipate the rent extraction, which accordingly lowers their incentive to exert costly effort in the first place.

Note further that the friction associated with the lack of agent coordination affects the denominator of the effort levels $e_k^{W,N}$ and $e_k^{u,N}$ in Equation (4): 2δ in the denominator of $e_k^{W,N}$ becomes δ in the denominator of $e_k^{u,N}$. Meanwhile, the friction associated with bank market power affects the denominator and numerator of the effort levels in Equation (4): $\left(r - c/\gamma\right)$ in the numerator of $e_k^{W,N}$ and $e_k^{u,2}$ becomes $\left(r - c/\gamma\right)/2$ in $e_k^{u,1}$. Thus, the two frictions are *mutually reinforcing*, interacting multiplicatively to drive agent effort, and thus social welfare, further below the socially optimal level. It follows that, as formally proven in the Appendix, the welfare reducing friction associated with bank market power is growing in the level of positive externalities in the economy (δ).

1.2 Bank Market Power with Negative Externalities

We now modify our analysis to consider negative externalities. We continue to restrict δ to be positive but reverse the sign in front of δ such that the quantity of the numéraire good generated by each saver and the scale of each borrower's investment project are both:

$$e_k \left(\theta - \delta \int_{j \in A} e_j dj \right) \tag{11}$$

where e_k is the effort of the focal agent. We then have:

Proposition 1.2 *With negative externalities, equilibrium effort is more than the socially optimal level if* $N = 2$ *but may be less than or more than the socially optimal level if* $N = 1$. *In particular,*

$$e_k^{W,2} = e_k^{W,1} = \frac{\theta\left(p + (1-p)\gamma\left(r - c/\gamma\right)\right)}{1 + 2\delta\left(p + (1-p)\gamma\left(r - c/\gamma\right)\right)} < \frac{\theta\left(p + (1-p)\gamma\left(r - c/\gamma\right)\right)}{1 + \delta\left(p + (1-p)\gamma\left(r - c/\gamma\right)\right)} = e_k^{u,2}$$

$$e_k^{u,1} = \frac{\theta\left(p + (1-p)\gamma\frac{\left(r - c/\gamma\right)}{2}\right)}{1 + \delta\left(p + (1-p)\gamma\frac{\left(r - c/\gamma\right)}{2}\right)} < e_k^{u,2} \tag{12}$$

Moreover, there exists a $\tilde{\delta} > 0$ *such that if and only if* $\delta < \tilde{\delta}$, *social welfare is higher in equilibrium if* $N = 2$ *than if* $N = 1$.

In the absence of bank market power (i.e., if $N = 2$), there is an overprovision of effort in equilibrium. The intuition is that, in equilibrium, agents rationally anticipate each other's effort toward economic activity but cannot coordinate their efforts, that is, they cannot agree to internalize the negative externalities of their efforts on each other. This result is the converse of what we obtained with positive externalities. Yet, here, there is an interesting twist. As before, a monopoly bank ($N = 1$) reduces the incentive of agents to exert costly effort. Therefore, with negative externalities, the friction associated with bank market power *offsets* the friction associated with the lack of agent coordination. In other words, bank market power acts like an implicit tax on economic activity, reducing agents' incentive to impose negative externalities on each other. Proposition 1.2 formally proves that there is a threshold intensity of the externality in economic activity $\tilde{\delta}$ such that if and only if $\delta > \tilde{\delta}$, social welfare is higher if there is a monopoly bank than if there is not. In other words, if the negative externalities are sufficiently large, a bank with market power leads to higher social welfare than a competitive banking sector.

1.3 The Cooperative Institutional Form

An unresolved question in financial intermediation is the relative prevalence of CFIs. Cuevas and Fischer (2006: 5) identify the following four features as archetypical of a CFI in a comprehensive survey of CFI activity throughout the world: (i) the principle of one-man/one-vote; (ii) unbundling votes and membership is not allowed; (iii) residual claimants (owners) both supply and use funds; and (iv) dividends (if any) are distributed to both savers and borrowers in proportion to their share of intermediation activity.

Suppose that instead of banks owned by third parties, the financial intermediation sector is composed of CFIs owned by their savers and borrowers, as described in the four principles above. As $\gamma(1-p) \leq p$, the CFIs will, by the principle of one-man/one-vote, ultimately seek to maximize loan profits, but, by the principle of distributing profits in proportion to intermediation activity, these profits will be redistributed to savers and borrowers. Using the subscript "C" to denote equilibrium effort where CFIs provide financial intermediation services, we have:

Proposition 1.3 *If financial intermediaries adopt the CFI form, their market power does not affect the gap between the socially optimal level of effort and the equilibrium level of effort. Equivalently, their market power does not increase the gap between optimum social welfare and equilibrium social welfare. In particular,* $e_{k,C}^{u,2} = e_k^{u,2} = e_{k,C}^{u,1} > e_k^{u,1}$.

The social planner's problem, of course, does not change. The agent's problems, by contrast, are now the following in the case of positive externalities:

$$\begin{aligned} \max_{e_k} u_1 &= e_k\left(\theta+\delta\int_{j\in A,\, j\neq k} e_j dj\right)\left(p+(1-p)\gamma\right)\left(\frac{\left(r-{}^{c}\!/\!_{\gamma}\right)}{2}+\pi_1\right)-\frac{e_k^2}{2} \\ \max_{e_k} u_2 &= e_k\left(\theta+\delta\int_{j\in A,\, j\neq k} e_j dj\right)\left(p+(1-p)\gamma\right)\left(\left(r-{}^{c}\!/\!_{\gamma}\right)+\pi_2\right)-\frac{e_k^2}{2} \end{aligned} \tag{13}$$

where $\pi_1 = \left(r - {}^{c}\!/\!_{\gamma}\right)/2$ and $\pi_2 = 0$. It is clear from Equation (13) that if the financial sector is composed of CFIs, each agent internalizes the profits of the intermediation sector when deciding how much costly effort to exert. The case of negative externalities is directly analogous. It follows that while the friction associated with the lack of agent coordination remains, the friction associated with intermediary market power has disappeared and, along with it, its aggravating effect on the lack of agent coordination in the case of positive externalities and its mitigating effect on the lack of agent coordination in the case of negative externalities.

The intuition is as follows. Like a monopoly bank, a monopoly CFI captures a share of the surplus generated by each borrower's project; this effect *disincentivizes* agent effort. With a monopoly CFI, however, each agent has a claim on the surplus generated by *other* agents' projects that is proportional to the expected surplus the focal agent generates as a saver or borrower at $t=1$ and thus to the effort the agent has exerted toward economic activity at $t=0$; this effect *incentivizes* agent effort; these two effects offset each other exactly. Thus, a monopolistic intermediation sector no longer reduces agents' incentive to exert effort.

Corollary 1.4 *The CFI form raises social welfare if and only if both (a) externalities are (i) positive or (ii) negative and smaller than* $\tilde{\delta}$ *; and (b)* $N=1$.

With the CFI form, bank market power does not affect agent incentives. Therefore, the CFI form only raises social welfare if banks have market power $(N = 1)$, and the friction associated with bank market power lowers social welfare, which is the case if and only if externalities are positive or not too negative. By contrast, if negative externalities are large, bank market power improves social welfare by disincentivizing agent effort toward the optimum; in this case, the CFI form lowers social welfare.

It is important to note that this result does not require exact adherence to the definition of a CFI given above; notably, a CFI may be owned only by its savers or even by only a randomly-chosen subset of its savers and Proposition 1.3 will still hold. The reason is that these alternative ownership structures simultaneously reduce the probability that the agent will obtain a financial claim on the profits of the CFI and increase the size of the agent's financial claim (conditional on obtaining one) in offsetting proportion. By contrast, our result will *not* obtain for a CFI that accords financial claims to each member equally, regardless of a member's use of the intermediary as a saver or borrower, or that does not accord financial claims to members at all, for example, because the CFI is governed by a charitable trust that does not pay dividends. We also note that the CFI form only leads to higher effort toward activities that may lead to having a larger financial claim on the CFI. Thus, if a CFI only accords financial claims to savers, the CFI form will only improve agents' incentive to engage in those efforts that could lead, perhaps stochastically, to a larger savings investment in the CFI. Our analysis thereby provides guidance to a social planner in devising the right governance structure for a CFI.

2 Discrete Effort Choices

Our base model features a continuous choice in effort to capture how hard an agent tries to develop entrepreneurial projects and acquire human capital. However, many important life choices in marginal economic areas have a discrete character. An example is the decision whether to leave one's village for the city to seek a career in an emerging formal economy or remain in the village to pursue cottage industries. To capture such situations, we modify our model as follows. For brevity of exposition, we only analyze positive externalities.

2.1 Coordination Game with Discrete Effort Choices

Assume that at $t = 0$ each agent makes a discrete effort choice of whether to "opt in" to or "opt out" of the formal economy. Opting out yields the agent a payoff normalized to 0 at $t = 1$. *If and only if* the agent opts in, the agent incurs an effort cost e, and becomes a saver with probability p and a borrower with probability $(1 - p)$, as before. In this case, the quantity of the numéraire good received by each saver and the scale of the project received by each borrower at $t=1$ are both $(\theta+\Delta)$, where θ is an economic state variable defined previously and $\Delta\in[0,1]$ is the endogenously determined proportion of agents who have opted in. We continue to assume that it costs $c\times(\theta+\Delta)$ to screen a loan. We also assume that agents who do not exert effort nonetheless try to borrow and that it is also costly to screen out these "fraudulent" borrowers. This latter assumption, which is only required to explore the possibility of redlining in equilibrium, can again be motivated by positing a private benefit from borrowing. For simplicity, we assume that the cost of screening out "fraudulent" borrowers is also $c\times(\theta+\Delta)$, but any positive cost will yield qualitatively the same results.

To avoid a multiplicity of equilibria, we use a global game to model the information environment as follows.[7] Define $\overline{\theta}$ as the threshold value of θ high enough that agents would prefer to opt in regardless of what other agents do. $\overline{\theta}$ solves $p\theta-e=0$. Define $\underline{\theta}_N, N\in\{1,2\}$ as the threshold value of θ low enough that, conditional on N, agents would prefer to opt out regardless of what other agents do. $\underline{\theta}_1$ and $\underline{\theta}_2$ are defined as the solutions to the following equations:

$$\begin{aligned}(\underline{\theta}_1+1)\left(p+(1-p)\gamma\frac{(r-c/\gamma)}{2}\right)-e=0\\(\underline{\theta}_2+1)\left(p+(1-p)\gamma(r-c/\gamma)\right)-e=0\end{aligned}\tag{14}$$

At $t=0$, agents do not know what θ will be at $t=1$ but do receive a private signal s that is uniformly distributed about the true future value of θ, i.e., s is uniformly distributed on $[\theta-\varepsilon,\theta+\varepsilon]$. Agents also know that the unconditional distribution of θ is uniform on an interval $[a,b]$, where $b>\overline{\theta}+\varepsilon$ and $a<\underline{\theta}_2-\varepsilon$, i.e., the unconditional distribution of θ extends at least a bit beyond the threshold values of $\underline{\theta}_2$ and $\overline{\theta}$.[8]

Define $\underline{\theta}^W$ as the threshold low value of θ such that a social planner would direct agents to opt in if and only if $\theta\geq\underline{\theta}^W$. It is immediate that $\underline{\theta}^W=\underline{\theta}_2<\underline{\theta}_1$. The following proposition characterizes the equilibrium formally:

[7] Our model may be regarded as a generalization of the investment game in Carlsson and van Damme (1993). We could incorporate continuous effort with the discrete choice of opting in or out by using the methods of Frankel, Morris, and Pauzner (2003); for simplicity, we do not pursue this complication.
[8] These assumptions can be made more general without fundamentally changing the paper's results.

Proposition 2.1 *For* $N \in \{1,2\}$ *, the iterated elimination of strictly dominated strategies results in a unique threshold signal* $s_N^u > \underline{\theta}_N$ *such that an agent opts in if and only if the agent receives a signal* $s > s_N^u$ *. For* $\forall \varepsilon < s_N^u - \underline{\theta}^W$ *,* $\exists \theta_N^u > \underline{\theta}^W$ *such that* $\forall \theta < \theta_N^u$ *, no agent opts in. Further,* $\theta_1^u > \theta_2^u$ *.*

The intuition underlying the equilibrium is as follows. Suppose that an agent receives a signal $s_{N,0} \geq \overline{\theta} + \varepsilon$. The agent opts in, because even if every other agent opts out, the focal agent's private returns make opting in worthwhile. We can eliminate other actions of such an agent as "dominated strategies." Now, consider an agent with a slightly lower signal $s_{N,1}$. The agent "knows" that all agents with a signal $s_{N,0} \geq \overline{\theta} + \varepsilon$ will opt in, and the measure of such agents must be close to 1, since $s_{N,1}$ is only slightly lower than $s_{N,0}$. Thus, our new focal agent opts in as well. We have thus eliminated dominated strategies a second time. We can repeat this exercise until we converge to a unique s_1^u or s_2^u where $s_1^u > s_2^u > \underline{\theta}^W$. ($s_1^u$ and s_2^u are given precise mathematical definitions in the Appendix.)

If we repeat the exercise in reverse by starting with a signal so low $\tilde{s}_{N,0} \leq \underline{\theta}_N - \varepsilon$ that the focal agent opts out regardless of what other agents do, we arrive at the same s_N^u. As long as the information environment is not sufficiently "coarse," i.e., as long as $\varepsilon < s_N^u - \underline{\theta}^W$ (and we henceforth assume ε is "small" in this sense), there will be economic states of the world above the first-best threshold $\underline{\theta}^W$ where no agent opts in, because even the most "optimistic" signals are below s_N^u. θ_N^u, the threshold value of the economic state variable below which no formal economy develops, converges to s_N^u from below as ε goes to 0.

Alternatively, consider the thought process of an agent who receives an arbitrary signal s. The agent does not know θ but does know that $\theta \in [s+\varepsilon, s-\varepsilon]$. The utility from opting out is 0. The utility from opting in is the expected earnings as a saver or borrower (minus the cost of effort e), calculated by integrating out θ over $[s+\varepsilon, s-\varepsilon]$. The lowest s where this calculation yields a non-negative outcome, given that other agents are engaged in a similar reasoning process, is s_N^u.

The implication is that there is again an underprovision of effort toward the formal economy. Now, however, that underprovision takes the form of a gap between the socially optimal threshold value of the economic state variable above which a formal economy arises ($\underline{\theta}^W$) and the equilibrium threshold value (θ_N^u). For $\theta \in \left(\underline{\theta}^W, \theta_N^u\right)$, it would be socially optimal for all agents to opt in, but all agents opt out, so no formal economy develops at all.

Proposition 2.1 also says that, as in the base model, bank market power aggravates the friction from lack of agent coordination, but does so in a slightly different way. The point of similarity is that a bank with market power extracts some of the surplus that would otherwise be captured by borrowers, reducing the incentive of agents to opt in. Agents who receive signals close to but higher than s_2^u accordingly opt out. Agents with somewhat (more optimistic) higher signals anticipate that the first set of agents with slightly (more pessimistic) lower signals will opt out and will, because of the externality from agent effort (Δ), opt out, too. The rent extraction by the monopoly bank thus has a ripple effect, with the result that bank market power raises the equilibrium threshold value above which a formal economy arises, i.e., $\theta_1^u > \theta_2^u$.

2.2 Equilibrium Dynamics with Discrete Choices

Equilibrium social welfare E as a function of θ is as follows:

$$\begin{array}{lll} 0 & \Delta = 0 & \text{if} \quad \theta < \theta_N^u \\ \left(\left(p+(1-p)\gamma\max\left(r-\frac{c}{\gamma\Delta},0\right)\right)(\theta+\Delta)-e\right)\Delta & \Delta = \dfrac{\theta+\varepsilon-s_N^u}{2\varepsilon} & \text{if} \quad \theta_N^u \le \theta \le s_N^u+\varepsilon \\ \left(p+(1-p)\gamma\left(r-\frac{c}{\gamma}\right)\right)(\theta+\Delta)-e & \Delta = 1 & \text{if} \quad \theta > s_N^u+\varepsilon \end{array} \tag{15}$$

If $\theta < \theta_N^u$, no agent receives a signal above s_N^u, so no agent opts in $(\Delta = 0)$ and there is no formal economy. If $\theta > s_N^u + \varepsilon$, every agent receives a signal above s_N^u, so every agent opts in $(\Delta = 1)$ and social welfare increases linearly in θ. In a small band around s_N^u, the size of the formal economy increases at a faster than linear rate in θ, because the proportion of agents who opt in is also increasing. Thus, as depicted in Figure 1, the equilibrium has the character of a "tipping point." The size of the formal economy "jumps" from nothing to a significant level across a potentially very small region of θ. The better the information environment, i.e., the smaller is ε, and the more "sudden" is the jump.

Remark 2.2 *Bank market power can choke off the development of the formal economy even in the absence of a bank to exercise that power.*

Suppose that the true value of the economic state variable (θ^*) is just a little bit larger than θ_2^u but smaller than θ_1^u. If agents anticipate that the bank market will be competitive, a healthy formal economy and loan market will develop (and this is the welfare-maximizing outcome). If agents anticipate that the bank market will be monopolistic (perhaps, because the local formal economy would be too small to support multiple competing banks), then there will be neither a formal economy nor a loan market. Thus, it would be simultaneously true that the friction associated with bank market power would prevent a formal economy from developing, yet no bank would exist to exercise that power. This result sheds light on the accusation that the financial system neglects marginal economic communities by suggesting that both banks and marginal communities would be better off if banks could credibly commit not to exercise market power.

Remark 2.3 *Redlining can arise in equilibrium.*

The loan market does not exist if the proportion of agents receiving a signal above the threshold s_N^u is sufficiently low, because the proportion of loan applicants with viable projects is too low for banks to operate profitably. (The parametric values where this would happen are $r < \left(c/\gamma \right) \times \left(2\varepsilon \right) / \left(\theta + \varepsilon - s_N^u \right)$, because the loan market only generates positive surplus from screening if r exceeds the cost of screening c divided by the proportion of loan applicants with viable projects, which is $\gamma \left(\varepsilon + \theta - s_N^u \right) / 2\varepsilon$.) In such a case, the loan market simply shuts down; hence the term $\max\left(r - c/\gamma\Delta , 0 \right)$ in Equation (15) for the region in the small band around s_N^u. Agents rationally anticipate this, which acts as an additional friction, impeding economic activity.

A further implication is that redlining may occur in equilibrium. To see why, suppose that $\varepsilon > s_N^u - \theta$ for some θ "close" to s_N^u, and that the fraction $\left(\varepsilon + \theta - s_N^u \right) / 2\varepsilon$ of agents who receive signals above s_N^u is too small for banks to operate profitably. Then, it is simultaneously true that (a) θ is high enough that a healthy formal economy and loan market could develop in the absence of a coordination problem among agents (and this is the welfare-maximizing outcome); (b) optimistic agents (i.e., those with a signal above s_N^u) opt in, fraction $\left(1 - p\right)\gamma$ of these agents develop viable projects, and fraction p of these agents could provide sufficient funds for the viable projects; and (c) given the agent coordination problem and banks' screening costs, the loan market never comes into being, so that borrowers with viable projects are denied credit, giving rise to the redlining phenomenon mentioned earlier.

2.3 The Cooperative Institutional Form with Discrete Effort

The following proposition uses the superscript C to denote the case where the financial intermediation sector is composed of CFIs:

Proposition 2.4 *If financial intermediaries adopt the CFI form, their market power does not increase the gap between the socially optimal threshold value of the economic state variable and the equilibrium value above which a formal economy develops. In particular,* $\theta_1^u > \theta_1^{u,C} = \theta_2^{u,C} = \theta_2^u > \underline{\theta}^W$.

As in the base case with continuous effort, if the monopolist in the financial intermediation sector is a CFI, the friction associated with bank market power is eliminated. Thus, the threshold level of the economic state variable above which a healthy formal economy and a loan market develop does not change with the level of competition in the financial intermediation sector. The implication is that in marginal economies that lack the wealth to support a competitive banking sector, a CFI may be the only viable organizational form for a monopoly financial intermediary and may be the difference between having a healthy formal economy and none at all.

3 Empirical & Policy Implications

Our results on bank organizational form suggest that areas without the economic potential to support a competitive banking system may benefit more from the formation of CFIs than shareholder-owned banks, which may not be viable due to the effects of rent extraction on incentives. In that connection, a crucial governance feature of the archetypical CFI form is that financial claims are allotted in proportion to use of the CFI for financial intermediation, whether as a saver, borrower, or both. CFIs that do not have this feature will not necessarily avoid the disincentivizing effects of bank market power; in particular, CFIs should not accord financial claims equally or by birthright.

A regulator can use several mechanisms to assist in the formation of CFIs. One possibility is a tax preferred status for CFIs vis-à-vis shareholder-owned banks. This is the case in the US, where credit unions do not pay taxes on income from financial intermediation activities undertaken on behalf of members. In the developing world, governments and multinational organizations may also assist in overcoming the organization costs of forming a CFI and in the development of basic credit analysis skills. Such policies may go further to improve social welfare than, say, subsidizing shareholder-owned banks to lend to underdeveloped regions (as such subsidies may be misappropriated) or modernizing banking and securities laws in the hope that a proper financial system will arise organically.

This analysis also sheds light on how CFIs arise. In communities that are too small to support a competitive banking system with multiple banks or where the potential for formal economic activity is initially low, a shareholder-owned bank would, through rent extraction, dampen incentives towards economic activity too much to be viable. Indeed, our analysis of discrete effort choices suggests that the CFI may be the only viable organizational form in such areas. So, members of the local community assume the organization costs to found and operate a CFI. This suggests that banks in small rural communities and disadvantaged urban areas are especially likely to be CFIs, a testable proposition that is in accordance with the avowed aims of the global CFI movement. Conditional on the endogeneity of organizational form, we would also expect widespread adoption of the CFI form to be positively associated with economic growth in such communities. Another testable proposition is that CFIs will tend to convert to shareholder ownership structures as the wealth of the local population increases.

In addition, we found that the welfare effects of bank market power depend crucially on the nature of economic interdependence in the local economy. On one extreme are economies like those of various regions in Northern Italy, where many small businesses exist in an almost symbiotic state, with each firm specializing in a small part of a much larger production chain (Boari, 2001). In this type of economy, economic agents are almost wholly dependent on the efforts of their neighbors. Likewise, some industries like hardware and software makers benefit enormously from each other’s innovations. Economies characterized by such a high level of positive externalities could suffer severe adverse effects from a monopolistic banking system. Conversely, the frictions associated with bank market power may actually be beneficial in economies where negative externalities prevail, for example, in an agrarian economy where local plantations compete with each other on the export market, largely to the benefit of foreign trading partners. We would expect that a monopolistic banking system would accelerate growth (or retard it much less) in such an economy. An empirical prediction would be that the effect of bank market power on economic development and growth would be more negative, the greater the positive externalities from economic activity; and that the effect of bank market power on economic development and growth would be positive if externalities from economic activity are sufficiently negative. Because the CFI form eliminates the disincentivizing effect of bank market power, we would expect to see a greater presence of CFIs in economies characterized by positive externalities than in economies characterized by negative externalities. This proposition has not been previously proposed or tested before, to our knowledge.

In addition, the interaction between bank market power and externalities in economic activity suggests that we may not have fully appreciated the costs and benefits of bank mergers. Where positive externalities predominate, regulators may need to enforce anti-trust laws rigorously. Conversely, where negative externalities prevail, the social planner may wish to facilitate bank mergers. Our analysis also suggests that the mergers of credit unions and mutual savings and loans should be regulated differently from the mergers of shareholder-owned banks.

Our analysis finds that redlining, when defined as a phenomenon whereby banks refuse to lend in areas despite the presence of viable borrowers, is more likely to be observed where the quality of “hard” information on borrowers is low, making it costly for banks to separate borrowers with potentially viable projects (or other legitimate reasons to borrow) from those without. We should accordingly see more redlining in markets where lending must be relationship driven and less redlining in markets like the US home mortgage market in more recent years, where creditworthiness is evaluated on the basis of readily quantifiable attributes like the borrower’s income.

Another implication is that improving the information environment to allow banks to separate potentially legitimate borrowers from “irresponsible” or “illegitimate” borrowers at low cost may result in a Pareto-superior outcome whereby both banks and disadvantaged communities benefit. This suggests an argument for teaching residents of disadvantaged neighborhoods how to build a good credit profile by paying bills in a timely manner, maintaining a bank account to create a transaction history, and keeping good financial records. It may also be helpful to require those receiving regular payments from consumers (e.g., utilities and landlords) to file complete and accurate records of payment so that the creditworthy might demonstrate the habit of timely payment.[9] Another way to reduce the cost of screening is to build and maintain a central credit bureau to which lenders have access. By contrast, pressuring banks to lend to certain areas (as per the US Community Reinvestment Act) may give rise to the problems and costs of enforcement; for example, if a bank is pressured to lend to a disadvantaged neighborhood where the bank takes deposits but does not wish to lend, the bank and a borrower from another neighborhood may have an incentive to set up a “front” address in the disadvantaged neighborhood.

A feature of our model of discrete effort choices is that the market power and organizational form of banks may have a significant impact on economic activity in the following

[9] For a discussion of these and other policies to promote access to the mortgage market for disadvantaged communities, see Joint Center for Housing Studies (2003).

way. For moderate values of the economic state variable, that is, values near the tipping point, the level of formal economic activity is zero until bank market power is reduced or the CFI form is adopted. Thereupon, the level of formal economic activity increases in a discontinuous jump. These results provide specific guidance on the kind of non-linearities that should be examined in empirical work on the co-development of the financial sector and the wider economy.

4 Conclusion

In this paper, we study how the organizational form of banks moderates the effects of bank market power. If the externalities from economic activity are positive or not too negative, bank market power may reduce social welfare by reducing the incentive of agents to undertake costly effort toward economic activity. Conversely, if the externalities in economic activity are sufficiently negative, bank market power raises social welfare above what would obtain with a competitive banking system by dissuading agents from imposing negative externalities on each other. We show that these disincentivizing effects of bank market power may be eliminated if intermediaries adopt the form of a cooperative financial institution, which is owned by its borrowers and savers instead of a third party. It follows that the cooperative form is welfare enhancing if and only if the externalities from economic activity are positive or not too negative and the actual or potential banking sector exhibits rent extraction.

In an extension of our model, we consider discrete effort choices, as may exist in marginal economies where agents may elect to participate in a cottage industry rather than in the formal economy. We show that the equilibrium is then a tipping point phenomenon in relation to an underlying economic state variable. Changes to the market power or organizational form of banks can consequently have a major impact on social welfare if the economy is near the tipping point. We also study “redlining,” showing that it can arise as an equilibrium phenomenon.

We believe the paper raises a number of interesting questions. Could shareholder-owned banks avoid the disincentivizing effects of their market power, for example, by committing to maximum interest rates? Does the size of a cooperative financial institution or of the community it serves moderate the degree to which the cooperative form reduces the frictions associated with intermediary market power? Is there a role for government in influencing the direction and the level of externalities from economic activity? To what extent do operational efficiencies from bank mergers offset the negative effects on the incentives of savers and borrowers to exert effort toward economic activity? Could other frictions in the financial intermediation sector give rise to similar effects? One example might be a belief that the banking sector is insolvent, prompting individuals to opt out, for example, by hoarding cash rather than making deposits. Likewise, the reluctance of banks with access to loanable funds to make new loans during the recent financial crisis may be a function of unobservably "bad" borrowers polluting the pool of loan applicants, as we found in our analysis of redlining. Study of these questions will be the subject of future research.

Appendix: Proof of Propositions

Completion of Proof of Proposition 1.1: It remains to prove that $e_k^{W,N} - e_k^{u,N}$ and $E^{W,N} - E^{u,N}$ are increasing in δ. Let $Y = p + (1-p)\gamma\left(r - c/\gamma\right)$, and let β be the strictly positive number less than 1 that solves $\beta Y = p + (1-p)\left(\gamma/2\right)\left(r - c/\gamma\right)$. We then have

$$e_k^{W,N} = \frac{\theta Y}{1-2\delta Y}, e_k^{u,2} = \frac{\theta Y}{1-\delta Y}, e_k^{u,1} = \frac{\theta Y\beta}{1-\delta Y\beta} \tag{16}$$

Substitution then yields

$$E^{W,N} = \frac{Y^2\theta^2}{2(1-2\delta Y)}, E^{u,2} = \frac{Y^2\theta^2}{2(1-\delta Y)^2}, E^{u,1} = \frac{Y^2\theta^2\beta(2-\beta)}{2(1-\delta Y\beta)^2} \tag{17}$$

We then have

$$\frac{d}{d\delta}\left(E^{W,N} - E^{u,2}\right) = \frac{Y^4\theta^2\delta\left(1-Y\delta-Y^2\delta^2\right)}{(1-Y\delta)^3(1-2Y\delta)^2} > 0 \tag{18}$$

We also have

$$\begin{aligned}&\frac{d}{d\delta}\left(E^{u,2} - E^{u,1}\right) = \\ &\frac{Y^3\theta^2(1-\beta)}{(1-Y\delta)^3(1-\delta Y\beta)^3} \times \left(2Y^3\beta^2\delta^3 - 3Y^2\beta^2\delta^2 + 3Y\beta^2\delta - 3Y\beta\delta - \beta^2 + \beta + 1\right)\end{aligned} \tag{19}$$

The terms to the left of the multiplication symbol are positive. Claim: the term in parentheses to the right of the multiplication symbol is also positive. Substitution shows that it is positive for $\beta = 0$ or $\beta = 1$. Continuity in β implies that there would have to be a $\beta \in (0,1)$ that set the term in parentheses equal to zero for the term to achieve a negative value in the relevant range of $(0,1)$. Let $x = Y\delta \in \left(0, 1/2\right)$. We then have:

$$\begin{aligned}&\beta^2\left(2x^3 - 3x^2 + 3x - 1\right) - \beta(3x-1) + 1 = \\ &\beta^2\left(2x^3 - 3x^2\right) - \beta(1-\beta)(3x-1) + 1\end{aligned} \tag{20}$$

If $3x - 1 < 0$, Equation (20) is clearly positive. If $3x - 1 \geq 0$, we have $\forall x \in \left[1/3, 1/2\right)$:

$$\begin{aligned}\beta^2\left(2x^3-3x^2\right)-\beta(1-\beta)(3x-1)+1&>\\ \beta^2\left(2x^3-3x^2\right)-(3x-1)+1&\geq \\ \beta^2\left(2x^3-3x^2\right)+\tfrac{1}{2}&>0\end{aligned} \tag{21}$$

where the last step follows from maximizing the last line with respect to x.

Proof of Proposition 1.2: The values of $e_k^{W,2}, e_k^{W,1}, e_k^{u,2}, e_k^{u,1}$ follow by changing $+\delta$ to $-\delta$ in the analysis of positive externalities. The analogue to Equation (16) is

$$e_k^{W,N}=\frac{\theta Y}{1+2\delta Y}, e_k^{u,2}=\frac{\theta Y}{1+\delta Y}, e_k^{u,1}=\frac{\theta Y\beta}{1+\delta Y\beta} \tag{22}$$

The properties of the threshold level of externalities $\tilde{\delta}$ are derived as follows. The difference between $e_k^{W,N}$ and $e_k^{u,1}$ is a linear function of δ with equality at $\hat{\delta}=(1-\beta)/Y\beta>0$. Because the social welfare function is quadratic in e_k, whichever of $e_k^{u,1}$ or $e_k^{u,2}$ is closest to $e_k^{W,N}$ in absolute value will generate higher social welfare. The derivative of $e_k^{u,1}$ with respect to β is positive, so that $e_k^{u,2}>e_k^{u,1}, \forall\delta$. Clearly, if $\delta=0$, $e_k^{u,2}=e_k^{W,N}$. Thus, $E^{u,2}>E^{u,1}$ for δ close to 0, and $E^{u,2}<E^{u,1}$ for all $\delta\geq\hat{\delta}$. Claim: there is a single threshold $\tilde{\delta}\in\left(0,\hat{\delta}\right)$ such that $E^{u,2}>E^{u,1}$ if and only if $\delta<\tilde{\delta}$. To see this, note that, in the relevant range, $E^{u,2}>E^{u,1}$ if and only if

$$\begin{gathered}e_k^{u,2}-e_k^{W,N}<e_k^{W,N}-e_k^{u,1}\\ \frac{\theta Y}{1+\delta Y}-\frac{\theta Y}{1+2\delta Y}<\frac{\theta Y}{1+2\delta Y}-\frac{\theta Y\beta}{1+\delta Y\beta}\end{gathered} \tag{23}$$

The bounds of this inequality are quadratic in δ and have one and only one positive solution, namely $\tilde{\delta}$, where $0<\tilde{\delta}=\left(\sqrt{\beta(2-\beta)}-\beta\right)/2Y\beta<\hat{\delta}$.

Proof of Proposition 2.1: Given a signal s, the expected utility to an agent from opting in if no other agent opts in (and there is accordingly no loan market) is

$$\frac{1}{2\varepsilon}\int_{s-\varepsilon}^{s+\varepsilon}p\theta d\theta-e=ps-e \tag{24}$$

By assumption, there is a signal $s_{N,0}\geq\overline{\theta}+\varepsilon$ such that the foregoing expectation is non-negative. Thus, every agent who receives a signal of $s_{N,0}$ or higher opts in. Consider an agent who receives a signal $s < s_{N,0}$. This implies $\theta \in [s+\varepsilon, s-\varepsilon]$. Given the assumption that only those agents with a signal above $s_{N,0}$ opt in, the return to the focal agent from exerting effort is:[10]

$$\begin{aligned}
&\frac{1}{2\varepsilon}\int_{s-\varepsilon}^{s+\varepsilon}(\theta+\Delta)\,pd\theta + \\
&\frac{1}{2\varepsilon}\int_{s-\varepsilon}^{s+\varepsilon}(\theta+\Delta)(1-p)\left(\frac{1}{2}+\frac{1}{2}\times 1_{\{N=2\}}\right)\left(r-c/_{\gamma\Delta}\right)\times 1_{\{r>c/_{\gamma\Delta}\}}\,d\theta - e = \\
&\frac{1}{2\varepsilon}\int_{s-\varepsilon}^{s+\varepsilon}\left(\theta+\max\left(\frac{\theta+\varepsilon-s_{N,0}}{2\varepsilon},0\right)\right)pd\theta + \\
&\frac{1}{2\varepsilon}\int_{s-\varepsilon+\frac{2c}{r\gamma}}^{s+\varepsilon}\left(\theta+\max\left(\frac{\theta+\varepsilon-s_{N,0}}{2\varepsilon},0\right)\right)(1-p)\left(\frac{1}{2}+\frac{1}{2}\times 1_{\{N=2\}}\right)\left(r-\frac{c}{\gamma}\times\frac{2\varepsilon}{\theta+\varepsilon-s_{N,0}}\right)d\theta - e
\end{aligned} \tag{25}$$

(To understand where Equation (25) comes from, note that the proportion of borrowers with viable projects is $\gamma\Delta = \gamma\left(\theta+\varepsilon-s_{N,0}\right)/2\varepsilon$ and that there will be no loan market whenever this expression declines so much that $r-\left(c/_{\gamma}\right)\times(2\varepsilon)/\left(\theta+\varepsilon-s_{N,0}\right)<0$, which occurs whenever $\theta < s_{N,0}-\varepsilon+{}^{2c}/_{r\gamma}$.) It is clear that for s sufficiently close to (but less than) $s_{N,0}$, Equation (25) is positive. Define $s_{N,1}$ as the lowest s for which Equation (25) is non-negative. We can then construct a decreasing sequence $\{s_{N,n}\}$, where $s_{N,n}$ is substituted for $s_{N,0}$ above and $s_{N,n+1}$ is calculated as we calculated $s_{N,1}$. Since the sequence is bounded below by $\underline{\theta}_N$ and the support of θ is continuous, the sequence must converge to an s_N^u such that

$$\begin{aligned}
&\frac{1}{2\varepsilon}\int_{s_N^u-\varepsilon}^{s_N^u+\varepsilon}\left(\theta+\frac{\theta+\varepsilon-s_N^u}{2\varepsilon}\right)pd\theta + \\
&\frac{1}{2\varepsilon}\int_{s_N^u-\varepsilon+\frac{2c}{r\gamma}}^{s_N^u+\varepsilon}\left(\theta+\frac{\theta+\varepsilon-s_N^u}{2\varepsilon}\right)(1-p)\left(\frac{1}{2}+\frac{1}{2}\times 1_{\{N=2\}}\right)\left(r-\frac{c}{\gamma}\times\frac{2\varepsilon}{\theta+\varepsilon-s_N^u}\right)d\theta - e = 0
\end{aligned} \tag{26}$$

It is clear that $s_N^u > \underline{\theta}^W$ and that $\theta_N^u \to s_N^u$ from below as $\varepsilon \to 0$. The uniqueness of s_N^u is apparent from the fact that the foregoing expression only has one solution. That $\theta_1^u > \theta_2^u$ follows from the fact that $s_1^u > s_2^u$, which follows from inspection of Equation (26).

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[10] The agent can assume that a viable project will be funded, because there is a supply of funds from the measure of agents with a signal greater than $s_{N,0}$. To the extent that agents with lower signals exert effort too, proportion *p* of such agents also provide funding.

Proof of Proposition 2.4: That $\theta_1^u > \theta_1^{u,C} = \theta_2^{u,C} = \theta_2^u$ follows from the fact that if the financial intermediation sector is composed of CFIs, Equations (25) and (26) are modified such that, regardless of the value of N, they take their form for when $N = 2$.

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Figure 1
Net Social Welfare as a Function of θ
Discrete Effort Choices