Good Co-ops, Bad Co-ops : Financing Cooperatives under Asymmetric Information

Abstract

Cooperatives follow principles like limitations in trading shares and democratic control that supposedly imply financial constraints. As a matter of fact, that makes banks their first external sources of finance and raises specific issues of financial structure and internal governance. This study proposes a principal-agent model to better understand how information asymmetry relates retained earnings and debt in a context where cooperative governance is either managerial or member-oriented. Our findings are consistent with our observations of the financial trends of US agricultural cooperatives in the 2010-2020 period. Plus, they explain a puzzling feature of cooperative finance, the concurrence of overinvestment and financial constraints. They also provide a rationale for the persistence of member dominance, which may be not optimal when value creation calls for market-oriented strategies.

Keywords: Cooperative, bank contract, governance, asymmetric information, finance.

1 Introduction

Agricultural cooperatives are involved in the processing of about 50 percent of food products in most Western countries (Bijman and Iliopoulos, 2014). Observing the US agricultural cooperative financial data for the 2010-2020 period raises question on how financial structure relates to investment: the recovery of the dairy cooperative industry relies on investment financed by debt and non-redeemable retained earnings while the livestock cooperatives divest and redeem equity faster than they repay debt. What does it say about the financial behavior of cooperatives? To address this question, we propose a principal-agent modeling in the particular context of agricultural cooperatives finance, where banks are the main external source of funds (Valentinov, 2007) in a relationship marked by asymmetric information (Cross and Buccola, 2004).

While most theoretical papers on cooperative finance focuses on issues related to core characteristics of co-ops like the heterogeneity of membership (active and non-active members, old versus new members, different asset preferences), or the timing of payment and equity redemption on their financial decisions (VanSickle and George, 1983; Sexton, 1986; Hart and Moore, 1996; Cross and Buccola, 2004; Rey and Tirole, 2007; Royer, 2017; Royer and Mckee, 2020), we here focus on their relationship with banks in a setting that reflects their main financial characteristics: a profit that can be transferred to members through allocated equity and cash payment, or permanently to the cooperative via retained earnings; limited capacity to raise equity; a high discount rate related to the risk preferences of members and their investment horizon; tangible asset that can be used as collateral by banks; a difference in the preferences for investment according to the dominance of members or managers in the governance of cooperatives.

We consider asymmetric information as follows: The bank is not able to distinguish between good cooperatives with a high probability to repay debt, and bad cooperatives with a lower probability to repay. This could lead banks to propose sub-optimal contracts taken only by bad cooperatives. To account for the different horizons of members, managers, and banks, we distinguish the short-term utility of cash and the long-term value created by investment. This allows us to create an index of managerial orientation which relates the short-term disutility to invest with the short-term utility to cash in. It formalizes the idea that the cost of one invested dollar is lower for managers than for cooperative members.

We find that banks contracting with cooperatives under asymmetric information results in: (i) lower interest rates and so "overinvestment" for all cooperatives, (ii) higher retained earnings for the safest ones to deter mimicking by the riskiest cooperatives, and (iii) higher interest rates for risky cooperatives regardless of the tangibility of assets. Plus, (iv) tangibility may result in a sub-optimal pooling equilibrium where all cooperatives are financed the same way, and (iv) managerial orientation may lead cooperatives to invest more but may reduce the effectiveness of the contracts proposed by banks. In this case, banks propose a contract that can be chosen only by the riskiest cooperatives. Therefore, credit rationing is more likely when cooperatives are managerial.

Section 2 presents our observations of the investment and recent financial trends for US cooperatives. Section 3 describes the model and the benchmark under perfect information. Section 4 specifies the contract between banks and cooperatives in asymmetric information and shows the impact of the managerial orientation. Section 5 concludes.

2 Financial Structure and Investment Dynamics of US Co-ops

2.1 Investment trends

USDA data (2022) shows that sales of US agricultural cooperatives have grown from 119 to 200 billion dollars between 2002 and 2017, at a growth rate of 2.68 percent per year, a slightly lower rate than the growth of total farm outputs. Compared to farm sales, cooperatives have kept their position in agribusiness but the trends are different from one sector to another. While the sales of grain cooperatives had increased from 50 to 70 billion dollars between 2014 and 2020 after a sharp increase in 2018, the dairy cooperatives saw their sales slightly decrease between 2014 and 2016 (from 50 to 40 billion dollars) before growing to 45 thousand billions in 2020. The sales of livestock cooperatives had steadily decreased between 2014 and 2020.

We also see distinctive financial performances. While the gross margin of grain cooperatives is rather steady (around 6 and 7 percent of business volume), the dairy cooperatives' gross margin improved significantly from 5 to 9 percent of sales between 2014 and 2020. The gross margin of livestock cooperatives is steady, around 1 percent of sales. Grain and dairy cooperatives have both increased their assets between 2015 and 2020: from 10 to 20 billion and 5 to 8 billion dollars respectively. Meanwhile the assets of livestock cooperatives have decreased from 95 to 84 million dollars. These numbers can be interpreted as three broad trends (Cadot, 2022): a successful development for the grain cooperatives, a rebound for the dairy cooperatives and a decline for the livestock cooperatives.

2.2 Financial structure

Our point of interest is how financial structures of cooperatives relate to these trends. While the grain cooperatives are profitable enough to finance growth and keep remarkably steady leverage ratios, the long-term debt of dairy cooperatives jumped from two-third of equity in 2017 to 100 percent in 2020. More surprisingly, while livestock cooperatives had divested between 2016 and 2020, their ratio of debt to equity increased from 20 percent to 34 percent. But a look at cooperative equity needs to distinguish the equity that is redeemable to members (allocated equity) from the equity that is transferred to the cooperative on a permanent basis (retained earnings). The ratio of debt over retained earnings has decreased for dairy cooperatives from 4 to 3 while it increased from 0.38 to 0.75 for livestock cooperatives. It means that dairy cooperative members have accepted to give up cash payments or allocated equity to provide co-ops with non redeemable retained earnings and so, increase its leverage capacity. By contrast, equity, and especially retained earnings, had decreased at a faster rate than debt repayment for livestock cooperatives.

2.3 Research objective

What do these numbers say about the financial behavior of cooperatives? Here are some hypotheses. First, there is no reason to change when things work: grain cooperatives grow but keep the same balance of debt, equity and retained earnings. Second (and more interestingly), in less predictable context, banks can finance growth if cooperative members agree to secure a certain amount of non redeemable equity to the cooperative via retained earnings. This explains the reverse relationship of the debt-to-equity and debt-to-retained earnings ratios observed for dairy cooperatives. Third (and it's related to the precedent point), cooperatives can reduce equity at a faster rate than debt repayment, which corresponds to a sort of liquidation as modeled by Cross and Buccola (2004). To investigate these hypotheses through an economic lens require a coherent framework. This is the objective of this paper.

3 The Model

3.1 The benchmark case

In the benchmark case, the cooperative has enough internal funds to finance investment. We define G as an exogenous gain (i.e. cash flow from the previous period) at $t = 0$, i is the level of investment, ρ_c is the discount factor of the cooperative, and $V(i)$ is the long-term value function created by investment i. Furthermore, function $V(i)$ is increasing and concave in i and the first derivative, $V_i(i)$, is decreasing and convex in i,[1] meaning that $V_i > 0$, $V_{ii} < 0$, and $V_{iii} > 0$.

Let us consider a G large enough so that $G - i \geq 0$, meaning that cooperatives finance their investment with internal funds. Cooperatives maximize profit function $\pi(i) = \rho_c V(i) - i$, the difference between the present value of the project and investment. In this context, the optimal level of investment $\hat{i}$ is such that:

$$\begin{cases} \frac{dV(i)}{di} = V_i(\hat{i}) = \frac{1}{\rho_c} \\ G - \hat{i} \geq 0. \end{cases} \tag{1}$$

At the optimum, the level of investment is so that the marginal value of investment is equal to the reverse of the discount factor of cooperatives. In this context, the level of investment depends on the investment horizon. $(G - \hat{i})$ is used for cash payments to cooperative members. This may correspond to the investment behavior of agribusiness investors-owned firms, except that they have a higher discount factor than cooperatives (Staatz (1989), Cook (1995), among others).

[1] We use an indexed variable in the function to refer to the first partial derivative in relation to this variable.

3.2 Financing cooperatives with debt under perfect information

3.2.1 Cooperatives' profit function

In the following, exogenous gain G is not large enough to finance investment, but the cooperative can use debt d provided by the bank. We distinguish short- from long-term utilities for cooperative members who decide the level of debt and investment. The cooperative profit function can be formalized as follows:

$$\Pi(d,i) = U(d,i,G,\theta) + \rho_c V(i) - \rho_c p(1+r^*)d, \quad (2)$$

where function $U(d,i,G,\theta)$ corresponds to the short-term utility, depending on the level of debt raised d, level of investment i, exogenous gain G, and level of retained earnings $\theta \in [0,1]$, which is the part of the exogenous gain used for investment. As such, we decompose the profit function in two parts. The expected payment of debt as well as the long term value are not elements of the short-term utility.

The entire exogenous gain is retained when $\theta = 1$. The cooperative is unable to raise equity from members, thus $\theta \leq 1$. The cooperative distributes all the gain to cooperative members, resulting in no retained earnings, when $\theta = 0$. The bank will never provide equity capital to the cooperative; thus, $\theta \geq 0$. This results in limited liability constraint $LC : \theta \in [0,1]$.

Function U is quasi-concave and subject to the following assumptions:

Assumption 1 *:* $U_i(d,i,G,\theta) = U_\theta(d,i,G,\theta) = Um_1 < 0$.

Assumption 1 means that the short-term marginal disutility of investment is negative as well as the use of retained earnings.

Assumption 2 *:* $U_d(d,i,G,\theta) = U_G(d,i,G,\theta) = Um_2 > 0$.

Assumption 2 implies that the short-term marginal utility of cash is independent of the origin of funds (debt or exogenous gain). Then, we can define the coefficient $\alpha \in]0,1]$ as an index of managerial orientation, such as:

Assumption 3 : $Um_1 = -\alpha Um_2 < 0$.

Assumption 3 relates the short-term marginal disutility of investment to the short-term marginal utility of cash inflows. It accounts for the degree to which the cooperative board behaves more as a cooperative member or as a manager. Exogenous parameter α can be considered an index of managerial orientation.

If $\alpha = 1$ (hereafter, standard governance or member-oriented cooperatives), the cooperative is indifferent between investing or renouncing to one dollar in the short term. This corresponds to the preference characteristic of cooperative members. However, when $\alpha < 1$ (hereafter, managerial governance, the cooperatives being more manager-oriented when $\alpha \to 0$), the marginal disutility of investment in absolute value is lower than the marginal utility of cash inflows in the short term. This corresponds to the preference characteristics of managers, who may be biased toward investment rather than profit distribution to owners (i.e., members) (Jensen, 1986; Porter and Scully, 1987; Featherstone and Al-Kheraiji, 1995). Managers may expect a raise in their wages in case of cooperative growth. In sum, the value of one dollar is equivalent for cooperative members regardless its use in the short term ($\alpha = 1$), but the short-term cost of one invested dollar is lower for managers ($\alpha \to 0$).

We also assume that $U(G) = \alpha G$, so that α reflects the discount on cash holding by managerial boards that prefer to invest over using cash for payments to members now or in the future via allocated equity. As such, the index of managerial orientation, α, captures the managerial behavior regarding both the value and use of cash.

Function $V(i)$ corresponds to the long-term value of investment, being independent of the repayment capacity and probability of success p. This assumption states that members can benefit from asset value through their business relationships as users even if their owner status may be jeopardized by financial mismanagement. Indeed, a key characteristic of cooperative members is that they are both owners and users of cooperatives. It reflects the fact that the nominal value of shares is often low compared to the volume of business between cooperatives and their members (Staatz, 1989).

Finally, $\rho_c p(1 + r^*)d$ corresponds to the discounted total cost of debt, which is determined by the expected utility of the bank. Interest rate r^* is determined by p, the probability of success, and collateral $k \in [0,1]$, which reflects the investment tangibility. The bank is risk neutral, so the interest rate decreases with the probability of success and investment tangibility. As such, expected gain EU_b for the bank is the weighted sum of the discounted repayment recovered in the case of success and the discounted collateral in case of default (where ρ_b represents the discount factor of the bank). We assume that the bank industry is competitive[2] and has an expected profit equal to zero:

$$EU_b = \rho_b\big(p(1+r^*)d + (1-p)ki\big) = d. \tag{3}$$

Finally, the cooperative members and the banks differ in their investment horizons (Staatz, 1989; Cook, 1995), as per the following assumption:

Assumption 4 *:* $\rho_c < \rho_b$.

Assumption 4 illustrates that the discount factor of the cooperative is lower than the one of the bank. This is consistent with the common wisdom of a short investment horizon of cooperatives (Staatz, 1989).

3.2.2 Optimal strategic decisions

Under perfect information, the cooperative's objective is to find the optimal levels of debt and investment (d^*, i^*) that maximize profit subject to financial constraint. This aims to maximize the sum of the short-term utility and the discounted long-term utility less the discounted cost of the debt, provided that the cooperative cannot invest more than the monetary amount raised as debt plus exogenous short-term gain G. Therefore, the cooperative's program corresponds to:

$$\begin{cases} \max_{\{d,i\}} \ \Pi(d,i) = U(d,i,G) + \rho_c V(i) - \rho_c p(1+r^*)d \\ \ s.t. \\ G + d \geq i. \end{cases} \tag{4}$$

[2]Even when banks are cooperatives, they act in a competitive market in terms of risk-taking.

The optimal amount of investment and debt are the solutions of the following system:

$$\begin{cases} U_d(d^*\,,\,i)\;-\rho_c p(1+r^*)=0 \\ U_i(d\,,\,i^*)+\rho_c V_i(i^*)=0. \end{cases} \tag{5}$$

Regardless of the managerial orientation, the FOCs can be rewritten as:

$$\frac{U_d(d^*\,,\,i)}{p(1+r^*)} = -\frac{U_i(d\,,\,i^*)}{V_i(i^*)} = \rho_c. \tag{6}$$

At the optimum, the cooperative trades off debt and investment to equalize the ratio between the marginal utility and marginal cost of both decisions. standard inter-temporal trade off. These ratios equal the discount factor of cooperatives. By Assumption 3, the optimal level of investment for any α is solution of the following equation:

$$\alpha p(1+r^*) = V_i(i^*). \tag{7}$$

Result (7) shows that cooperatives invest until the long-term value created by investment equals the long-term cost of debt weighted by the index of managerial orientation. For a given index of managerial orientation and interest rate, the riskier the cooperative is, the higher the investment becomes. This is consistent with the standard agency cost of debt described by Jensen and Meckling (1976).

In the following, we consider that cooperatives can differ in their probability of success p (ability to repay the loan). For modeling purposes, we consider the simple case where two types of cooperatives coexist. The riskiest cooperative (indexed under bar) is the bad type, the $\underline{p}$-coop. The safest (indexed upper bar) is the good type, the $\overline{p}$-coop (with $\underline{p} < \overline{p}$). The bank can distinguish among the two types of cooperatives. We also assume that default implies non-contractible costs related to the cost of collateral recovery, reputation, and other fees related to default processes. Therefore, the bank always applies a higher cost of debt for the riskiest cooperatives than for safest (Assumption 5), implying that $\underline{r}^* > \overline{r}^*$. Following the previous consideration:

Assumption 5 *:* $\overline{p}(1+\overline{r}^*) < \underline{p}(1+\underline{r}^*)$, If cooperative types are not publicly observable by the bank (asymmetric information), imitation behaviors can arise. The riskiest cooperatives have interest to mimic the safest ones for two reasons: to benefit from the value created by a higher investment and enjoy a lower cost of debt. As such, the bank must behave according to the observable information and implement an incentive contract.

4 Financing Co-ops under Asymmetric Information

4.1 Financing standard governance co-ops with incentive contracts

We here focus on standard governance cooperatives ($\alpha = 1$) under complete information. Risky cooperatives can perfectly pass themselves as safe cooperatives. They can announce the level of risk (imperfectly observable by the bank) to obtain the favorable interest rate and behave so that the bank cannot detect them. The interest rate only cannot be a screening device (Stiglitz and Weiss, 1981). To counteract information asymmetry, the bank (the principal) must build a menu of contracts to screen the types of cooperatives (the agent), for which is required an additional contracting device.

As the amount of exogenous gain, G, is common knowledge, the bank can ask for a contribution θG, with $\theta \in [0, 1]$ (the LC constraint) as an additional tool for contracting. Contribution θ is costly for cooperatives, since it prevents them from capturing the exogenous gain for cash payment to cooperative members. Conversely, the bank benefits from a higher level of θ, since it increases the level of collateral recovered if cooperatives default.

1. Nature draws p in set $\{\underline{p}\,; \overline{p}\}$ with probabilities ν and $1 - \nu$ respectively.

2. Cooperatives observe p and the bank only observes the set of p.

3. The bank proposes a menu of contracts $[(\underline{\theta}, \underline{r}); (\overline{\theta}, \overline{r})]$ if such a contract exists.

4. Cooperatives announce level of investment i and level of debt d related to the contract that they choose or recover their *status quo* value, $\Pi^{\star}$, if they decide not to contract with the bank.

5. The bank implements the contract if agreed by the cooperatives.

In the following section, we consider the case of perfect information when the probability of success, p, is perfectly observable and when the bank implements a contract.

4.1.1 Standard governance first best solutions

This section consists of the benchmark case for contracting. Under perfect information, the bank builds a contract with interest rate r and a requirement in retained earnings of θG. As this financial contribution increases the level of collateral relatively to debt, the bank may decrease the interest rate by increasing the retained earnings. The interest rate is now endogenous, since it is a contracting device. Expected gain $EU_b(\theta, r)$ for the bank is the weighted sum of the discounted repayment recovered in case of success and the discounted collateral in case of default.[3]

$$EU_b(\theta, r) = \rho_b\big(p(1+r)d + (1-p)k(d+\theta G)\big) - d. \tag{8}$$

When contracting with the bank, the cooperative's profit function is:

$$\Pi(\theta, r) = U(d, i, \theta) + \rho_c V(i) - \rho_c p(1+r)d. \tag{9}$$

The cooperative will accept the contract only if the profit with investment is higher than the *status quo* profit, $\Pi^\star$, obtained without investment. Therefore, the participation constraint of the cooperative is:

$$\Pi(\theta, r) \geq \Pi^\star \tag{PC}$$

Under perfect information, the bank must find a contract maximizing its objective function subject to participation constraint PC of the cooperative and limited liability constraint LC on θ. This leads to finding the solution (indexed FB) of the following program:

$$\begin{cases} \max_{\{\theta, r\}} \;\; EU_b(\theta, r) \\ \;\; s.t. \\ PC; LC \end{cases} \tag{10}$$

[3]The expected utility of the bank is increasing in r and in θ : $\frac{\delta EU_b(\theta,r)}{\delta\theta} > 0$ and $\frac{\delta EU_b(\theta,r)}{\delta r} > 0$.

The bank must find a contract that binds the participation constraint of the cooperative. Therefore, we can rewrite the maximization program of the bank in term of financial contribution θ. The limited liability constraints may imply corner solutions. We assume they are satisfied, and we verify ex-post (see Proposition 1). The first-order conditions lead to the following first-best solution for the financial contribution. θ^{FB} is so that:

$$U_{\theta^{FB}}(d^{FB}, i^{FB}, \theta^{FB}) = -\rho_c(1-p)kG. \tag{11}$$

The optimal financial contribution is so that the marginal disutility ($U_\theta < 0$) of the contribution in the short run (left-hand side of result (11)), is equal to the discounted value related to the collateral effect of the contribution (right-hand side of result (11)). Indeed, financing tangible assets with internal funds increases the value received by the bank in case of bankruptcy. The optimal financial contribution is so that this supplement of value for the bank is equal to the marginal cost of the cooperative. The first best interest rate is:

$$(1+r^{FB}) = \frac{U(d^{FB}, i^{FB}, \theta^{FB}) + \rho_c V(i^{FB}) - \Pi^\star}{\rho_c\, p\, d^{FB}}. \tag{12}$$

The bank considers an interest rate that binds the participation constraint of the cooperative. The following proposition summarizes the optimal contract for any type of cooperative (see Figure 3).

Proposition 1 *Financing any standard governance cooperatives under perfect information leads the bank to build a contract* $[(\theta^{FB}, r^{FB})]$ *so that:*

- *General solution:* θ^{FB} *and* r^{FB} *are the solutions of equations (11) and (12), if* $\theta^{FB} \in [0,1]$.
- *Corner solution: if* $\theta^{FB} \notin [0,1]$ *with* $\theta < 0$, *then* $\theta^{FB} = 0$ *and* $r^{FB} = r^{max}$ *is the solution of equation (12) with* $\theta^{FB} = 0$.
- *Constrained solution: if* $\theta^{FB} \notin [0,1]$ *with* $\theta > 1$, *then* $\theta^{FB} = 1$ *and* $r^{FB} = r_{\theta=1}$ *is the solution of equation (12) with* $\theta^{FB} = 1$.

Proposition 1 implies that the first-best interest rate is so that cost of debt $\rho_c\, p\, d^{FB}(1+r^{FB})$ equals the surplus of the cooperative, $U(d^{FB}, i^{FB}, \theta^{FB}) + \rho_c V(i^{FB}) - \Pi^\star$ (first point of Proposition 1).

In the case where the marginal disutility of the financial contribution is very high relative to its collateral effect, the trade off in equation (11) may imply a negative level for theta, which is not implementable because the bank will not provide equity to cooperatives. In this case, the bank will not require any financial contributions but will ask for the highest interest rate compatible with the participation constraint of cooperatives (second point of Proposition 1, the ordinate at the origin of Figure 3).

If the marginal disutility of the financial contribution is very low relative to its collateral effect, the trade off in equation (11) implies a level of theta higher than one, which is not implementable because cooperative members cannot provide the cooperative with their own funds. In this case, the bank will ask to use all G as retained earnings and the compatible interest rate solution of equation (12) (third point of Proposition 1 and CS in Figure 3).

Under perfect information with two different types ($\overline{p} > \underline{p}$) the bank can distinguish, it follows from result (11) that:

$$\begin{cases} U_{\underline{\theta}^{FB}}(\underline{d}^{FB}, \underline{i}^{FB}, \underline{\theta}^{FB}) + \rho_c(1-\underline{p})kG = 0 \\ U_{\overline{\theta}^{FB}}(\overline{d}^{FB}, \overline{i}^{FB}, \overline{\theta}^{FB}) + \rho_c(1-\overline{p})kG = 0. \end{cases} \tag{13}$$

Then, Assumption 1, U concavity, and result (13) imply that $\underline{\theta}^{FB} > \overline{\theta}^{FB}$, and Proposition 1 applies for both types of cooperatives. In the case where $\overline{\theta}^{FB} \geq 1$, the constrained solution of Proposition 1 applies and $\theta = 1$ for both types of cooperatives with $\underline{r} > \overline{r}$. However, in other cases, the bank requires a higher financial contribution from risky cooperatives than from safe ones. Indeed, the expected collateral value is higher for risky cooperatives due to their lower probability of success. This is consistent with the conventional higher requirement of internal funds from risky borrowers by banks.

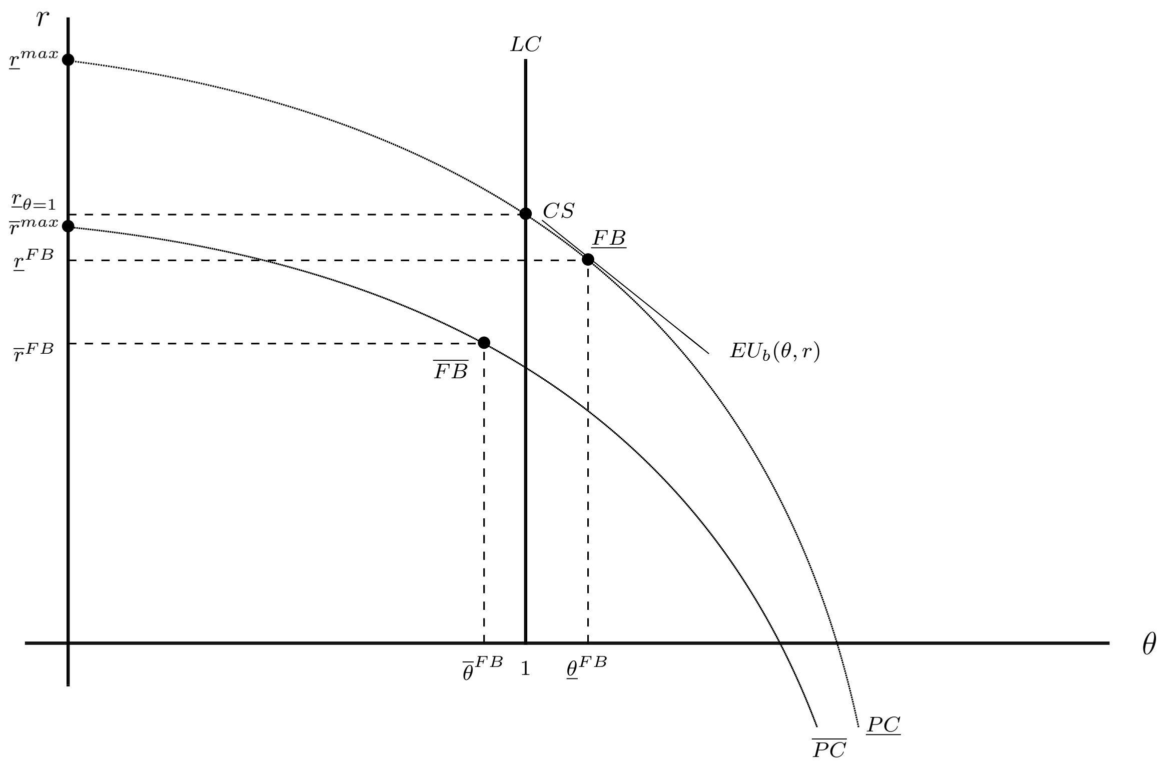

Figure 3. First-best contracts when $\overline{r}^{FB} < \underline{r}^{FB}$. Equation (9) implies that risky cooperatives would accept a higher interest rate than safe ones. Cooperatives pay the highest interest rate when there is no financial contribution ($\theta = 0$), and $\underline{r}^{max} > \overline{r}^{max}$ is the corner solution (second point of Proposition 1). $\underline{PC}$ is steeper than $\overline{PC}$ for any given θ. The FOCs imply that $\underline{\theta}^{FB} > \overline{\theta}^{FB}$ is the general solution (first point of Proposition 1). The constrained solution (CS) at the intersection of LC and $\underline{PC}$, implies a higher interest rate than the first-best unconstrained solution, $\underline{r}_{\theta=1} > \underline{r}^{FB}$ (third point of Proposition 1). Same results hold for the second-best when $\overline{r}^{FB} < \underline{r}^{FB}$.

In the next section, we focus on the second-best solutions, given that information asymmetry requires a contract with incentives to deter the risky cooperatives from mimicking the safe ones.

4.1.2 Standard governance second best solutions

Under asymmetric information, the bank builds a menu of contracts composed of level of interest rate r and financial contribution $\theta \in [0, 1]$ to screen good (in proportion $(1-\nu)$) and bad types (in proportion ν). The expected gain, $EU_b(\underline{\theta}, \underline{r}, \overline{\theta}, \overline{r})$, of the bank is the weighted sum of the discounted repayment recovered in case of success and the discounted collateral in case of default, minus the debt weighted by the proportion of both types:

$$EU_b(\underline{\theta}, \underline{r}, \overline{\theta}, \overline{r}) = \rho_b\big[\nu\big(\underline{p}(1+\underline{r})\underline{d} + (1-\underline{p})k(\underline{d}+\underline{\theta}G)\big) + (1-\nu)\big(\overline{p}(1+\overline{r})\overline{d} + (1-\overline{p})k(\overline{d}+\overline{\theta}G)\big)\big] - \big(\nu\underline{d} + (1-\nu)\overline{d}\big). \tag{14}$$

In the case of contracting with the bank, the profit function of cooperatives that behave according to their type is $\underline{\Pi}(\underline{\theta},\underline{r})$ for $\underline{p}$-coops (respectively, $\overline{\Pi}(\overline{\theta},\overline{r})$ for $\overline{p}$-coops). Both participation constraints are:

$$\begin{cases} \underline{\Pi}(\underline{\theta},\underline{r}) = U(\underline{d},\underline{i},\underline{\theta}) + \rho_c V(\underline{i}) - \rho_c \underline{p}(1+\underline{r})\underline{d} \geq \Pi^\star & (\underline{PC}) \\ \\ \overline{\Pi}(\overline{\theta},\overline{r}) = U(\overline{d},\overline{i},\overline{\theta}) + \rho_c V(\overline{i}) - \rho_c \overline{p}(1+\overline{r})\overline{d} \geq \Pi^\star & (\overline{PC}). \end{cases}$$

The bank's issue is designing a contract providing the incentives for $\underline{p}$-coops (respectively $\overline{p}$-coops) to choose the contract intended to them. To this end, incentive constraint $\underline{IC}$ for $\underline{p}$-coops (respectively $\overline{IC}$ for $\overline{p}$-coops) may imply that the profit of $\underline{p}$-coops (respectively, $\overline{p}$-coops) is always higher when choosing the $[(\underline{\theta},\underline{r})]$ contract (respectively, the $[(\overline{\theta},\overline{r})]$ contract). This leads to:

$$\begin{cases} \underline{\Pi}(\underline{\theta},\underline{r}) \geq \underline{\Pi}(\overline{\theta},\overline{r}) & (\underline{IC}) \\ \\ \overline{\Pi}(\overline{\theta},\overline{r}) \geq \overline{\Pi}(\underline{\theta},\underline{r}) & (\overline{IC}), \end{cases}$$

The bank's objective is to find the optimal contract for each cooperative type that maximizes its expected gain subject to participation constraints ($\underline{PC}$ and $\overline{PC}$), incentive constraints ($\underline{IC}$ and $\overline{IC}$), and limited liability constraints on θ ($\underline{LC}$ and $\overline{LC}$):

$$\begin{cases} \max_{\{(\underline{\theta},\underline{r});(\overline{\theta},\overline{r})\}} \quad EU_b(\underline{\theta},\underline{r},\overline{\theta},\overline{r},) \\ \quad s.t. \\ \underline{PC};\overline{PC};\underline{IC};\overline{IC};\underline{LC};\overline{LC}. \end{cases} \tag{15}$$

The $\overline{IC}$ constraint is always satisfied and verified ex post (second equation of (17)). In our setting, the safe cooperatives are never interested to mimic the risky ones. The $\overline{PC}$ constraint is always satisfied with strict equality, as the bank will implement a program so that safe cooperatives can always invest. The participation constraint for the good type is binding and leads to the following interest rate for $\overline{p}$-coops:

$$(1+\overline{r}) = \frac{U(\overline{d},\overline{i},\overline{\theta}) + \rho_c V(\overline{i}) - \Pi^\star}{\rho_c \overline{p}\,\overline{d}}. \tag{16}$$

The $\underline{IC}$ constraint is binding (first equation of (17)), as the bank seeks to provide the right incentives to prevent risky cooperatives from mimicking safe ones. In our setting, both incentive constraints are so that:

$$\begin{cases} U(\underline{d},\underline{i},\underline{\theta}) + \rho_c V(\underline{i}) - \rho_c \underline{p}(1+\underline{r})\underline{d} = U(\overline{d},\overline{i},\overline{\theta}) + \rho_c V(\overline{i}) - \rho_c \underline{p}(1+\overline{r})\overline{d} \\ \\ U(\overline{d},\overline{i},\overline{\theta}) + \rho_c V(\overline{i}) - \rho_c \overline{p}(1+\overline{r})\overline{d} \geq U(\underline{d},\underline{i},\underline{\theta}) + \rho_c V(\underline{i}) - \rho_c \overline{p}(1+\underline{r})\underline{d}. \end{cases} \tag{17}$$

The $\underline{IC}$ constraint is binding and sets the interest rate for $\underline{p}$-coops such that:

$$(1+\underline{r}) = \frac{U(\underline{d},\underline{i},\underline{\theta}) - U(\overline{d},\overline{i},\overline{\theta})}{\rho_c\,\underline{p}\,\underline{d}} + \frac{U(\overline{d},\overline{i},\overline{\theta})}{\rho_c\,\overline{p}\,\underline{d}} + \frac{V(\underline{i}) - V(\overline{i})}{\underline{p}\,\underline{d}} + \frac{\rho_c V(\overline{i}) - \Pi^\star}{\rho_c\,\overline{p}\,\underline{d}}. \tag{18}$$

We now use (16) and (18) to rewrite the maximization program of the bank in terms of the financial contributions of both types. We assume that the $\underline{PC}$ constraint is satisfied and verified ex post. We also assume that limited liability ($\underline{LC}$ and $\overline{LC}$) is satisfied and verified ex post (see Proposition 2).

The first-order conditions lead to the following second-best solution for the financial contribution. $\underline{\theta}^{SB}$ and $\overline{\theta}^{SB}$ are such that:

$$\begin{cases} U_{\underline{\theta}^{SB}}(\underline{d}^{SB},\underline{i}^{SB},\underline{\theta}^{SB}) + \rho_c(1-\underline{p})kG = 0 \\ U_{\overline{\theta}^{SB}}(\overline{d}^{SB},\overline{i}^{SB},\overline{\theta}^{SB}) + \rho_c(1-\overline{p})kG = \left(\frac{\nu}{1-\nu}\right)R(\overline{\theta}^{SB}), \end{cases} \tag{19}$$

where, for any $\overline{\theta} \in [0,1]$, $R(\overline{\theta})$ depends on the financial contribution asked from safe cooperatives. This is equivalent to the informational rent that the bank must pay to risky cooperatives via a lower interest rate to deter mimicking the safe ones. This can be formalized as follows:

$$R(\overline{\theta}) = \left(\frac{\overline{p}-\underline{p}}{\overline{p}}\right)U_{\overline{\theta}}(\overline{d},\overline{i},\overline{\theta}) < 0. \tag{20}$$

Furthermore, $R_{\overline{\theta}}(\overline{\theta}) < 0$, as U is quasi-concave. Therefore, the bank can decrease the informational rent by increasing the financial contribution asked from safe cooperatives, which increases the interest rate asked from risky cooperatives (equation (18)). The following Proposition summarizes the optimal contract (see Figures 5.a and 5.b).

Proposition 2 *Financing two different types of standard governance cooperatives under asymmetric information leads the bank to build a menu of contracts,* $[(\underline{\theta}^{SB}, \underline{r}^{SB}), (\overline{\theta}^{SB}, \overline{r}^{SB})]$, *such that:*

- *If* $\nu \geq \frac{\overline{p}}{2\overline{p}-\underline{p}}$, *the optimal contract is* $\underline{\theta}^{SB} = \underline{\theta}^{FB}$ *and* $\underline{r}^{SB} = \underline{r}^{FB}$, *with shutdown of the* $\overline{p}$*-coops.*

- *If* $\nu < \frac{\overline{p}}{2\overline{p}-\underline{p}}$, *and* $\underline{LC}$ *is satisfied, then the optimal menu of contracts is so that:*

  (i) $\underline{\theta}^{SB} = \underline{\theta}^{FB}$,

  (ii) $\underline{r}^{SB} < \underline{r}^{FB}$,

  (iii) $\overline{\theta}^{SB} > \underline{\theta}^{SB} = \underline{\theta}^{FB} > \overline{\theta}^{FB}$,

  (iv) $\overline{r}^{SB} < \overline{r}^{FB}$ *and* $\overline{r}^{SB} < \underline{r}^{SB}$.

- *If* $\nu < \frac{\overline{p}}{2\overline{p}-\underline{p}}$ *and* $\underline{LC}$ *is not satisfied, then the optimal menu of contracts is a pooling contract so that:* $\underline{\theta}^{SB} = \overline{\theta}^{SB} = 1$ *and* $\underline{r}^{SB} = \overline{r}^{SB} = r^P$.

Proof:

Let us consider the following cases:

- When $\nu > \frac{\overline{p}}{2\overline{p}-\underline{p}}$, then $\left(\frac{\nu}{1-\nu}\right)\left(\frac{\overline{p}-\underline{p}}{\overline{p}}\right) > 1$. It follows from this result that the second FOC in equation (19) is never true. This is the case of the shutdown of $\overline{p}$-coops and corresponds to the first part of the Proposition. The bank proposes the first-best contract intended for $\underline{p}$-coops, which is not compatible with $\overline{PC}$.

- When $\nu = \frac{\overline{p}}{2\overline{p}-\underline{p}}$, then $\left(\frac{\nu}{1-\nu}\right)\left(\frac{\overline{p}-\underline{p}}{\overline{p}}\right) = 1$. It follows from this result that the second FOC in equation (19) is never true. Indeed, $\rho_c(1-\overline{p})kG > 0$. The first FOC in equation (19) is true, as there is no contract for $\overline{p}$-coops. This corresponds to the intersection between $\overline{PC}$ and $\underline{IC}$ in $\underline{\theta}^{SB} = \underline{\theta}^{FB}$ and to the first part of the Proposition. The bank proposes the first best contract intended for $\underline{p}$-coops, which is not compatible with $\overline{PC}$.

- When $\nu < \frac{\overline{p}}{2\overline{p}-\underline{p}}$ and $\underline{LC}$ is satisfied, the first FOC in equation (19) shows there is no distortion at the bottom for $\underline{\theta}$ (see equation (11)). This corresponds to point (i) of the Proposition. It follows from equations (12) and (18) that there is a downward distortion in $\underline{r}$. This corresponds to point (*ii*). Indeed,

$$\underline{r}^{FB} - \underline{r}^{SB} = (\overline{p} - \underline{p})\frac{U(\overline{d}, \overline{i}, \overline{\theta}) + \rho_c V(\overline{i}) - \Pi^\star}{\rho_c \, \overline{p} \, \underline{p} \, \underline{d}} \geq 0$$

.

- When $\nu < \frac{\overline{p}}{2\overline{p} - \underline{p}}$ and $\underline{LC}$ is satisfied, the second FOC in equation (19) is true and shows there is an upward distortion for $\overline{\theta}$. Indeed, the right-hand side of the second FOC is negative and U is decreasing in θ. Furthermore, $\overline{\theta}^{SB} > \underline{\theta}^{SB}$; otherwise, $\overline{IC}$ is not satisfied. Assumption 1 and result (13) imply that $\underline{\theta}^{FB} \geq \overline{\theta}^{FB}$. This corresponds to point (*iii*) of the proposition. It follows from equation (16) that there is a downward distortion in $\overline{r}$ ($\overline{PC}$ is binding). Furthermore, $\overline{r}^{SB} < \underline{r}^{SB}$ because $\overline{PC}$ and $\underline{IC}$ are binding, implying that $\overline{IC}$ is satisfied (the Spence-Mirrlees condition). This corresponds to point (*iv*).

- When $\nu < \frac{\overline{p}}{2\overline{p} - \underline{p}}$ and $\underline{LC}$ is not satisfied, then $\overline{LC}$ is not satisfied in the second best, as $\overline{\theta}^{SB} > \underline{\theta}^{SB}$ (see (*iii*)). Therefore, the constrained solution implies that $\underline{\theta}^{SB} = \overline{\theta}^{SB} = 1$ and $\underline{r}^{SB} = \overline{r}^{SB}$ to deter the imitation of bad types. The constrained solution is a pooling contract. This corresponds to the last bullet of the proposition.

■

The first implication of Proposition 2 is a standard lemon issue: only risky cooperatives are financed. Even a low proportion $(1 - \nu)$ of safe cooperatives would lead the bank to pay costly information rent to risky cooperatives via a low interest rate. This effect is even more pronounced the riskier the cooperatives are (when $\underline{p}$ is low). This leads to the shutdown of safe cooperatives.

Proposition 2 also states that information asymmetry leads to lower interest rates for both types. The first reason lies in the imitation behavior of risky cooperatives, which leads the bank to propose a lower interest rate than under perfect information (the informational rent). The second reason lies in an increase of safe cooperatives' financial contribution, compensated by the bank via a lower interest rate (the participation constraint for safe cooperatives is binding). This is one way to decrease the informational rent paid to risky cooperatives. The decrease of the interest rate leads all types of cooperatives to invest more than under perfect information.

This also tends to increase the short-term financial constraint of safe cooperatives due to an increase in their financial contribution, while information asymmetry does not affect the financial contributions of risky cooperatives. This is due to informational rent $R(\overline{\theta})$, weighted by the frequency of the bad type relative to the good type (see equation (19)). Indeed, informational rent is decreasing in $\overline{\theta}$ (U is quasi-concave in θ: $U_{\theta\theta} < 0$):

$$\frac{dR(\overline{\theta})}{d\overline{\theta}} = \Big(\frac{\overline{p} - \underline{p}}{\overline{p}}\Big) U_{\overline{\theta}\overline{\theta}}(\overline{d}, \overline{i}, \overline{\theta}) < 0. \tag{21}$$

From Assumption 1, U is decreasing in θ. As such, the second-best financial contribution is higher than the first-best one. The bank trades off between economic efficiency (left-hand side of equation (19)) and the cost of the informational rent (right-hand side of equation (19)). A good way to decrease the informational rent paid to risky cooperatives is to increase $\overline{\theta}$ above the first best. The incentive constraint of the safe cooperative, $\overline{IC}$, leads the bank to ask for a higher financial contribution for safe cooperatives than for risky ones. This counter-intuitive result implies that good projects require higher financial contributions (i.e., safer cooperatives use more retained earnings).

Another result of Proposition 2 is that the interest rate paid by safe cooperatives is always lower than the one paid by risky cooperatives due to $\overline{IC}$, which is not necessarily the case for the first best. This is a regular pattern, as good projects benefit from a lower cost of debt. Consequently, safe cooperatives invest more than risky ones.

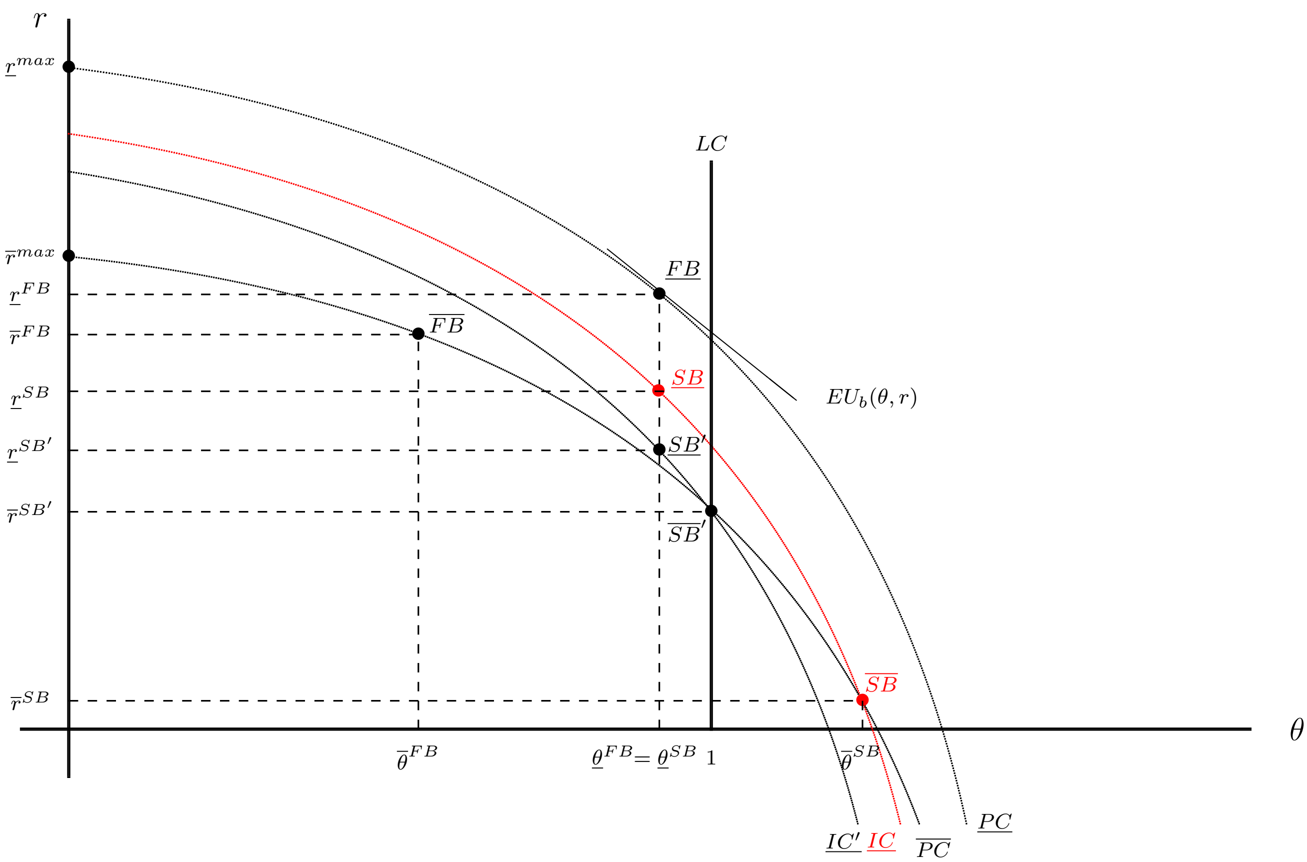

Figure 4.a. First- and second-best contracts when $\overline{r}^{FB} < \underline{r}^{FB}$. In the second-best, safe cooperatives have to pay higher financial contributions than risky ones ($\overline{\theta}^{SB} > \underline{\theta}^{SB}$), but their interest rate is necessarily lower ($\overline{r}^{SB} < \underline{r}^{SB}$), (solutions $\overline{SB}$ and $\underline{SB}$). The constrained solution when $\overline{\theta}^{SB} > 1$ leads the bank to propose a contract for safe cooperatives such that $\underline{IC}'$ crosses $\overline{PC}$ and LC (solution $\overline{SB}'$). The FOCs imply no distortion at the bottom, which leads the bank to propose a contract for risky cooperatives on $\underline{IC}'$ with $\underline{\theta}^{FB} = \underline{\theta}^{SB}$ (solution $\underline{SB}'$). This implies a lower interest rate for risky cooperatives ($\underline{r}^{SB'} < \underline{r}^{SB}$) and a higher interest rate for safe ones ($\overline{r}^{SB'} > \overline{r}^{SB}$), but still lower than $\underline{r}^{SB'}$ (second point of Proposition 2). This result still holds when $\overline{r}^{FB} > \underline{r}^{FB}$.

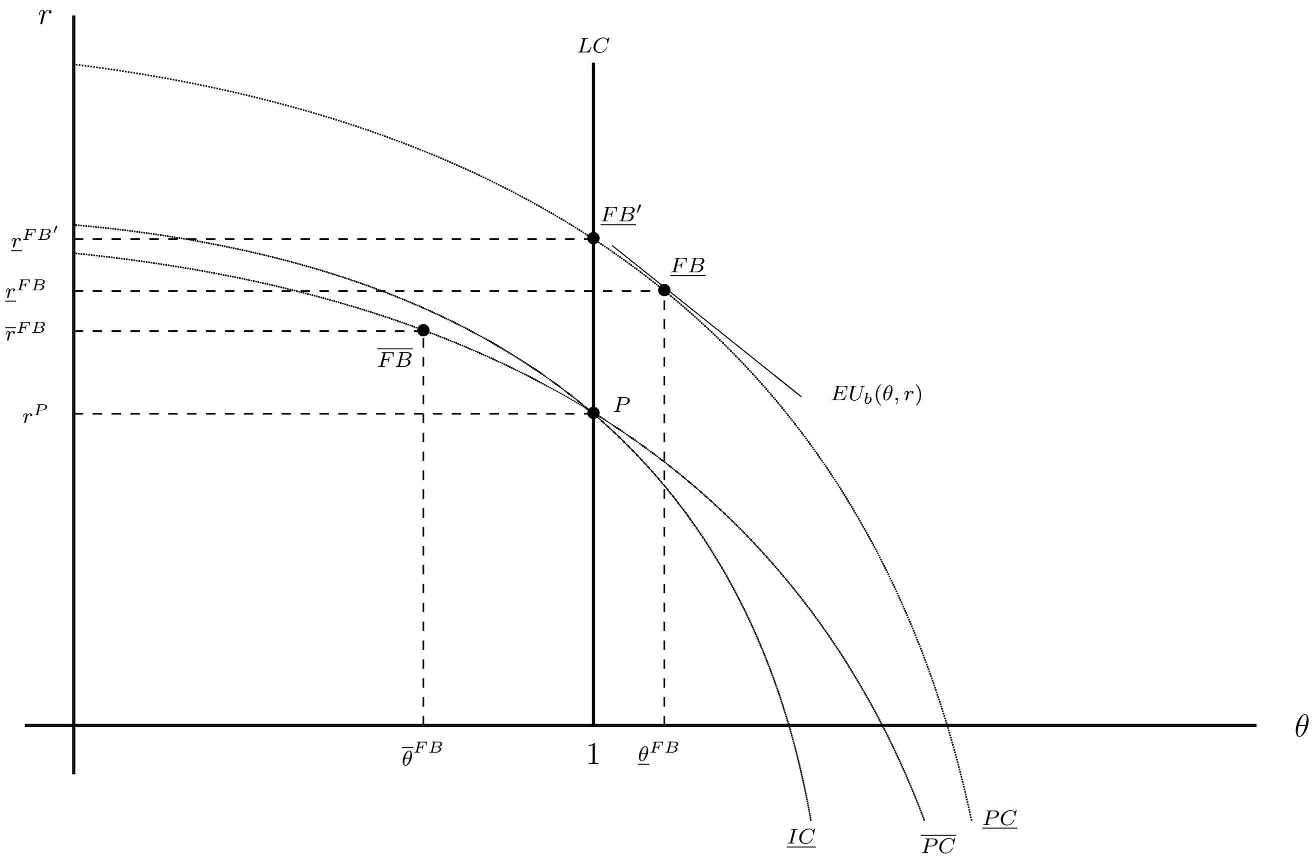

Figure 4.b. Second-best, pooling, and shutdown contracts. The constrained solution when $\underline{\theta}^{FB} > 1$ leads the bank to propose a pooling contract such that $\underline{IC}$ crosses $\overline{PC}$ and LC (solution P). The large distance between $\underline{PC}$ and $\underline{IC}$ indicates a large informational rent benefiting risky cooperatives via a low interest rate (second point of Proposition 2). A high proportion of risky cooperatives leads the bank to propose a shutdown contract (solution $\underline{FB}$), which excludes safe cooperatives from the deal (first point of Proposition 2).

4.2 Financing managerial governance co-ops with incentive contracts

Hitherto, we considered the case of standard governance ($\alpha = 1$). In the following section, we discuss the results for the managerial orientation ($\alpha < 1$ and $\alpha \to 0$). The main difference consists of the preference for allocating all the exogenous gain to members (case of member dominance seen in the previous section) or use it to invest. In the latter case, the requirement for retained earnings is no longer an effective contract term as co-ops do it spontaneously. We first consider the case of contracting under perfect information with one type of managerial-oriented cooperative. Then, we consider the case of contracting under perfect information with safe and risky managerial-oriented cooperatives. Finally, we generalize the previous argument to contracting under asymmetric information.

4.2.1 Managerial governance first-best solutions

The capture of cash by members and retained earnings behaviors depend on the managerial orientation of cooperatives. Under perfect information, the bank can elicit the financial behavior that maximizes short-term utility and long-term value. The following Proposition deals with the contract in that case.

Proposition 3 *Financing any managerial governance cooperatives under perfect information lead the bank to build a contract* $[(\theta_\alpha^{FB}, r_\alpha^{FB})]$ *such that, for any* α*:*

- $\theta_\alpha^{FB} = \theta^{FB}$,
- $r_\alpha^{FB} = r^{FB}$.

Proof:

Let us denote by Π_α^{cap} the profit when managerial cooperatives capture G and by Π_α^{inv} the profit when managerial cooperatives invest G. Then:

$\Pi_\alpha^{cap} = \alpha G + \rho_c(V(i^*) - i^*p(1+r^*))$,

$\Pi_\alpha^{inv} = \rho_c(V(i^*) - (i^* - G)p(1+r^*))$.

Then, $\Pi_\alpha^{cap} \geq \Pi_\alpha^{inv}$ if and only if $\alpha \geq \hat{\alpha} = \rho_c(1+r^*)p$.

If $\alpha \geq \rho_c(1+r_\alpha^{FB})p$, then the cooperative tends to capture the exogenous gain for the short-term benefit of cooperative members and, then, the bank proposes the first-best contract of Proposition 1 because α does not affect the FOCs of equation (11).

If $\alpha < \rho_c(1+r_\alpha^{FB})p$, then the cooperative tends to use the exogenous gain as internal funds to invest, but the bank proposes the first-best contract of Proposition 1 because α does not affect the FOCs of equation (11).

■

Note that, in our setting, the managerial orientation of cooperatives does not affect the optimal contract under perfect information. Financing managerial governance cooperatives under perfect information are characterized by Proposition 1. A second implication is that the bank may deter cooperatives from investing all their earnings when they have a managerial behavior.

4.2.2 Managerial governance second-best solutions

Under asymmetric information, the main issue is that more managerial cooperatives ($\alpha \to 0$) want to invest their exogenous gains, implying that the requirement of a financial contribution by the bank becomes irrelevant. By contrast, the financial contribution is constraining for less managerial cooperatives ($\alpha \to 1$) that want to use the exogenous gains for payment to members. As such, the managerial orientation determines the bargaining power of the bank. The following Proposition deals with the contract in that case.

Proposition 4 *Financing two different types of managerial governance cooperatives under asymmetric information leads the bank to build a menu of contracts* $[(\underline{\theta}_\alpha^{SB}, \underline{r}_\alpha^{SB}); (\overline{\theta}_\alpha^{SB}, \overline{r}_\alpha^{SB})]$ *such that:*

- *If* $\alpha > \hat{\alpha}^{SB} = \rho_c(1 + \underline{r}_\alpha^{SB})\underline{p}$, *then* $[(\underline{\theta}_\alpha^{SB}, \underline{r}_\alpha^{SB}); (\overline{\theta}_\alpha^{SB}, \overline{r}_\alpha^{SB})]$ *is the solution of Proposition 2.*
- *If* $\alpha \leq \hat{\alpha}^{SB} = \rho_c(1 + \underline{r}_\alpha^{SB})\underline{p}$, *then* $\underline{\theta}_\alpha^{SB} = \underline{\theta}^{FB}$ *and* $\underline{r}_\alpha^{SB} = \underline{r}^{FB}$. *This reflects shutdown of* $\overline{p}$ *-coops and perfect information contract for* $\underline{p}$ *-coops.*

Proof:

Let us consider the following cases:

- Following Proposition 2, we know that $\underline{r}^{SB} > \overline{r}^{SB}$ and both types of cooperatives want to capture exogenous gain for cooperative members. Then, the financial contribution is an incentive tool, contracting is possible and Proposition 2 applies since α does not appear in the FOCs of equation (19) (first point of Proposition 4).

- Otherwise, $\underline{p}$-coops want to invest the exogenous gain. Then, the financial contribution is not an incentive tool since $\underline{p}$-coops will choose the contract intended for $\overline{p}$-coops with a higher financial contribution and a lower interest rate. Therefore, the second-best contract does not allow the bank to screen $\underline{p}$-coops and $\overline{p}$-coops. The bank proposes the first-best contract intended to $\underline{p}$-coops, which is not compatible with $\overline{PC}$ (second point of Proposition 4).

■

A first implication of Proposition 4 is that the managerial orientation determines the possibility of contracting. When cooperatives have a too pronounced managerial behavior, the bank is not able to implement an incentive contract, which leads to the shutdown of safe cooperatives. This is a standard lemon issue. However, the managerial orientation does not change the terms of the financing contracts.

5 Conclusions

Observing the 2010-2020 financial trends of US co-ops confirms some of the underlying forces of cooperative finance identified by cooperative scholars: the case of livestock co-ops shows that members can make the repayment of redeemable equity faster than the repayment of debt, which suggests both that members can exert pressures on co-ops to transfer cash to members, and also asymmetric information between co-ops and banks. Plus, the rebound of dairy co-ops shows that financing investment mostly rely on debt at the conditions that members accept to increase the level of retained earnings, in line with the recommendations of Boland (2012). These observations are in line with our results in the sense that it confirms the assumptions of our setting (livestock cooperatives tend to transfer all profit to members) and their results (dairy cooperatives raising their debt ratio against a more than proportional increase of non-allocated equity). In this perspective, we understand the possibility of a rebound for the dairy co-ops where debt is primarily used to finance growth after years of uncertainties and low performances.

Furthermore, our model explains a puzzling feature of cooperative finance like the concurrence of overinvestment and financial constraints. Indeed, we establish that banks require cooperatives to use retained earnings to screen safe from risky cooperatives. This may induce a sensitivity of investment to cash flows, which may be interpreted as a financial constraint. However, this form of financial constraint does not preclude overinvestment: the high level of equity implies a reduction in debt costs, which encourage cooperatives to invest, leading to excess capacity and financial fragility. At this stage, we cannot exclude that dairy co-ops do not follow this path.

Another (and novel) result is that the managerial orientation implies more investment but can lead to credit rationing because of its impact on the incentive contract. This provides a rationale for the persistence of member dominance in the governance of cooperatives, even when the managerial orientation is more desirable.

References

Bijman, J. and Iliopoulos, C. (2014). Farmers' cooperatives in the eu: Policies, strategies, and organization, *Annals of Public and Cooperative Economics* **85**(4): 497–508.
URL: *https://onlinelibrary.wiley.com/doi/abs/10.1111/apce.12048*

Boland, M. (2012). Cooperative finance and equity management, *Proceedings of the 2012 CHS Insight Meetings* pp. 1–9.

Cadot, J. (2022). Success, rebound, or resignation. the divergent financial dynamics of ag co-ops, *Southern Ag Today* **2(28.5)**: 739–751.

Cook, M. (1995). The future of us agricultural cooperatives: A neo-institutional approach, *American Journal of Agricultural Economics* **77**(5): 1153–1159.

Cross, R. and Buccola, S. (2004). Adapting cooperative structure to the new global environment, *American Journal of Agricultural Economics* **5**(86): 1254–1261.

Featherstone, A. and Al-Kheraiji, A. (1995). Debt and input misallocation of agricultural and marketing cooperatives, *Applied Economics* (27): 871–878.

Hart, O. and Moore, J. (1996). The governance of exchanges: Members' cooperatives versus outside ownership, *Oxford Review of Economic Policy* **12**(4): 53–69.
URL: *http://www.jstor.org/stable/23606401*

Jensen, M. (1986). Agency costs and free cash flow corporate finance and takeover, *American Economic Review* **76**: 323–329.

Jensen, M. and Meckling, W. (1976). Theory of the firm : Managerial behavior, agency costs and ownership structure, *Journal of Financial Economics* **3(4)**: 305–360.

Porter, P. K. and Scully, G. W. (1987). Economic efficiency in cooperatives, *The Journal of Law Economics* **30**(2): 489–512.
URL: *http://www.jstor.org/stable/725506*

Rey, P. and Tirole, J. (2007). Financing and access in cooperatives, *International Journal of Industrial Organization* **25**: 1061–1088.

Royer, J. (2017). Financing agricultural cooperatives with retained earnings, *Agricultural Finance Review* **77(3)**: 393–411.

Royer, J. and Mckee, G. (2020). Optimal capital structure in agricultural cooperatives and implications for equity retirement, *Agricultural Finance Review* **81**: 277–291.

Sexton, R. J. (1986). The formation of cooperatives: A game-theoretic approach with implications for cooperative finance, decision making, and stability, *American Journal of Agricultural Economics* **68**(2): 214–225.
URL: *https://onlinelibrary.wiley.com/doi/abs/10.2307/1241423*

Staatz, J. (1989). Farmer cooperative theory: Recent developments, *Agricultural Cooperative Services Research Report* **84**: 1–30.

Stiglitz, J. and Weiss, A. (1981). Credit rationing in markets with imperfect information, *American Economic Review* **71(3)**: 393–410.

USDA (2022). agricultural-cooperative-statistics-reports-data, *www.rd.usda.gov* .

Valentinov, V. (2007). Why are cooperatives important in agriculture? an organizational economics perspective, *Journal of Institutional Economics* **3**(1): 55–69.
URL: *https://EconPapers.repec.org/RePEc:cup:jinsec:v:3:y:2007:i:01:p:55-69*$_0$0

VanSickle, J. J. and George, W. L. (1983). A model of cooperative finance, *American Journal of Agricultural Economics* **65**(2): 273–281.
URL: *https://onlinelibrary.wiley.com/doi/abs/10.2307/1240873*