Research Article

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Good Co(o)p or Bad Co(o)p? Redistribution Concerns and Competition in Credit Markets with Imperfect Information

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Abstract: Non-profit organizations (NPOs), such as financial cooperatives, have a longstanding tradition in advanced market economies. We develop a model of 'mixed credit markets' where pure for-profit institutions (e.g. commercial banks) can coexist with financial NPOs which feature a concern for inter-member surplus redistribution (e.g. credit cooperatives) and enjoy privileged borrower-specific information vis-à-vis their for-profit peers, while facing higher funding costs. We formally investigate market competition between the two alternative financial organizations both offering contracts whose terms entail cross subsidization. We argue that heterogeneity in organizational models can explain stable coexistence under competitive conditions, and also help us interpret the variety of market outcomes — in terms of e.g. overall coverage and market shares — as documented in modern financial systems. Importantly, the viability of redistribution-oriented NPOs is shown not to rest on under-investment issues or concerns about market power, for they can successfully operate in markets where credit rationing never arises.

Keywords: credit markets, imperfect information, financial cooperatives, cross subsidization

JEL Classification: D20, D40, G20

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1 Introduction

Historical examinations of credit markets in advanced economies provide ample evidence on the coexistence of a variety of banking and financial institutions, some of which explicitly operate on principles other than profit maximization (e.g. Ayadi et al. 2010; Butzbach and Mettenheim 2015). The rise and growth of cooperatives banks and other kinds of non-profit financial organizations in Europe — e.g. the Raiffeisen movement in Germany and Holland (Guinnanne 2001, 2002) — is a case in point. Created in reaction to peculiar economic challenges in the 19th century, credit cooperatives have not disappeared — in some circumstances they even thrived — in industrialized countries within the development process; and have generally proved able to withstand strong competitive pressure in modern banking industries (Butzbach and Mettenheim 2014). Notwithstanding their distinctive traits, several credit organizations that explicitly commit to non-profit missions — such as credit unions, mutual savings banks and community lenders — have been empirically documented to fare well in comparative perspective, oftentimes managing to outperform their for-profit peers along several dimensions (e.g. Ayadi et al. 2010; Beck et al. 2014; Bongini and Ferri 2008; Cihák and Hesse 2007).

The present paper introduces a simple theoretical framework that accommodates this institutional heterogeneity across financial players, in order to investigate properties of competitive outcomes generated by 'mixed credit markets', where both for profit and not for profit institutions compete with each other. We are particularly interested in a peculiar form of financial NPOs, which have been historically quite relevant in Europe especially in the transition from a rural economy to one based on manufacturing and services: credit cooperatives. In accordance with historical paths of institutional development, our analysis assigns credit cooperatives two defining features. First, by their very nature, they cannot make profits: any surplus generated on the market activities is shared among borrowers/members by force of explicit contractual provisions (assuming absence of any reserve requirement). Second, they operate so as to enlarge as much as possible the size of their client base, in an attempt to provide funding to profitable (yet possibly rationed) entrepreneurs and redistribute the aggregate surplus from their operation among the members.

The rather novel feature of our model is that the loan contracts issued by the two credit institutions necessarily enforce a form of cross subsidization among borrowers. There are two sources of cross subsidization here. One is internal to the firm and hinges on the credit contract within each institutions (given the market share). The other is due to the equilibrium effect of competition ruling the allocation of the market share and the quality composition of credit portfolios within each institution. More specifically, in the case of for-profit lenders, cross subsidization emerges because of the standard problem of adverse selection they face (as in Akerlof 1970, and in de Meza and Webb 1987). In the case of credit cooperatives, cross subsidization is imposed as a feature of their operational model, to capture redistribution concerns as arising from social norms or local politics, shaping their objective function. The equilibrium in the credit market in our model emerges, therefore, as the competitive outcome between two distinct forms of cross subsidization that either type of financial organization entails.

The analysis of our model uncovers two aspects of financial markets where heterogeneous organizations run the credit business. First, the informational advantage enjoyed by credit cooperatives can support stable coexistence under competitive conditions even if they enact arbitrary forms of redistribution among their members. The model thus offers a potential explanation for the variety of market outcomes — in terms of e.g. overall market coverage, credit volumes and prices — which has been empirically documented in real world financial systems (e.g. Ayadi et al. 2010). In fact, our analysis predicts that the presence of redistribution-concerned credit cooperatives along with for-profit organizations creates scope for multiple equilibrium configurations to arise in the marketplace. Hence, an important role for history to shape the relative *size of* and *access to* credit by entrepreneurs of heterogeneous quality can emerge. Importantly, equilibrium multiplicity also arises in the *allocation* of the quality of projects to either credit organization, so that it is not necessarily the case that the presence of NPOs is supported by their ability to cover the residual demand for credit by under-served (and possibly undeserving) borrowers.

Second, the presence of NPO in the credit market *does not* endanger efficiency properties of the credit market in which they manage to enter. Indeed we show that successful operation of financial cooperatives in the presence of explicit redistribution concerns tends to erode rents from profitable investment opportunities and thus disciplines over-provision of credit by for-profit banks.

Strikingly, this prediction holds true even when all efficient ventures (i.e. those with positive expected net return) are undertaken no matter whether credit cooperatives are operative or not, and/or when for-profit banks are bound to earn zero profits because of free entry. This is important: we highlight that the viability of such NPOs and their role in the credit market do not necessarily rest on under-investment issues or concerns about market power (e.g. Hart and Moore 1998).

Our framework of analysis builds upon a standard fixed-investment model in which entrepreneurial ventures of heterogeneous quality (probability of success) require external finance to run the business. The market for loans is populated by two types of risk-neutral credit organizations, which differ in terms of both their business objective and informational expertise: on the one side there are pure profit seeking organizations (e.g. commercial banks), who lack precise information about borrowers' characteristics (Akerlolf 1970); on the other stand credit cooperatives, which rather exhibit a concern for surplus redistribution within the pool of their clients/members, and enjoy superior information due to their local focus and the adoption of relational banking practices. We posit, by contrast, the former face a lower refinincing (or intermediation) cost relative to the latter — a competitive disadvantage in the market for funds.[1]

The characteristics of loan contracts will naturally reflect lenders' asymmetric informational footing in the absence of collateral provisions: While for-profit organizations will offer standard debt contracts that pool all applicants together, a quality-contingent surplus sharing rule will be enforced by credit cooperatives under a (full) surplus redistribution constraint. Because of competition on loan supply on the basis of differential information, equilibrium sorting of entrepreneurs will depend on their type-dependent incentives to joining the pool served by either credit organization. We posit that the goal of the cooperatives is that of extending the gains from financial trade to the largest feasible client base which does not violate their balanced-budget constraint, provided the whole aggregate surplus is redistributed over the pool of signing entrepreneurs. We provide sufficient conditions for existence of a (possibly non-unique) competitive equilibrium in mixed credit markets, while also characterizing their efficiency properties and other observable features — e.g. the ensuing market segmentation across credit institutions.

Our study speaks to several strands of literature. First, there exists sizable work on the industrial organization of credit markets featuring heterogeneous financial players, especially microfinance institutions in developing countries (e.g. Ghosh and Ray 2016; McIntosh and Wydick 2005; Morduch 1999, 2000). While much of the emphasis has been granted to the analysis of the implications of relational banking

1 This assumption is consistent with a simple theory of information acquisition with fixed costs, in which any lender must be indifferent between acquiring the information (e.g. screening) technology or not, whose outcome would have NPOs on the supply side of the credit market. See D'Amato, Di Pietro, and Sorge (2020) for a deeper discussion on this point.

and long-lasting credit relationship vis-à-vis standard profit-oriented banking models (e.g. Agarwal and Hauswald 2010; Berger and Udell 2002; Bolton et al. 2016; Dell'Ariccia and Marques 2004; Gormley 2014; Hauswald and Marquez 2006; Rajan 1992; Sharpe 1990), relatively few studies have dealt with the operation of markets in mature (high-income) economies in which several types of NPOs have emerged and flourished next to conventional financial institutions. Relevant exceptions are represented by scholarly work offering theoretic foundations of credit unions and other credit organizations that label themselves not-for-profit (Canning, Jefferson, and Spencer 2003, Smith 1984; Smith, Cargill, and Meyer 1981); and studies on corporate social responsibility in ethical banks, which has been shown to play an increasingly important role in many developed countries (e.g. Barigozzi and Tedeschi 2014, 2019; Becchetti and Garcia 2011; Becchetti, Garcia, and Trovato 2011). We add to this literature by exploring the operation of mixed markets in which credit organizations exhibiting redistribution concerns — as well as a distinctive set of competitive (dis) advantages stemming from their local rooting — shape the behavior of NPOs which compete with their for-profit peers within the same playing field, i.e. the market for loans.

From an analytical point of view, our model is close in spirit to that of de Meza and Webb (1987), where investment projects are ranked according to their expected returns, rather than by increasing risk. As a result, favorable selection in entrepreneurship occurs in equilibrium, so that bad entrepreneurs will benefit from over-provision of credit relative to the efficiency level. Whereas the effect of better informed NPOs in an imperfect information model generating underinvestment (e.g. Stiglitz and Weiss 1981) would be that of improving on inefficient allocations by serving high-quality (or low-risk) and yet rationed entrepreneurs, we are able to show that financial NPOs are viable even when too much investment, rather than credit rationing, is the essential market failure.[2] In a similar vein, D'Amato, Di Pietro, and Sorge (2020) show that competition between asymmetrically informed, profit-oriented lenders create room for multiple equilbria to arise, all associated with varying degrees of overlending. The presence of redistribution concerns in NPOs entails a number of issues in comparison to D'Amato, Di Pietro, and Sorge (2020). In order to attract good entrepreneurs, which helps meet their redistribution task, credit cooperatives could be forced to provide them with an overly large share of the projects' surplus and/or implement a more favorable redistribution scheme, with possibly adverse effects on their overall budget. By the

2 It should be stressed that recent empirical work suggests that overlending has been an empirically relevant phenomenon for opaque, credit-seeking firms in a fair number of advanced industries (Bonnet, Cieply, and Dejardin 2016).

same token, a varying amount of redistribution from high to low quality projects induced by uniform pricing from their uninformed for-profit competitors alters the amount of redistribution that is feasible for the NPOs and yet meets the balanced-budget requirement. As a consequence, different surplus sharing rules are in principle enforceable in equilibrium — a further source of equilibrium multiplicity, other than the adverse selection one.

Our analysis reveals that, while a unique form of vertical separation is bound to arise in the credit market model studied by D'Amato, Di Pietro, and Sorge (2020), by which better informed lenders end up attracting the upper tail of the quality distribution (cherry picking), heterogeneity in banking models can produce a fundamental disconnection in the allocation of credit, according to which for-profit lenders attract both 'peaches' and 'lemons', with medial quality (and efficient) projects being served by credit cooperatives. The intuition for this result is quite straightforward: higher quality borrowers necessarily get larger rents in the credit relationship with commercial banks. Therefore by competing them away from the for profit sector into the credit cooperatives would require raising the rents to all other members to a level that can be simply non-affordable in environments where adverse selection is not severe enough. This may help clear a common misconception, which is at odds with observed real-world market outcomes, holding that borrowers of the highest credit merit in financial NPOs necessarily lie below the lowest credit merit in traditional commercial banks.

A distinct strand of literature has been concerned with the design of firms' constitution and the resulting assignment of property rights, in order to study efficiency of ownership structures (e.g. Bontems and Fulton 2009; Borgen 2004; Hansmann 1996; Hart and Moore 1996, 1998). Further studies have rather investigated the links between organizational structures and information-dependent allocation of capital to investment projects (e.g. Stein 2002), optimal design of credit cooperatives as peer monitoring devices (Banerjee, Besley, and Guinnane 1994) as well as the economic consequences of different objective and behavioral patterns in production cooperatives (e.g. Bonin et al. 1993; Novkovic 2008). Our analysis shows that explicit redistribution concerns in NPOs crucially alter the allocation of investment projects to either financial intermediary and hence the emergence of diverse market configurations compatible with a competitive setting. This finding is consistent with the empirically documented varying success of alternative banking models, such as credit cooperatives, along with universal banks in advanced economies (e.g. Ayadi et al. 2010; Fonteyne 2007).

The paper proceeds as follows. In Section 2, we motivate our theoretical framework with a brief historical account of the rise and endurance of financial NPOs in advanced economies, while also discussing a number of peculiar traits of the cooperative banking model, which are consistent with our modeling assumptions. Section 3 introduces the market environment, focusing attention on the heterogeneous objectives of the credit organizations that populate it. Upon presenting the benchmark case in which only for-profit banks can enter the marketplace (Section 4), we explore the consequences of competition between for-profit organizations and credit cooperatives (Section 5). Section 6 discusses the robustness of the paper's main findings to relaxation of the basic working assumptions. Section 7 offers concluding remarks. All the proofs are reported in the Appendix.

2 Background

2.1 Financial NPOs in Historical Perspective

Financial NPOs have a long and well-established tradition in the history of advanced economies (Butzbach and Mettenheim 2014, 2015). In the U.S. the number of banks has dramatically increased after the Second World War within a rapidly growing economy and a regulatory framework which strongly opposed the creation of monopoly rents in the banking industry. While this trend has almost reverted in the last decades, member-owned credit unions as well as small non-profit community lenders continue to operate in specific geographic areas and urban districts next to profit-oriented commercial banks. Given their strong links with local communities and institutions, community lenders typically offer financing and other services to business owners based on repeated interactions with their borrowers (relying on the reputation of the owners) and other relational lending practices, which help mitigate hidden information issues and thereby facilitate access to credit for under-served groups (e.g. Berger and Udell 1995, 2002; Petersen and Rajan 1994).

Originating in local areas at the turn of the 19th century, credit cooperatives and saving banks were founded to favor access to credit for the rural poor and working-class people along the industrialization process, e.g. the Raiffeisen and Schultz-Delitz credit cooperatives in German-speaking areas (Guinnane 2001, 2002); other public and cooperative credit associations pursuing mutualistic aims sprang up across francophone countries over the same years.

While still playing a role in overcoming financial exclusion of population groups who would otherwise have no access to affordable credit, in most advanced economies financial cooperatives compete vis-à-vis other types of financial institutions, e.g. commercial banks, in providing funding to retail customers and to small and medium-sized enterprises. Over the last decades, drastic regulatory changes and the process of financial innovation in the U.S. and most European countries allowed several types of financial NPOs to expand the scope of their operations across financial services and beyond local markets. Nowadays, cooperative banks and credit cooperatives make up a large share of the financial industry in several jurisdictions, oftentimes coordinating in federations and networks with shared solidarity schemes (Ayadi et al. 2010).[3]

2.2 Banks, Information and Redistribution

Modern banking theory situates for-profit commercial banks within a market-based frame, according to which such financial institutions go well beyond collecting deposits and originating loans — i.e. intermediating financial resources; for they generally engage in a wide range of sophisticated operations (such as trading assets and offering insurance products) and spread and diversify risk invoking the law of large numbers in the presence of market imperfections (e.g. Battacharya and Thakor 1993). Credit cooperatives and other financial NPOs, by contrast, operate on alternative principles which make explicit reference to socially shared objectives, such as local project finance and public policies, savings for local communities, economic and social development. Financial cooperatives generally abide by statutory provisions according to which profits (surplus) are redistributed based on members' participation. As a result, while redistribution within for-profit universal banks occurs because of information asymmetries and through the market (cross-subsidization), in the case of financial cooperatives redistribution concerns are explicitly stated and exogenous with respect to market forces (Fonteyne 2007).

Carrying unique features inherent to member ownership, the cooperative banking model does not rest on an exclusive notion of efficiency as measured by the ability to create value for its shareholders. Rather, it typically pursues distinctive member-related objectives — e.g. pooling resources to secure and improve access to credit to their members, that are also the cooperative's clients, depositors and borrowers. Members of credit cooperatives typically benefit from

3 An historical example we have been studying concerns the rise and growth of Italian credit cooperatives over the 19th and the 20th century. Much like their counterparts in European countries, these financial organizations were characterized by geographical diffusion and a slow yet constant growth of saving accounts and loans; a process which continued steadily up until the start of World War I, while private banks were rather experiencing a dramatic decline in their fraction of total loan supply (Conti 1999; Conti and Ferri 1997; D'Amato and Sorge 2012). Credit cooperatives in Italy also managed to retain relevant market shares during the first and second post-war period without betraying their core social mission, up until the occurrence of structural reforms of the financial industry which, during the 1990s and 2000s, fostered a process of privatization of most savings banks.

surplus sharing in the form of e.g. reduced fees and dividends. Member ownership, originally inspired by the cooperative principles of democratic decision-making and participation (“one person, one vote”), social commitment and solidarity, also lies at the core of the redistribution mechanism within the supported community (Butzbach and Mettenheim 2014, 2015).

Strong focus on territorial economic needs and proximity to customers are distinctive traits that allow cooperatives to be perceived as local and trustworthy banks (Fonteyne 2007) and thus gathering soft information about their creditworthiness — cooperatives as *information machines* (Banerjee, Besley, and Guinnane 1994). By its very nature, relational lending practices largely rely on mutual trust and reputation rather than explicit collateral requirements in business transactions (e.g. Cosimano 2004), awarding an information-based advantage to local cooperatives (e.g. Sharpe 1990) while also enhancing their screening power over new loan applications (e.g. Agarwal and Hauswald 2010). In this case, the same sources of good information — e.g. social networking, trust-based personal relationships — are also at the root of the cooperative redistributive goals.

3 Environment

We consider a simple credit market model with private information and heterogeneous credit organizations. Let q denote the random *quality* of investment projects to be financed, distributed over the compact support Q according to twice continuously differentiable distribution $F(q)$ with density $f(q) > 0$ for all $q \in (0, 1)$. We interpret q as the probability of success of projects, with $Q = [0, 1]$. All the projects have the same size, each requiring one unit of capital to be undertaken and yielding a return of $\pi > 1$ (if a project fails, it delivers a zero return).[4]

Entrepreneurs are risk-neutral and have no private capital, so external finance has to be raised from either of two distinct types of risk-neutral credit organizations: commercial banks (henceforth indexed by b), that are unaware of the quality of projects and act as profit maximizers in the presence of free entry; and a coalition of credit cooperatives (henceforth indexed by c), which rather observe the actual borrower type $q \in Q$ and share a concern for surplus redistribution among their borrowers/members.

A *debt contract* is a couple $\{\rho_i, 1\}$, $i \in \{b, c\}$, which specifies a price $\rho_i \in (0, \pi]$ for the unit loan — i.e. a share of the return on the undertaken project — to be paid if

4 Entrepreneurial ventures are therefore ranked by increasing expected returns, rather than risk. See de Meza and Webb (1987) for a discussion of the implications of this assumption vis-à-vis the mean preserving spread one adopted in e.g. Stiglitz and Weiss (1981).

(and only if) the latter succeeds. For simplicity, we exclude the possibility of multiple lending (one project to one bank if lending occurs).

On the liability side, let R_b be the cost of funding faced by commercial banks (i.e. the prime rate in the money market), and R_c the corresponding refinincing cost for cooperative ones. For reasons discussed in the introduction, we assume $R_b < R_c$.

3.1 Entrepreneurs

The (expected) utility of the entrepreneur from accepting the contract offered by the type i bank is

$$U(\rho_i\,; q) = (\pi - \rho_i) \cdot q, \quad i \in \{b, c\} \tag{1}$$

Hence, entrepreneur $q \in Q$ selects the contract offered by the type i bank if and only if

$$U(\rho_i\,; q) \geq \max\left\{u_0, U\left(\rho_j, q\right)\right\}, \quad j \neq i \tag{2}$$

where $u_0 > 0$ denotes the (type-independent) entrepreneurs' outside option.[5]

3.2 Credit Organizations

Commercial banks are modeled as pure for-profit organizations, and thus aim at maximizing expected profits

$$\int_{Q_b} [\rho_b \cdot q - R_b] dF(q) \tag{3}$$

where ρ_b is the uniform price (gross interest rate) and Q_b is the set of subscribing entrepreneurs.

As in standard models of credit markets with imperfect information (e.g. de Meza and Webb 1987; Mankiw 1986), separation of entrepreneurial types is not possible under individual lending arrangements in the absence of collateral or other observable characteristics of borrowers. The only solution is thus to offer a pooling (unsecured) debt contract providing all subscribing entrepreneurs

5 This is without loss of generality, as discussed in D'Amato, Di Pietro, and Sorge (2020). Notice that this setup is essentially static, and entrepreneurs cannot start a new project after failure; see Schumacher, Gerling, and Kowalik (2015) for a model with dynamic entrepreneurial risk choice.

with the required capital to start their own venture, and that has a fixed (type-independent) repayment ρ_b in non-bankruptcy states, whereas non-defaulting entrepreneurs retain full ownership rights over their project's return net of repayment.[6]

As discussed above, credit cooperatives rather operate on the basis of explicit *redistribution concerns*: they aim at maximizing the size — here, the measure — of their client base over which to redistribute the aggregate surplus flowing from funded (and successful) investment projects. The explicit cross-subsidization scheme adopted by credit cooperatives is restricted to enforce *equal treatment* of signing entrepreneurs: the aggregate surplus flowing to the banks is equally redistributed across served entrepreneurs of sufficiently high quality (where the quality threshold is endogenously determined), so as to provide them with the same level of expected utility.[7] The surplus-sharing contract offered by cooperative banks, which is specifically designated for (and only available to) entrepreneurs of type q, thus stipulates an expected (constant) payoff πc for all signing entrepreneurs, for some share $c \in (0,1)$, and entail a type-dependent repayment $\rho_c(q)$ when the projects are successfully undertaken: an unsecured debt contract with type-dependent interest rates. Equal treatment must then be achieved by stipulating a type-increasing price function $\rho_c(q)$, that explicitly enforces cross-subsidization from high-quality entrepreneurs to low-quality ones.[8]

Surplus redistribution with equal treatment involves collecting all individual (project-specific) surpluses from subscribing entrepreneurs (members) $q \in Q_c$, and granting them a constant expected utility

$$U(\rho_c(q); q) = (\pi - \rho_c(q)) \cdot q = \pi c, \quad q \in Q_c$$

provided Q_c maximizes the measure $\mu_F(Q_c) = \int_{Q_c} dF(q)$ of the pool.[9] When $\rho_c(q)$ is restricted to be non-negative, we have

6 The debt contract — let us call it D_b — can be thought as a mapping from the observable output from the project into a non-negative payment for the entrepreneur of type q, i.e. $D_b : \{0, \pi\} \to \mathbb{R}_+$, with $D_b(0) = 0$ and $D_b(\pi) = \pi - \rho_b$. Non-negativity of the payment is implied by the fact that entrepreneurs have no private wealth.

7 This is of course not the only way credit cooperatives can redistribute surplus back to their clients, and may appear somewhat exceptional. But insofar as our focus is on establishing conditions for co-existence of two distinct cross-subsidizing structures – one implicit in the market mechanism and the other explicitly enacted — our analysis naturally allows us to conjecture that less extreme forms of surplus allotment across subscribing entrepreneurs would be even more likely to be sustained in a competitive equilibrium.

8 The surplus-sharing contract — let us call it D_c^q — can thus be thought as a mapping of the form $D_c^q : \{0, \pi\} \to \mathbb{R}_+$ with $D_c^q(0) = 0$ and $D_c^q(\pi) = \frac{\pi c}{q}$.

9 The restriction $c < 1$ is necessary for redistribution to occur: credit cooperatives cannot operate up to the point that the whole project-specific surplus is left to the entrepreneur.

$$\rho_c(q) = \pi\left(1 - \frac{c}{q}\right), \quad q \in Q_c\,; \qquad (4)$$
$$Q_c \subseteq [c, 1]$$

Notice that a *negative price* $\rho_c(q) < 0$ would result for all projects of quality $q < c$ — see relation (4): the payment $(\pi - \rho_c(q))$ for entrepreneurs of inferior quality with a successful project would in fact exceed the return on the latter; as a result, those holding the debt claim (the cooperatives) would need to subsidize some of their debtors in the good state of the world. As this provision would conflict with the structure of standard debt contracts, our entire analysis and the ensuing results are based on the restriction that debt repayments on termination $\rho_c(q)$ be non-negative.[10]

It is worth emphasizing that the choices of c and Q_c necessarily intertwine with each other, since the former shapes the boundaries of the pool of entrepreneurs that credit cooperatives can target. For any price ρ_b^e that they expect their for-profit competitors to offer, credit cooperatives in fact set the lowest share $c(\tilde{q})$ inducing targeted entrepreneurs to self-select into the associated contract, where $\tilde{q} \leq 1$ identifies the marginal entrepreneur who finds herself just indifferent between the two borrowing possibilities; while no contract $\{\rho_c(q), 1\}$ is supplied to entrepreneurs endowed with projects of quality $q < c(\tilde{q})$ — see (4), any $q \geq \tilde{q}$ will necessarily accept the commercial banks' offer, for this grants subscribing entrepreneurs a type-increasing expected utility — see (1). If several couples $(c(\tilde{q}), Q_c)$ exist that support a balanced budget, credit cooperatives then select the one(s) yielding Q_c with maximal measure.

Formally, cooperatives solve the following problem: for any ρ_b^e, let

$$c := c(\tilde{q}) = \left[1 - \frac{\rho_b^e}{\pi}\right]\tilde{q}$$

from $U(\rho_b^e\,; \tilde{q}) = \pi c$, and define the sets

$$\Phi\left(c(\tilde{q}), \rho_b^e\right) = \left\{ Q_c \subseteq [c(\tilde{q}), 1] : \sup(Q_c) = \tilde{q}, \int_{Q_c} [\pi(q - c(\tilde{q})) - R_c] d\mathcal{F}(q) = 0 \right\} \qquad (5)$$

$$\Phi\left(\rho_b^e\right) = \cup_{c(\tilde{q}) \in (0,1)} \Phi\left(c(\tilde{q}), \rho_b^e\right) \qquad (6)$$

then Q_c is optimally selected so as to maximize the measure $\mu_F(\Phi(\rho_b^e))$.

10 Section 6 discusses alternative financial contracts that credit cooperatives can offer to redistribute surplus on an equal treatment basis.

4 Equilibrium Analysis

4.1 Equilibrium Notion

The timing of the model is as follows. First, the distribution of projects $F(q)$ is known to both credit organizations, only credit cooperatives know the realization q before entering the contracting stage. Then, all bank types (commercial banks and cooperatives) decide whether or not to enter the market and simultaneously offer contracts to the entrepreneurs (i.e. no offer corresponds to no entry). All banks hold correct expectations about both their rival's pricing choices and the pool of entrepreneurs who will accept the contract. Entrepreneurs choose whether to implement the project and select the contract that yields the higher expected payoff, agreeing to make repayment subject to their terms. Once contracts are signed, the subset Q_j of funded projects by type j banks take place and each succeeds with own probability q.

Let us restrict the model's parameters $\Gamma = \{F, \pi, R_b, R_c, u_0\}$ to satisfy $R_c + u_0 < \pi$, which creates room for profitable bank-borrower relationships and implies that the set of efficient projects

$$Q^{\star} := \left\{ q : q \geq q^{\star} = \frac{R_b + u_0}{\pi} \right\} \subset Q \tag{7}$$

is non-empty.[11] The following notion of a competitive equilibrium in the presence of redistribution concerns is next adopted:

Definition 1. For given Γ, a competitive equilibrium — denoted $\mathcal{M}(\Gamma)$ — consists of prices $(\rho_c^{\mathcal{M}}, \rho_b^{\mathcal{M}})$, sets $(Q_c^{\mathcal{M}}, Q_b^{\mathcal{M}})$ and share $c^{\mathcal{M}}$ such that:

(i) $\int_{Q_b^{\mathcal{M}}} [\rho_b^{\mathcal{M}} \cdot q - R_b]\ dF(q) = 0$;

(ii) $Q_c^{\mathcal{M}} \in \underset{Q_c \subseteq [c^{\mathcal{M}}, 1]}{\arg\max}\ \mu_F(\Phi(\rho_b^{\mathcal{M}}))$;

(iii) $U(\rho_c^{\mathcal{M}}(q)\,; q \in Q_c^{\mathcal{M}}) = \pi c^{\mathcal{M}}, \quad U(\rho_b^{\mathcal{M}}\,; q \in Q_b^{\mathcal{M}}) = (\pi - \rho_b^{\mathcal{M}})q$;

(iv) $Q_j^{\mathcal{M}} = \left\{ q \middle| U(\rho_j^{\mathcal{M}}\,; q) \geq \max\{u_0, U(\rho_k^{\mathcal{M}}\,; q)\} \right\}, \quad j \neq k \in \{b, c\}$;

11 See the Appendix for a formal definition of the set of efficient projects $Q^{\star}$.

(v) $\mu_F(Q_j^{\mathcal{M}}) > 0, j \in \{b, c\}$.

Part (i) is the expected zero profit condition for the commercial banks. Parts (ii) and (iii) jointly state that the redistribution process undertaken by credit cooperatives must be consistent with their maximal measure objective, cannot violate their balanced budget requirement, and must enforce equal treatment of subscribing entrepreneurs — see Eqs. (4)–(6); whereas uniform pricing within the for-profit sector involves type-increasing utility for their pool of borrowers. Part (iv) stipulates that the allocation of projects to the two types of credit organizations must be consistent with the self selection incentives faced by the entrepreneurs. Notice that the borrower pools $Q_j^{\mathcal{M}}$ served by either type of banks is endogenously determined. We focus attention on competitive equilibria in which both bank types are active in the marketplace and have positive market shares; i.e. the sets $Q_j^{\mathcal{M}}$ must be of non-zero measure — part (v).

4.2 Benchmark Equilibrium

How would credit be allocated in a free entry market populated by for-profit banks only, which compete for investment projects whose quality is entrepreneurs’ private information? Since type-increasing (expected) utility emerge in entrepreneurship relative to a constant outside option — i.e. $U(\rho_b; q)$ increases with q for any given ρ_b — favorable selection occurs, with good entrepreneurs drawing bad ones in (de Meza and Webb 1987).[12] The zero (expected) profit conditions will settle the market (uniform) price consistent with individuals’ sorting into entrepreneurship. A competitive equilibrium is thus a set Q_b^b and a price ρ_b^b such that

$$\int_{Q_b^b} \left[\rho_b^b \cdot q - R_b\right] dF(q) = 0, \quad Q_b^b := \left\{q \in Q : U\left(\rho_b^b; q\right) \geq u_0\right\} \tag{8}$$

12 Favorable selection mechanisms in competitive markets under imperfect information are studied in Black and de Meza (1994) for general risk preferences structures. In particular, the equilibrium studied in Stiglitz and Weiss (1981) is shown to engender overlending under a sufficiently strong degree of absolute risk aversion, whenever expected returns to investment increase with entrepreneurial ability. In a similar vein, de Meza and Webb (2006) provide a formal investigation of conditions for credit rationing to occur, and find them to be rather stringent within standard model setups.

Then the following holds true:

Proposition 1. (D'Amato, Di Pietro, and Sorge 2020). *For any given* Γ, *a unique market equilibrium* (ρ_b^b, Q_b^b) *exists and it entails overlending, i.e.* $Q_b^b = \left[\underline{q}^b, 1\right]$, *with* $\underline{q}^b < q^*$.

A key feature of such 'too much investment' outcome is that all loan applicants endowed with efficient projects are approved and thus can start their own ventures. Which role, if any, may then redistribution-concerned credit organizations play in market environments in which no rationing occurs, and where their for-profit peers operate in the absence of market power? We address this question in the next section.

5 Competitive Equilibrium in Mixed Credit Markets

The peculiar nature of credit cooperatives as redistribution-concerned, size-maximizing institutions identifies a particular trade-off between the opportunity of attracting higher quality projects in order to generate larger project-specific revenues and the ability of sustaining the extreme form of cross-subsidization (i.e. equal treatment) that cooperatives enforce. In fact, the amount of aggregate surplus which stands available for redistribution crucially depends both on the number of served entrepreneurs and on the share of surplus that credit cooperatives decide to retain on each individual project: granting a sufficiently low price $\rho_c(q)$ on a given project $q \in Q$ may help increase the number of their clients, and yet prevent them from collecting sufficient surplus to meet the balanced-budget requirement.

The occurrence of market competition with for-profit (uninformed) banks complicates the picture. Recall that this type of credit organization is bound to offer uniform price contracts, which engender a positive relationship between the quality of the funded project and the (expected) utility of the relative entrepreneur. To attract the upper end of the quality distribution, which helps meet the redistribution constraint (all else equal, the higher the quality of a given project the higher the associated expected surplus), credit cooperatives must commit to increase rents to all of their members, which is potentially in conflict both with running a balanced budget and with maximizing the size of the pool of served entrepreneurs.

Since both the surplus share c and the revenues on the highest quality project served are increasing in $\tilde{q}$, cherry picking from the upper end of the quality distribution may either facilitate or hinder the achievement of the maximum measure objective, provided it fulfills the balanced-budget requirement.[13] In any event, whenever the price charged by for-profit banks is sufficiently low, the cooperatives cannot profitably enter any segment of the market, as stated in the following

Lemma 1. *If a competitive equilibrium $\mathcal{M}(\Gamma)$ exists, then it must feature $\rho_b^{\mathcal{M}} > R_c$.*

Proof. See the Appendix. □

Notice that, consistent with self selection incentives of entrepreneurs, credit cooperatives can only raise surplus over the interval $[c, \tilde{q}]$. Hence, while any project involves a constant cost of funding R_c, expected revenues per project are nondecreasing in $q \in Q_c$ for any given share c. As a major consequence, Q_c is strictly convex and uniquely determined by its supremum $\tilde{q}$[14]. The following indeed holds true:

Lemma 2. *In any equilibrium $\mathcal{M}(\Gamma)$, $Q_c^{\mathcal{M}} \subseteq [c^{\mathcal{M}}, \tilde{q}^{\mathcal{M}}]$ is a convex set, where $\tilde{q}^{\mathcal{M}} \leq 1$ satisfies $U(\rho_b^{\mathcal{M}}; \tilde{q}^{\mathcal{M}}) = \pi c^{\mathcal{M}}$.*

Proof. See the Appendix. □

Notice that, whenever credit cooperatives aim at serving higher quality projects, a larger fraction of the return on investment π must be granted to $q \in Q_c$. As a result, different forms of market separation and/or different market shares within the same segmentation can in principle be supported at equilibrium.

We next provide a number of important insights into the distinctive (necessary) features of competitive equilibria and the potential for equilibrium multiplicity in our model:

Proposition 2. *For any given Γ*

(i) *There exists no equilibrium in which $Q_b^{\mathcal{M}} = [\tilde{q}^{\mathcal{M}}, 1]$;*

(ii) *If an equilibrium exists with $\tilde{q}^{\mathcal{M}} < 1$ and $c^{\mathcal{M}} = \min(Q_c^{\mathcal{M}})$, then $Q_b^{\mathcal{M}}$ is disconnected, i.e.*

$$Q_b^{\mathcal{M}} = \left[\underline{q}^{\mathcal{M}}, c^{\mathcal{M}}\right) \cup \left[\tilde{q}^{\mathcal{M}}, 1\right]$$

13 For given $q \in Q_c$, profits of cooperatives evaluated at $q = \tilde{q}$ reduce to $\rho_b \cdot \tilde{q} - R_c$, and hence increase with $\tilde{q}$.

14 This follows readily from the equivalence between maximizing the measure $\mu_F(Q_c)$ under full redistribution, and maximizing expected revenues over Q_c.

where $\underline{q}^{\mathcal{M}}$ *is the marginal entrepreneur for whom* $U\left(\rho_b^{\mathcal{M}}; \underline{q}^{\mathcal{M}}\right) = u_0$*;*

(iii) *If an equilibrium* $\mathcal{M}(\Gamma)$ *exists, then it entails overlending;*

(iv) *Let* $\mathcal{M}(\Gamma)$ *and* $\widehat{\mathcal{M}}(\Gamma)$ *denote any two distinct equilibria. Then* $c^{\mathcal{M}} \neq \widehat{c}^{\mathcal{M}}$ *only if* $\rho_b^{\mathcal{M}} \neq \widehat{\rho}_b^{\mathcal{M}}$.

Proof. See the Appendix. □

Part (i) states that, in the presence of redistribution concerns, no vertical separation of borrowers can emerge in which for-profit banks attract high-quality projects with redistribution-concerned ones covering the residual. Put simply, redistribution across entrepreneurs endowed with low-quality projects is too costly for credit cooperatives, for any cost gap R_c/R_b. Conversely, if a competitive equilibrium exists where the best entrepreneurs — the 'peaches' — accept the pooling contract offered by for-profit banks, then low-quality entrepreneurs — the 'lemons' — will follow suit (part [ii]). A fundamental disconnection in the market configuration then emerges, according to which credit cooperatives serve and redistribute over projects of intermediate quality. Most notably, whatever segmentation is produced at equilibrium, aggregate investment will necessarily exceed the efficient level, as uninformed banks will retain a positive share of loans to entrepreneurs — part (iii).

The potential for multiple equilibria in the presence of redistribution concerns lies in the fact that a varying amount of redistribution from high- to low quality projects induced by uniform pricing from their for-profit competitors alters the amount of redistribution that is feasible for the cooperatives and yet does not violate their balanced budget requirement. As a consequence, different shares c, each consistent with equal treatment, are in principle enforceable in equilibrium. In this respect, part (iv) of Proposition 2 points out that, for any price charged by for-profit banks, there exists at most one c which is measure-maximizing in a full redistribution setup.

Based on the previous observations, we are ready to establish an equilibrium existence result:

Proposition 3. *For any given* Γ*, let* $\mathbb{E}[Q] = \int_Q q dF(q)$ *denote the unconditional mean of the quality distribution. Then an equilibrium* $\mathcal{M}(\Gamma)$ *exists if the following conditions are fulfilled:*

$$R_c < \pi - \sqrt{\pi u_0} \tag{9}$$

$$\mathbb{E}[Q] \geq 1 + \frac{R_c}{\pi} - \frac{R_b}{\sqrt{\pi u_0}} \tag{10}$$

$$\mathbb{E}\left[q \middle| q \in \left[\frac{u_0}{\pi - R_c}, \frac{\pi - R_c}{\pi}\right]\right] \geq \frac{R_b}{R_c} \tag{11}$$

Proof. See the Appendix. □

All of the conditions of Proposition 3 have a rather intuitive interpretation. Condition (9) is needed to allow credit cooperatives to profitably enter the marketplace, for it constrains the extent of their cost disadvantage vis-à-vis for-profit banks. Condition (10) reflects the fact that better investment perspectives, as summarized in the quality distribution F, entail a larger degree of over-lending in a world populated by for-profit lenders only — a simple corollary of Proposition 1; all else equal, this makes entry by credit cooperatives more likely to occur, provided the return on investment projects (π) is sufficiently large relative their cost of funding (R_c) and the entrepreneurs' outside option (u_0). Finally, condition (11) ensures that entry by both bank types is mutually consistent.

We shall observe that if all the conditions of Proposition 3 hold, and the density function $f(q)$ further complies with a given monotonicity restriction, then the resulting competitive equilibrium is fully characterized as producing vertical separation of the market for investment projects, with top quality entrepreneurs being attracted by the credit cooperatives and the residual segment covered by for-profit banks. A direct implication of this result is that equilibrium existence, as a property of our model for a given parameterization Γ, will be retained by all other distributions $\tilde{F}$ fulfilling a set of stochastic ordering restrictions, keeping all the other parameters fixed. Formally

Corollary 1. *For any given* Γ, *let the conditions in Proposition 3 be fulfilled.*

(i) *If, in addition, it holds* $f'(q) \geq 0$ *for all* $q \in (0,1)$, *then all competitive equilibria* $\mathcal{M}(\Gamma)$ *feature vertical separation, i.e.*

$$\tilde{q}^{\mathcal{M}} = 1, \quad Q_c^{\mathcal{M}} = \left[c^{\mathcal{M}}, 1\right], \quad Q_b^{\mathcal{M}} = \left[\underline{q}^{\mathcal{M}}, c^{\mathcal{M}}\right);$$

(ii) *A competitive equilibrium* $\mathcal{M}(\tilde{\Gamma})$ *will exist for any* $\tilde{\Gamma} = \{\tilde{F}, \pi, R_b, R_c, u_0\}$ *if* $\tilde{F}$ *satisfies*

$$\tilde{F} \succcurlyeq_{FOSD} F \quad \cup \quad \frac{\int_{Q^+} q dF(q)}{\int_{Q^+} q d\tilde{F}(q)} \leq \frac{\mu_F(Q^+)}{\mu_{\tilde{F}}(Q^+)} \tag{12}$$

where $Q^+ := \left[\frac{u_0}{\pi - R_c}, \frac{\pi - R_c}{\pi}\right] \subset Q$.

Proof. See the Appendix. □

Intuitively, non-decreasing density in the population of entrepreneurs forces measure maximizing credit entities to target the upper end of the quality distribution. As a simple example, assume quality is uniformly distributed over the unit interval, i.e. $q \sim \mathcal{U}[0,1]$. Then a competitive equilibrium with vertical separation obtains when e.g. $\Gamma = \{F, \pi, R_b, R_c, u_0\} = \{\mathcal{U}, 12.5, 1.6, 6, 0.2\}$. By virtue of Corollary 1 part (ii), equilibrium existence would be preserved under the same model's parameterization when the distribution of quality is e.g. beta with shape parameters $\alpha = 5$ and $\beta \in (0,1)$.[15]

When an equilibrium with both credit organizations can be supported, market failures caused by informational asymmetries will necessarily be mitigated, for the degree of overlending is bound to shrink relative to the benchmark outcome. Intuitively, when redistribution-concerned institutions are operative in the marketplace, rents from profitable borrowers are reduced, and so is the ability of their for-profit peers to cross subsidize (via uniform pricing) within the pool of their clients; this in turn weakens the favorable selection effect, driving entrepreneurs of the lowest quality out of the market. Formally

Proposition 4. *For given* Γ, *in any equilibrium* $\mathcal{M}(\Gamma)$ *it holds*

$$\min\left(Q_b^b\right) < \min\left(Q_b^{\mathcal{M}} \cup Q_c^{\mathcal{M}}\right) < q^\star$$

Proof. See the Appendix. □

6 Robustness

6.1 Heterogeneity of Credit Organizations

Either kind of credit organization in our model values loans to entrepreneurs in a risk neutral way, yet they explicitly differ in terms of refinincing costs and available information at the contractual stage. Specifically, credit cooperatives enjoy an informational advantage (they have perfect information about entrepreneurial types) over their for-profit peers, while facing a higher funding cost per loan (i.e. $R_c > R_b$). Such a cost disadvantage may be due to an unbalanced access to different sources of funding (e.g. deposits versus wholesale debt or bonds issued on international financial markets), heterogeneity in underwriting costs, varying costs for asset holdings and collateral-based loans from central banks (as occurs in e.g. the euro area) or rather to the peculiar cooperative feature of gathering information on

15 We remark that under such a parameterization the inequalities (10) and (11) are strict; by force of continuity, and keeping the quality distribution fixed, small perturbations around the chosen parameter values will retain existence of the competitive equilibrium.

opaque projects vis-à-vis universal banks' specialization on providing ancillary services to fund owners. As discussed in the Background Section, there exists an extensive literature exploring the reasons why lenders may specialize in different tasks and operate their business more on relational lending rather than on anonymous trade (see for example, Berger and Udell 1995; Guinnane 2002).

Assuming $R_c \leq R_b$ in the model would grant credit cooperatives an overwhelming advantage in terms of both information and cost. If these credit organizations were pure profit-seeking entities, they would capture all the efficient borrowers and thereby force their imperfectly informed, high-cost competitors out of the market.[16] In principle, the presence of redistribution concerns and of the maximal coverage objective may still sustain competitive equilibria in which uninformed, high-cost banks retain a positive market share; intuitively, given the equal treatment principle they enforce, credit cooperatives may optimally decide to refrain from offering debt contracts to top quality entrepreneurs, which would self-select into the credit relationship with for-profit banks, as it engenders type-increasing expected utility. Being able to attract efficient projects, for-profit banks would in turn be able to break even on a pool formed by good and bad entrepreneurs, provided the cost gap R_b/R_c is not too large. In this very specific situation, credit cooperatives would find themselves enforce surplus sharing across projects of intermediate quality — see Proposition 2, part (ii).

Let us first consider the case $R_c = R_b$. It is easy to see that there cannot be any competitive equilibrium with vertical separation where for-profit banks attract the most capable while coops attract less capable entrepreneurs: the competitive equilibrium (if it exists) either is in the disconnected form described above, or rather complies with the vertical separation result emphasized in D'Amato, Di Pietro, and Sorge (2020) (cooperatives above, for-profit banks below). Further decreasing R_c strictly below R_b would all else equal definitely push up the measure of the pool of entrepreneurs served by the cooperatives, possibly causing a new market configuration to replace a former one: in fact, the specific way cooperative banks will decide to use this extra surplus under equal treatment depends on the underlying probability distribution of quality. In the market disconnection case, it might induce coops to target higher quality projects or, in the opposite case, to start serving low-quality ones. As a consequence, when R_c falls to a sufficient extent, the disconnected form vanishes, and a new equilibrium separation of the market might arise, where for-profit banks find themselves at the top end of the quality spectrum with coops covering the residual. In the vertical separation case, a falling R_c induces coops to extend their offers to inferior quality projects. This would at

16 This is an immediate implication of the analysis conducted in D'Amato, Di Pietro, and Sorge (2020).

some point result in the competition for borrowers being unsustainable for the type of credit institution facing a double disadvantage: perfectly informed, low-cost credit cooperatives would then become the sole external financiers active in the market.

6.2 Financial Contracts

Our analysis of mixed credit markets abstracts from characterizing *optimal* financial arrangements: the only possible contracts between borrowers and lenders are either pure debt with fixed repayment (for-profit banks) or a debt contract with type-dependent repayments enforcing equal treatment (cooperative banks). As argued, this working assumption allows us to highlight what we consider the two essential features of a cooperative credit institutions: mutualistic statutory objectives and their informational advantage. The two aspects are separated in our analysis in the sense that we only allow redistribution concerns within the cooperative banks to interact with the features of the credit relationship only through the budget constraints and not the terms of the contract which, also in the case of a cooperative credit institution is taken to be a standard debt contract (more details on this point below). Faced with the alternative of choosing between a mutualistic credit institution and a standard commercial bank the entrepreneurs, in our model, choose between contracts with similar features issued by the two lenders. Only the terms of the contract (the interest rate) can differ. This assumption is made to simplify the analysis of the competitive forces emerging in mixed environments and their role in shaping the market equilibrium configuration.

Careful scrutiny of the literature on *ex ante* informational asymmetries suggests that confining attention to entrepreneurs raising outside finance rather than issuing equity is less restrictive than it may appear. In fact, de Meza and Webb (1987) as well as subsequent work (e.g. Innes 1993) have already shown that in asymmetric information models of credit markets in which entrepreneurial returns are ranked by increasing (expected) returns, the equilibrium requires that all ventures be debt financed. For example, in a model related to our banks-only setting, Boadway and Keen (2006) show that screening is prevented in the presence of inside equity on the part of entrepreneurs, for a pooling equilibrium always occurs as the only admissible outcome. This result carries over to more general settings in which investment projects feature variable size, and project returns increase with their own size, provided entrepreneurs differ by their probability of success, as our model assumes; under a mild monotonicity condition on the lenders' payoff function, debt financing also emerges as the unique equilibrium contractual form when allowing for arbitrary distributions of returns to entrepreneurial ventures (Innes 1993).[17]

It is in general true that, by conditioning financial contracts on some observables (e.g. collateral, inside equity, size of the investment) or alternatively envisioning a collective, incentive-compatible lending mechanism (e.g. Daripa 2008) would allow forms of screening of entrepreneurial types (e.g. through borrowers' self-revealing choices from the menu of offered contracts), and it would reduce or, under certain conditions, even eliminate inefficiencies arising from informational frictions. However, to the extent that cross subsidization among projects is a feature of the equilibrium contract, the basic point we raise in our model would still hold, i.e. that the inclusion in the analysis of better informed banks (here, credit cooperatives) will impact the specific features of cross-subsidizing debt contracts (in our case the amount of overlending).

There in principle exist alternative deals that credit cooperatives can offer in order to equally redistribute surplus over their client base while standing on a clear path to budget balance. In general, by virtue of the risk-neutrality assumption, any arrangement entailing cross subsidies and/or unconditional transfers that provide entrepreneurs with a constant level of utility πc would do the job. One of such surplus-sharing contract — let us call it S_c^q — stipulates the following: entrepreneurs are granted πc for some share $c \in (0,1)$ *whatever the underlying state* — that is, $S_c^q(0) = S_c^q(\pi) = \pi c$ for all $q \in Q_c$ — in exchange for the residual claim to the net project's return — that is, $\pi(1-c)$.[18]

Under the specified conditions, the cooperatives' budget would read as

$$\int_{\widehat{Q}_c} (\pi(1-c)q - \pi c(1-q) - R_c)dF(q) = \int_{\widehat{Q}_c} (\pi q - (\pi c + R_c))dF(q) \tag{13}$$

where $\widehat{Q}_c \subseteq Q$ is the set of signing entrepreneurs. Notice that (13) is in the same form as the one dictated by the debt contract with price $\rho_c(q)$ i.e.

$$\int_{Q_c} (\rho_c(q) \cdot q - R_c)dF(q) = \int_{Q_c} (\pi(q-c) - R_c)dF(q) \tag{14}$$

and yet Q_c is possibly different from $\widehat{Q}_c$ because of the restriction $\rho_c(q) \geq 0$. In fact, the arrangement S_c^q involves subsidizing the cooperatives' members (also) in the bad state of the world, while placing no restriction on the set of entrepreneurs

17 In Stiglitz and Weiss (1981)'s framework, where risky projects are modeled as a mean preserving spread on the safe ones, it is assumed that uninformed banks lend trough a standard debt contract. Williamson (1987) shows that in a costly state verification environment, credit rationing may be an equilibrium, and the debt contract does arise as the optimal financial contract.

18 We thank the Reviewer for pointing this out.

participating in the credit relationship: credit cooperatives can serve as a source of financing for entrepreneurial ventures of inferior quality $q < c$, who are expected negative contributors to the aggregate cooperative surplus; both of these features (positive payments to all failed entrepreneurs and negative contributions from some of the subscribing entrepreneurs) are precluded in our environment where standard (unsecured) debt contracts are traded.

For the purpose of our analysis, let us assume here that credit cooperatives offer the surplus-sharing contract S_c^q. Then

Definition 2. A competitive equilibrium consists of a price $\rho_b^{\mathcal{M}}$, a share $c^{\mathcal{M}}$ and sets $(\widehat{Q}_c^{\mathcal{M}}, \widehat{Q}_b^{\mathcal{M}})$ such that

(i) $\int_{\widehat{Q}_b^{\mathcal{M}}} [\rho_b^{\mathcal{M}} \cdot q - R_b] dF(q) = 0$;

(ii) $\widehat{Q}_c^{\mathcal{M}} \in \arg \max \mu_F(\widehat{Q}_c), \quad \widehat{Q}_c \subseteq Q$;

(iii) $U(\pi c^{\mathcal{M}}; q \in \widehat{Q}_c^{\mathcal{M}}) = \pi c^{\mathcal{M}}, \quad U(\rho_b^{\mathcal{M}}; q \in \widehat{Q}_b^{\mathcal{M}}) = (\pi - \rho_b^{\mathcal{M}}) q$;

(iv) $\widehat{Q}_b^{\mathcal{M}} = \left\{ q \middle| U(\rho_b^{\mathcal{M}}; q) \geq \max\left\{u_0, \pi c^{\mathcal{M}}\right\}\right\}$;

(v) $\widehat{Q}_c^{\mathcal{M}} = \left\{ q \middle| U(\pi c^{\mathcal{M}}; q) \geq \max\left\{u_0, (\pi - \rho_b^{\mathcal{M}}) q\right\}\right\}$;

(vi) $\mu_F(\widehat{Q}_j^{\mathcal{M}}) > 0, \quad j \in \{b, c\}$.

We start noticing that studying setup in which credit cooperatives offer the surplus-sharing arrangement S_c^q rather than the debt contract D_c^q is equivalent (up to features of market outcomes) to removing the restriction $\rho_c(q) \geq 0$. Since the price function $\rho_c(q)$, whether positive or negative, proves strictly increasing over Q, the content of Lemma 2 carries over to the set $\widehat{Q}_c$, which must be then convex in any competitive equilibrium; under any admissible model's parameterization (in particular, the assumed cost disadvantage for the cooperatives) it is then easy to establish the following:

Proposition 5. *For any given* Γ

(i) There exists no competitive equilibrium with vertical separation in which for-profit banks attract the top end of the quality distribution;

(ii) Any competitive equilibrium entails overlending;

(iii) A competitive equilibrium exists if the model's parameters fulfill the very same conditions (9), (10) *and* (11) *stated in* Proposition 3.

Proof. See the Appendix. □

Proposition 5 allows us to argue that lifting the debt financing assumption does not affect the main findings of our analysis (about e.g. the conditions for existence of competitive equilibria in mixed credit markets and the nature of the associated market failure); yet, it may alter their interpretation in terms of e.g. the mitigating role played by cooperatives in otherwise standard markets with imperfect information (as discussed next).

We would finally like to emphasize that a competitive equilibrium with analogous features would also arise in a more sophisticated setting where imperfectly informed banks are allowed to invest in a screening, quality-revealing technology and yet the cost of acquiring information is so high as to induce banks to rather pool all entrepreneurs together with a uniform debt contract (e.g. Gormley 2014). Even in that case, relative to the efficient allocation, over-provision of credit to low-quality, inefficient projects would be enforced in equilibrium.

6.3 Coops-Only World and Market Failures

One of our main results concerns the mitigation of excessive lending due to the coexistence of credit cooperatives and for-profit banks, as opposed to a world populated by equally uninformed, profit-seeking banks whose uniform price contract pools efficient and inefficient types together. This suggests that cooperatives have a potential role in mitigating market failures.

We next show that, while the emergence of financial NPOs in a world of for-profit banks never produces an expansion of credit to riskier borrowers, the introduction of imperfectly informed, for-profit competitors into a market reserved for credit cooperatives may under some circumstances *increase*, rather than decrease, the intensity of excessive lending. And more generally, this prediction is ambiguous, for it depends on the specific parameterization of the model.

To see this, let us first explore the nature of equilibrium in a world made by credit cooperatives only, that offer the surplus-sharing debt contract D_c^q described above and raise funds at the cost R_c (without loss of generality we let this latter equal the socially efficient one). A coops-only equilibrium consists of a set Q_c°, a non-negative price $\rho_c^\circ(q) = \pi\left(1 - \frac{c^\circ}{q}\right)$ and a share $c^\circ \in (0,1)$ such that

(i) $Q_c^\circ \in \arg\max \mu_F(Q_c)$ s.t. $\int_{Q_c^\circ} (\rho_c^\circ(q) \cdot q - R_c) dF = 0$;

(ii) $U(\rho_c^\circ(q); q \in Q_c^\circ) = (\pi - \rho_c^\circ(q)) \cdot q = \pi c^\circ$;

(iii) $Q_c^\circ = \{q \in [c^\circ, 1] \,|\pi c^\circ \geq u_0\}$.

We next show that a coops-only equilibrium (i) always exists and (ii) it does not necessarily generate over-lending. First, notice that in any coops-only equilibrium Q_c° must be a convex set with $\max(Q_c^\circ) = 1$. Suppose not, then it must be the case that $Q_c^\circ = Q_c^{'} \cup Q_c^{''}$ where:

$$cl\left(Q_c^{'}\right) \cap cl\left(Q_c^{''}\right) = \emptyset \tag{15}$$

$$\int_{Q_c^{'}} [\rho_c^\circ(q)q - R_c]dF(q) > 0 \tag{16}$$

$$\int_{Q_c^{''}} [\rho_c^\circ(q)q - R_c]dF(q) < 0 \tag{17}$$

Then there exists an $Q_c^{'''}$ such that $\mu_F(Q_c^{'''}) = \mu_F(Q_c^{''})$ and:

$$cl\left(Q_c^{'''}\right) \cap cl\left(Q_c^{'}\right) = \{q\} \tag{18}$$

$$\int_{Q_c^{'} \cup Q_c^{'''}} [\rho_c^\circ(q)q - R_c]dF(q) > 0 \tag{19}$$

This in turn implies that there exists a nonzero measure set $\overline{Q}_c$ such that

$$\int_{Q_c^{'} \cup Q_c^{'''} \cup \overline{Q}_c} [\rho_c^\circ(q)q - R_c]dF(q) = 0 \tag{20}$$

$$\mu_F\left(Q_c^{'''} \cup \overline{Q}_c\right) > \mu_F\left(Q_c^{''}\right) \tag{21}$$

which contradicts the fact that Q_c° is measure-maximizing. Hence, Q_c° must be convex to be part of a market equilibrium. By the same token, since for any $Q_c \subset Q$ one has

$$\begin{aligned}\int_{\min(Q_c)}^{1} (\rho_c(q)q - R_c)dF(q) &= \int_{\min(Q_c)}^{1} (\pi(q-c) - R_c)dF(q)\\ &\geq \int_{Q_c} (\pi(q-c) - R_c)dF(q)\\ &= \int_{Q_c} (\rho_c(q)q - R_c)dF(q)\end{aligned}$$

any Q_c with $\max(Q_c) < 1$ cannot be measure-maximizing for the coops: there exists room for boosting membership by raising surplus from the best entrepreneurs.

Second, notice that for any $c \geq u_0/\pi$ entrepreneurs prefer the cooperative contract over their outside option, yet only entrepreneurs with projects of sufficiently high quality $q \geq c$ will receive an offer. An immediate consequence is that full market participation can never occur. Furthermore, it is straightforward to show that a coops-only equilibrium is always supported by any set of parameters (F, π, R_c, u_0).

To this end, let us denote the least efficient project as $q^\star = \frac{u_0+R_c}{\pi}$. Consider first the case where the unconditional average quality project $\mathbb{E}[Q] = \int_Q q dF(q)$ is inefficient, i.e. if $\mathbb{E}[Q] < q^\star$, then pricing at $\rho_c^\circ = \pi\left(1 - \frac{u_0}{\pi q}\right)$ for $c^\circ = \frac{u_0}{\pi}$ delivers an equilibrium with $Q_c^\circ = [q_c^\circ, 1]$ with q_c° solving

$$\int_{q_c^\circ}^{1} [\rho_c^\circ(q) \cdot q - R_c] dF(q) = \int_{q_c^\circ}^{1} [\pi q - (u_0 + R_c)] dF(q) = 0 \tag{22}$$

or equivalently

$$\mathbb{E}[q | q \in [q_c^\circ, 1]] = q^\star \tag{23}$$

if and only if $\mathbb{E}\left[q | q \in \left[\frac{u_0}{\pi}, 1\right]\right] \geq q^\star$ (if equality holds, then $q_c^\circ = c^\circ$). In words, when the average project is of sufficiently low quality, cooperatives can offer the highest price $\rho_c^\circ(q)$ (or equivalently, the lowest surplus share c°) consistent with participation of both efficient and inefficient entrepreneurs into the credit relationship; notice that $q_c^\circ \geq \frac{u_0}{\pi}$ implies $\rho_c^\circ(q) \geq 0$ for all $q \in Q_c^\circ$, while the balanced-budget Eq. (23) suggests that $q_c^\circ < q^\star$ (over-lending).

Consider now the case where $\mathbb{E}\left[q | q \in \left[\frac{u_0}{\pi}, 1\right]\right] > q^\star$ (and *a fortiori* where $\mathbb{E}[Q] \geq q^\star$). Then c° — and thereby $\rho_c^\circ(q)$ and $Q_c^\circ = [c^\circ, 1]$ — is determined by the balanced-budget equation

$$\int_{c^\circ}^{1} [\rho_c^\circ(q) \cdot q - R_c] dF(q) = \int_{c^\circ}^{1} [\pi(q - c^\circ) - R_c] dF(q) = 0 \tag{24}$$

or equivalently

$$\mathbb{E}[q | q \in [c^\circ, 1]] = c^\circ + \frac{R_c}{\pi} \tag{25}$$

Notice that such a c° always exists by continuity of the conditional expectation operator and the limiting behavior of the left- and right-hand side of (25) when $c^\circ \to \frac{u_0}{\pi}$ and $c^\circ \to 1$; it also is unique.[19] The key point here is that, conditional on the selection (F, π, R_c, u_0), the coops-market equilibrium can entail either over- or under-provision of credit, or even entail the socially efficient level of investment. To show this, let us take quality to be uniformly distributed on the unit support Q; when parameters are such that

19 There can be in principle more than one solution to (25), depending on the properties of the distribution F. Yet only the smallest of them can be part of a coops-only equilibrium, for it entails the maximal measure for Q_c°.

$$\mathbb{E}\left[q\middle|q \in \left[\frac{u_0}{\pi}, 1\right]\right] = \frac{1}{2} + \frac{u_0}{2\pi} > \frac{R_c + u_0}{\pi} = q^\star \tag{26}$$

relation (25) is the relevant one to pin down the share $c^\circ > \frac{u_0}{\pi}$, delivering

$$\frac{1 + c^\circ}{2} = c^\circ + \frac{R_c}{\pi} \quad \Leftrightarrow \quad c^\circ = 1 - 2\frac{R_c}{\pi} \tag{27}$$

thus over-lending would require

$$c^\circ \in \left(\frac{u_0}{\pi}, q^\star\right) \quad \Leftrightarrow \quad \pi \in (u_0 + 2R_c, u_0 + 3R_c) \tag{28}$$

Hence, under-investment can occur in such a coops-only world when the projects' return π is sufficiently high relative to cooperatives' funding cost R_c, all else equal.[20]

Finally, let us explore the the case where credit cooperatives offer the above described surplus-sharing arrangement S_c^q rather than the debt contract D_c^q. Recall that in this case a coops-only equilibrium would be characterized by the following

(i) $\widehat{Q}_c^\circ \in \arg\max \mu_F(\widehat{Q}_c)$ s.t. $\int_{\widehat{Q}_c^\circ} (\pi q - (\pi c + R_c))dF(q) = 0$;
(ii) $U(\pi c^\circ; q \in \widehat{Q}_c^\circ) = \pi c^\circ$;
(iii) $\widehat{Q}_c^\circ = \{q \in Q | \pi c^\circ \geq u_0\}$.

Notice that $q < c^\circ$ can belong to $\widehat{Q}_c^\circ$ (as it would occur if $\rho_c(q)$ were allowed to be negative). If the unconditional average quality project is efficient, i.e. if $\mathbb{E}[Q] \geq q^\star$, then full market coverage $\widehat{Q}_c^\circ = Q$ arises with $c^\circ \geq \frac{u_0}{\pi}$.[21] This is of course an instance of over-lending.

In any other equilibrium with partial coverage, a convex $\widehat{Q}_c^\circ = \left[\underline{q}^\circ, 1\right] \subset Q$ of course maximizes participation when $c^\circ = \frac{u_0}{\pi}$. Again, over-lending is bound to arise. Suppose not, i.e. suppose $q^\star < \underline{q}^\circ$. Then by the balanced budget constraint one has

$$\begin{aligned}\int_{q^\star}^{1} (\pi q - u_0 - R_c)dF(q) &< \int_{\underline{q}^\circ}^{1} (\pi q - u_0 - R_c)dF(q) \\ &= \int_{\underline{q}^\circ}^{1} (\pi(q - c^\circ) - R_c)dF(q) = 0\end{aligned}$$

20 In the knife-edge case $\pi = u_0 + 3R_c$, the coops-only equilibrium would reproduce the efficient allocation of credit, and successful operation of both credit organizations would therefore cause market failures.

21 Equality obtains if and only if $\mathbb{E}[Q] = q^\star$; otherwise, balancing the budget requires increasing the surplus share c which is left to entrepreneurs by the terms of contract.

from which one has $\mathbb{E}[q|q \in [q^\star, 1]] < q^\star$, which cannot hold true. It can be also shown that $\underline{q}^\circ < \underline{q}^b$, where $\underline{q}^b$ is the lower bound of the pool Q^b that would be served in for-profit banks-world only, where funds can be raised at cost $R_b = R_c$ (so that the efficient threshold $q^\star$ stays the same between the setups); in fact, recalling that in the banks-only equilibrium it holds $\rho_b^b \cdot \mathbb{E}\left[q \middle| q \in \left[\underline{q}^b, 1\right]\right] = R_b$ (see Proposition 1), one has

$$\underline{q}^b \leq \underline{q}^c \quad \Rightarrow \quad \mathbb{E}\left[q \middle| q \in \left[\underline{q}^b, 1\right]\right] < q^\star \quad \Rightarrow \quad \rho_b^b > \frac{R_b}{q^\star} \tag{29}$$

and since $\underline{q}^b = \frac{u_0}{\pi - \rho_b^b}$ one has

$$\underline{q}^b = \frac{u_0}{\pi - \rho_b^b} > \frac{u_0}{\pi - \frac{R_b}{q^\star}} = q^\star > \underline{q}^\circ \tag{30}$$

i.e. a contradiction. As a result, *a coops-only world in which the contract S_c^q is traded always generates a higher degree of over-lending than the corresponding banks-only environment*. It follows that mixed credit markets, in which both types of credit organizations co-exist, necessarily entail a reduction in excess lending relative to either of the two worlds. As mentioned above, this prediction is not warranted when the debt contracts D_c^q are traded instead.

7 Concluding Remarks

Credit cooperatives have been remarkably resilient in advanced market economies, to a much greater extent than has been suggested in the literature. The present paper investigates the operation of mixed credit markets, in which redistribution-concerned financial cooperatives compete vis-à-vis pure for-profit banks for heterogeneous quality projects. The theory developed here is the first, to the best of our knowledge, to investigate competition in terms of credit contracts enforcing distinct mechanisms of cross subsidization among borrowers, which naturally reflect both market forces (borrowers' selection under imperfect information) and explicit institutional features (concerns for surplus redistribution).

Two main findings stand out. First, a variety of market outcomes — in terms of overall market coverage and credit volumes — can obtain in equilibrium. In particular, competition for loans need not result in 'cherry-picking' by better informed institutions but might rather induce a fundamental disconnection in the allocation of credit, according to which for-profit lenders attract both 'peaches' and 'lemons', with average quality (efficient) projects being funded by redistribution-concerned cooperatives. Second, by tilting the allocation of rents from profitable borrowers, competition in mixed markets of the kind investigated herein naturally produces a contraction in inefficient credit provision, thereby mitigating market failures. Importantly, the viability of financial NPOs is shown not to necessarily rest on under-investment issues and/or concerns about market power, for they can successfully enter the marketplace and operate even in a world with too much investment.

Credit market failures generated by inefficient pooling of heterogeneous investment projects typically demand corrective policies. Our analysis shows that mixed credit markets, in which investment projects differ in their probability of success only and thus are ranked by increasing expected returns, are unambiguously characterized by more investment than is efficient, whereas credit rationing never occurs. A direct implication for policy is that taxing financial institutions, rather than publicly subsidizing entrepreneurs, will drive the market outcome closer to its efficient counterpart.

Similar to de Meza and Webb (1987), whatever the distribution of entrepreneurs' characteristics in population, the uniform price charged by for-profit banks (i) determines the least quality project being funded in equilibrium, and (ii) acts as sorting device insofar as lemony entrepreneurs will increasingly withdraw from the market as this price increases. As a consequence, an interest rate ceiling (e.g. usury laws) is bound to generate adverse effects, for it can cause the market to collapse.

Appendix

Set of Efficient Projects $Q^\star$

Assume $q \in Q$ is publicly observable. Then the aggregate surplus in the credit market at the lowest possible cost of funding R_b is given by $\int_Q [(\pi q - R_b)I(q) + u_0(1 - I(q))]dF(q)$, where $I(q) = 1$ for entrepreneurs $q \in Q$ entering the market and $I(q) = 0$ otherwise. Maximizing this function over $I(q) = \{0,1\}$ delivers $Q^\star$.

Proof of Lemma 1

Let $I_{\rho_b} = \{(c, \tilde{q}) | (\tilde{q} - c)\pi > R_c\}$ denote the set of contracts that entrust credit cooperatives with strictly positive surplus on project $\tilde{q} \le 1$, when their for-profit peers price at ρ_b. When $\rho_b < R_c$, it holds $\tilde{q} - c = \frac{\rho_b}{\pi}\tilde{q} < \frac{R_c}{\pi}\tilde{q} \le \frac{R_c}{\pi}$, and I_{ρ_b} is empty.

Proof of Lemma 2

Here we show that the equilibrium set $Q_c^{\mathcal{M}}$ is a convex set. Suppose not, then it must be the case that $Q_c^{\mathcal{M}} = Q_c^{'} \cup Q_c^{''}$ where:

$$cl\left(Q_c^{'}\right) \cap cl\left(Q_c^{''}\right) = \emptyset \tag{31}$$

$$\int_{Q_c^{'}} [\rho_c(q)q - R_c]dF(q) > 0 \tag{32}$$

$$\int_{Q_c^{''}} [\rho_c(q)q - R_c]dF(q) < 0 \tag{33}$$

Then there exists an $Q_c^{'''}$ such that $\mu_F(Q_c^{'''}) = \mu_F(Q_c^{''})$ and:

$$cl\left(Q_c^{'''}\right) \cap cl\left(Q_c^{'}\right) = \{q\} \tag{34}$$

$$\int_{Q_c^{'} \cup Q_c^{'''}} [\rho_c(q)q - R_c]dF(q) > 0 \tag{35}$$

This in turn implies that there exists a nonzero measure set Q_c° such that

$$\int_{Q_c^{'} \cup Q_c^{'''} \cup Q_c^{\circ}} [\rho_c(q)q - R_c]dF(q) = 0 \tag{36}$$

$$\mu_F\left(Q_c^{'''} \cup Q_c^{\circ}\right) > \mu_F\left(Q_c^{''}\right) \tag{37}$$

which contradicts the fact that $Q_c^{\mathcal{M}}$ is measure-maximizing. Hence, $Q_c^{\mathcal{M}}$ must be convex.

Proof of Proposition 2

(i) Assume there exists such an equilibrium. To meet the full redistribution constraint, it must be the case that $\tilde{q}^{\mathcal{M}}$ satisfies

$$\pi(\tilde{q}^{\mathcal{M}} - c^{\mathcal{M}}) > R_c \tag{38}$$

which is equivalent to having

$$\pi\tilde{q}^{\mathcal{M}} - (\pi - \rho_b^{\mathcal{M}})\tilde{q}^{\mathcal{M}} = \rho_b^{\mathcal{M}} \cdot \tilde{q}^{\mathcal{M}} > R_c \tag{39}$$

Given the (expected) zero-profit condition on the side of for-profit banks — i.e. $\rho_b^{\mathcal{M}} \cdot \mathbb{E}[q|q \geq \tilde{q}^{\mathcal{M}}] = R_b$ — one has

$$R_b > \rho_b^{\mathcal{M}} \cdot \tilde{q}^{\mathcal{M}} > R_c \tag{40}$$

i.e. a contradiction.

(ii) When $\tilde{q}^{\mathcal{M}} < 1$, then $(\tilde{q}^{\mathcal{M}}, 1] \subset Q_b^{\mathcal{M}}$. Given uniform pricing by for-profit banks, we have

$$\rho_b^{\mathcal{M}} \cdot \mathbb{E}\left[Q_b^{\mathcal{M}}\right] < \pi\left(\tilde{q}^{\mathcal{M}} - c^{\mathcal{M}}\right) \Leftrightarrow \mathbb{E}\left[Q_b^{\mathcal{M}}\right] < \tilde{q}^{\mathcal{M}}$$

hence there exists a non-zero measure subset of projects $P(q)$ such that $P(q) \subset Q_b^{\mathcal{M}}$ and $q < \mathbb{E}[Q_b^{\mathcal{M}}]$ for all $q \in P(q)$.

(iii) Notice first that, by point (i) and (ii) above, in any competitive equilibrium, and irrespective of the associated market segmentation, it holds $\underline{q}^{\mathcal{M}} = \min(Q_b^{\mathcal{M}} \cup Q_c^{\mathcal{M}})$. Since $u_0 = \Pi q^\star - R_n$, from the zero-profit condition $\int_{Q_b^{\mathcal{M}}} [\rho_b^{\mathcal{M}} q - R_b] dF(q) = 0$ one obtains

$$\underline{q}^{\mathcal{M}} - q^\star = \frac{R_b}{\pi}\left(\frac{\underline{q}^{\mathcal{M}}}{\mathbb{E}\left[q | q \in Q_b^{\mathcal{M}}\right]} - 1\right) < 0$$

that is $\underline{q}^{\mathcal{M}} \notin Q^\star$.

(iv) We show that $\rho_b^{\mathcal{M}} = \widehat{\rho}_b^{\mathcal{M}}$ implies $c^{\mathcal{M}} = \widehat{c}^{\mathcal{M}}$. This is trivial for any equilibrium with vertical segmentation in which $Q_c^{\mathcal{M}} = [\tilde{q}^{\mathcal{M}}, 1]$ and $Q_b^{\mathcal{M}} = \left[\underline{q}^{\mathcal{M}}, \tilde{q}^{\mathcal{M}}\right)$. Consider now equilibrium configurations in which $Q_c^{\mathcal{M}} = [q(c^{\mathcal{M}}), \tilde{q}^{\mathcal{M}}]$ and $Q_b^{\mathcal{M}} = \left[\underline{q}^{\mathcal{M}}, (q(c^{\mathcal{M}}, \tilde{q}^{\mathcal{M}})) \cup (\tilde{q}^{\mathcal{M}}, 1\right]$, where the pair $(q(c^{\mathcal{M}}), \tilde{q}^{\mathcal{M}})$ is budget-balancing for credit cooperatives, i.e. it solves

$$\int_{q(c^{\mathcal{M}})}^{\tilde{q}^B} \left[\pi(q - c^{\mathcal{M}}) - R_c\right] dF(q) = 0$$

By contradiction, assume that $\rho_b^{\mathcal{M}} = \widehat{\rho}_b^{\mathcal{M}}$ when $\widehat{c}^{\mathcal{M}} \neq c^{\mathcal{M}}$ – with no loss of generality, let $\widehat{c}^{\mathcal{M}} < c^{\mathcal{M}}$. Then it must be the case that $\mathbb{E}[q|q \in Q_b^{\mathcal{M}}] = \mathbb{E}[q|q \in \widehat{Q}_b^{\mathcal{M}}]$ and $\mu_F(Q_c^{\mathcal{M}}) = \mu_F(\widehat{Q}_c^{\mathcal{M}})$. Since $\tilde{q}^{\mathcal{M}}(\widehat{c}^{\mathcal{M}}) < \tilde{q}^{\mathcal{M}}(c^{\mathcal{M}})$, to preserve the average quality of the pool accepting the contract offered by for-profit banks it needs $\mathbb{E}\left[q|q \in \left[\underline{q}^{\mathcal{M}}, q(\widehat{c}^{\mathcal{M}})\right)\right] > \mathbb{E}\left[q|q \in \left[\underline{q}^{\mathcal{M}}, q(c^{\mathcal{M}})\right)\right]$. This requires $q(\widehat{c}^{\mathcal{M}}) > q(c^{\mathcal{M}})$ – as $\underline{q}^{\mathcal{M}}$ is unaltered insofar as $\rho_b^{\mathcal{M}} = \widehat{\rho}_b^{\mathcal{M}}$ – yet this contradicts $\mu_F(Q_c^{\mathcal{M}}) = \mu_F(\widehat{Q}_c^{\mathcal{M}})$. Hence, $\rho_b^{\mathcal{M}} = \widehat{\rho}_b^{\mathcal{M}}$ implies $c^{\mathcal{M}} = \widehat{c}^{\mathcal{M}}$. From the constraints $\pi c^{\mathcal{M}} = (\pi - \rho_b^{\mathcal{M}})\tilde{q}^{\mathcal{M}}$ and $(\pi - \rho_b^{\mathcal{M}})\underline{q}^{\mathcal{M}} = u_0$ it readily follows that $\rho_b^{\mathcal{M}} = \widehat{\rho}_b^{\mathcal{M}}$ also implies $\tilde{q}^{\mathcal{M}} = \widehat{\tilde{q}}^{\mathcal{M}}$. This in turn results in a unique budget-balancing $q(c^{\mathcal{M}})$ associated to $c^{\mathcal{M}}$.

Proof of Proposition 3

We shall consider candidate competitive equilibria $\mathcal{M}(\Gamma)$ in which $\tilde{q}^{\mathcal{M}} = 1$, $Q_c^{\mathcal{M}} = [c^{\mathcal{M}}, 1]$ and $Q_b^{\mathcal{M}} = \left[\underline{q}^{\mathcal{M}}, c^{\mathcal{M}}\right)$. Such candidates are pinned down by the following relations for generic distribution $F(q)$:

$$\rho_b^{\mathcal{M}} \mathbb{E}\left[q | q \in Q_b^{\mathcal{M}}\right] = R_b \tag{41}$$

$$\pi \mathbb{E}\left[q | q \in Q_c^{\mathcal{M}}\right] = \pi c^{\mathcal{M}} + R_c \tag{42}$$

$$c^{\mathcal{M}} = \left(1 - \frac{\rho_b^{\mathcal{M}}}{\pi}\right) \tag{43}$$

$$\underline{q}^{\mathcal{M}} = \frac{u_0}{\pi - \rho_b^{\mathcal{M}}} \tag{44}$$

$$0 < \underline{q}^{\mathcal{M}} < c^{\mathcal{M}} < 1 \tag{45}$$

$$\rho_b^{\mathcal{M}} \in (R_c, \pi - u_0) \tag{46}$$

i.e. zero expected profits for the commercial banks (Eq. 41), the balanced-budget requirement for the cooperatives (Eq. 42), the surplus share enforced by the cooperatives (Eq. 43), the least indifferent entrepreneur served by commercial banks (Eq. 44), provided the ordering relation (45) holds and that the price charged by commercial banks is strictly larger than the funding cost of the cooperatives — (46), from Lemma 1. For any given $\rho_b^{\mathcal{M}} \in (R_c, \pi - u_0)$, there can exist at most one share $c^{\mathcal{M}}$ which maximizes the measure of $Q_c^{\mathcal{M}}$ when $\tilde{q}^{M} = 1$, as pinned down by (43). Upon plugging (41), (43) and (44) into (42), and noticing that (45) and (46) are fulfilled if and only if $\rho_b \in (R_c, \pi - \sqrt{\pi u_0})$ it is immediate to see that existence of a competitive equilibrium $\mathcal{M}(\Gamma)$ is equivalent to existence of a solution to the following

$$\pi \mathbb{E}\left[q \middle| q \in \left[\frac{\pi - \rho_b}{\pi}, 1\right]\right] = \pi - \frac{R_b}{\mathbb{E}\left[q \middle| q \in \left[\frac{u_0}{\pi - \rho_b}, \frac{\pi - \rho_b}{\pi}\right]\right]} + R_c \tag{47}$$

which defines a continuous mapping over the open interval $(R_c, \pi - \sqrt{\pi u_0})$, provided $R_c < \pi - \sqrt{\pi u_0}$ (necessary condition). Assume the latter holds true. When $\rho_b \to R_c$, the right-hand side of (47) tends to

$$\pi + R_c - \frac{R_b}{\mathbb{E}\left[q \middle| q \in \left[\frac{u_0}{\pi - R_c}, \frac{\pi - R_c}{\pi}\right]\right]}$$

whereas the let-hand side tends to $\pi\mathbb{E}\left[q \middle| q \in \left[\frac{\pi - R_c}{\pi}, 1\right]\right] < \pi$. When $\rho_b \to \pi - \sqrt{\pi u_0}$, the right-hand side of (47) tends to

$$\pi + R_c - \frac{R_b\sqrt{\pi}}{\sqrt{u_0}}$$

whereas the left-hand side tends to $\pi\mathbb{E}\left[q \middle| q \in \left[\sqrt{\frac{u_0}{\pi}}, 1\right]\right] \in (\pi\mathbb{E}[Q], \pi)$. A sufficient condition for existence of a (possibly non-unique) ρ_b solving (47) is thus obtained by imposing the following restrictions at the boundaries

$$\pi + R_c - \frac{R_b}{\mathbb{E}\left[q \middle| q \in \left[\frac{u_0}{\pi - R_c}, \frac{\pi - R_c}{\pi}\right]\right]} \geq \pi \tag{48}$$

and

$$\pi\mathbb{E}[Q] \geq \pi + R_c - \frac{R_b\sqrt{\pi}}{\sqrt{u_0}} \tag{49}$$

which, upon rearrangement, deliver conditions (10) and (11). If these conditions hold true, there therefore exists a non-empty set S of collections of endogenous variables $(\rho_b, \rho_c, Q_b, Q_c, c)$ which satisfy, by construction, all the points of Definition 1 but the one concerning the maximal measure μ_F of the pool Q_c. Now, if there exists no further such collection, then the competitive equilibrium will be the element in S for which $\mu_F(Q_c)$ is the largest; if there exists a disjoint set S' of further collections $(\rho_b, \rho_c, Q_b, Q_c, c)$ which are not characterized by the parametric restrictions in Proposition 3 — as it would happen in case of disconnected Q_b — and yet comply with all the points in Definition 1 except the maximal measure one, then the competitive equilibrium will certainly belong in $S \cup S'$. Existence is therefore established.

Proof of Corollary 1

(i) Assume all the conditions in Proposition 3 hold. If $f'(q) \geq 0$ over the open interval (0, 1), then for any given $\rho_b \in (R_c, \pi - u_0)$, setting the surplus share according to Eq. (43) is optimal for the cooperatives: it is in fact the lowest share able to win the upper end of the quality distribution (since it induces indifference at $\tilde{q}^{\mathcal{M}} = 1$), and is such that any other lower share $\hat{c} < c^{\mathcal{M}}$ would fail to maximize the measure of served entrepreneurs. In fact, for $\hat{c}$ to be an equilibrium it must solve $\hat{c} = \left(1 - \frac{\rho_b^{\mathcal{M}}}{\pi}\right)\tilde{q}^{\mathcal{M}}$ for any equilibrium price $\rho^{\mathcal{M}}$, with $\tilde{q}^{\mathcal{M}} < 1$. Since $f'(q) \geq 0$ on (0, 1) by assumption, and since $c^{\mathcal{M}} - \hat{c} < 1 - \tilde{q}^{\mathcal{M}}$, one has $\int_{\widehat{c}}^{c^{\mathcal{M}}} dF(q) < \int_{\tilde{q}^{\mathcal{M}}}^{1} dF(q)$, i.e. a contradiction to $\widehat{c}$ being measure-maximizing. It follows that the (possibly non-unique) competitive equilibrium exists (by virtue of Proposition 3) and necessarily features vertical separation of the market for entrepreneurial ventures.

(ii) When $\tilde{F}$ first-order stochastically dominates F, the unconditional mean under $\tilde{F}(q)$ is not lower than its counterpart under $F(q)$. The second condition rather implies that the conditional mean over the subset $Q^{+} \subset Q$ under $\tilde{F}(q)$ is not lower than its counterpart under $F(q)$. Then Proposition 3 applies.

Proof of Proposition 4

We next show (i) that any competitive equilibrium with both types of credit organizations involves overlending (i.e. $\underline{q}^{\mathcal{M}} < q^{\star}$), and (ii) that a smaller degree of overlending is however induced relative to the benchmark (i.e. $\underline{q}^{\mathcal{M}} > \underline{q}^{b}$).

(i) Assume $\underline{q}^{\mathcal{M}} > q^{\star}$. Then:

$$\frac{u_0}{\pi - \rho_b^{\mathcal{M}}} > \frac{u_0 + R_b}{\pi} \quad \Leftrightarrow \quad \rho_b^{\mathcal{M}} > \frac{\pi R_b}{u_0 + R_b}$$

Using the (expected) zero-profit condition of the informed delivers

$$\frac{\pi R_b}{u_0 + R_b} \cdot \mathbb{E}\left[Q_b^{\mathcal{M}}\right] < R_b \quad \Leftrightarrow \quad \mathbb{E}\left[Q_b^{\mathcal{M}}\right] < q^{\star}$$

i.e. a contradiction.

(ii) Let us first consider any competitive equilibrium with vertical segmentation — cooperatives at the top, for-profit banks at the bottom. The assertion is trivially true when $\rho_b^{\mathcal{M}} \le R_c$. Consider now the case $\rho_b^{\mathcal{M}} > R_c$, and assume $\rho_b^{\mathcal{M}} \le \rho_b^{b}$, which is equivalent to assuming $\underline{q}^{\mathcal{M}} \le \underline{q}^{b}$. By the equilibrium conditions, we have

$$\rho_b^{\mathcal{M}} \cdot \mathbb{E}\left[q | q \in \left[\underline{q}^{\mathcal{M}}, \tilde{q}^{\mathcal{M}}\right]\right] = R_b = \rho_b^{b} \cdot \mathbb{E}\left[q | q \in \left[\underline{q}^{b}, 1\right]\right]$$

from which $\mathbb{E}\left[q|q \in \left[\underline{q}^{\mathcal{M}}, \tilde{q}^{\mathcal{M}}\right]\right] \ge \mathbb{E}\left[q|q \in \left[\underline{q}^{b}, 1\right]\right]$. But since

$$\mathbb{E}\left[q|q \in \left[\underline{q}^{\mathcal{M}}, \tilde{q}^{\mathcal{M}}\right]\right] < \mathbb{E}\left[q|q \in \left[\underline{q}^{\mathcal{M}}, 1\right]\right] \le \mathbb{E}\left[q|q \in \left[\underline{q}^{b}, 1\right]\right]$$

we obtain a contradiction. Hence, it must be $\underline{q}^{\mathcal{M}} > \underline{q}^{b}$.

To show the assertion for equilibria with disconnection, we prove by contradiction that ρ_b cannot be part of a such equilibrium if $\rho_b \le \rho_b^{b}$, i.e. if $\mathbb{E}\left[q|q \in \left[\underline{q}^{b}, 1\right]\right] \le \frac{R_b}{\rho_b}$. Assume the opposite, i.e. assume there exists $\rho_b^{\mathcal{M}} \le \rho_b^{b}$. Then there must exist $\tilde{q}^{\mathcal{M}} \in \left[\frac{R_c}{\rho_b^{\mathcal{M}}}, 1\right)$ and $\underline{q}^{\mathcal{M}} \le \underline{q}^{b}$ such that

$$\mathbb{E}\left[q|q \in \left[\underline{q}^{\mathcal{M}}, q(c^{\mathcal{M}})\right) \cup \left[\tilde{q}^{\mathcal{M}}, 1\right)\right] = \frac{R_b}{\rho_b^{\mathcal{M}}}$$

and

$$\mathbb{E}\left[q|q \in \left[q(c^{\mathcal{M}}), \tilde{q}^{\mathcal{M}}\right]\right] = \frac{\pi - \rho_b^{\mathcal{M}}}{\pi}\tilde{q}^{\mathcal{M}} + \frac{R_c}{\pi}$$

with the left-hand side conditional average in the latter equation being increasing in $\tilde{q}^{\mathcal{M}}$ and satisfying:

$$\mathbb{E}\left[q|q \in \left[q(c^{\mathcal{M}}), \tilde{q}^{\mathcal{M}}\right]\right] < \mathbb{E}\left[q|q \in \left[\underline{q}^{\mathcal{M}}, 1\right]\right] < \mathbb{E}\left[q|q \in \left[\underline{q}^{b}, 1\right]\right]$$

Since for $\tilde{q}^{\mathcal{M}} = \frac{R_c}{\rho_b^{\mathcal{M}}}$ it holds

$$\mathbb{E}\left[q|q \in \left[\underline{q}^{\mathcal{M}}, 1\right]\right] > \mathbb{E}\left[q|q \in \left[\underline{q}^{\mathcal{M}}, \tilde{q}^{\mathcal{M}}\right]\right] = \frac{R_c}{\rho_b^{\mathcal{M}}} > \frac{R_b}{\rho_b^{\mathcal{M}}} \geq \mathbb{E}\left[q|q \in \left[\underline{q}^{b}, 1\right]\right]$$

a contradiction is obtained.

Proof of Proposition 5

(i) Same as proof of Proposition 2, part (ii).
(ii) Same as proof of Proposition 2, part (iii).
(iii) Let us consider a candidate equilibrium with vertical separation (coops above, for-profit banks below) and $\min(\widehat{Q}_c^{\mathcal{M}}) = c^{\mathcal{M}}$. Under conditions (9), (10) and (11), there exists a non-empty set $\widehat{S}$ of collections of endogenous variables $(\rho_b, c, \widehat{Q}_b, \widehat{Q}_c, c)$ which satisfy all the points of Definition 2 but the one concerning the maximal measure μ_F of the pool $\widehat{Q}_c$. Since $\widehat{Q}_c$ is not restricted to lie in $[c, 1]$, there can exist a disjoint set $\widehat{S}'$ of collections $(\rho_b, c, \widehat{Q}_b, \widehat{Q}_c, c)$ that are not pinned down by (9), (10) and (11) and yet comply with all the points in Definition 2 except the maximal measure one. Then a competitive equilibrium necessarily exists for it is the element in $\widehat{S} \cup \widehat{S}'$ with entails the maximal measure for $\widehat{Q}_c$.

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