Outgrower Schemes and Cooperatives: a Problem of Moral Hazard in Teams with Peer-Monitoring*

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Abstract

This paper examines the performance of contract farming and outgrower schemes when agents are groups of jointly-liable farmers who receive input credit from an agribusiness. We provide a theoretical framework where the group's farmers play a credit repayment game with peer-monitoring and moral hazard on production effort. According to effort levels, credit is repaid or not by the group who can be refunded in the future. We show that the principal takes into account not only price incentives on farmers' effort but also on peer-monitoring.

We compare the Principal-agent contract to the Nash-bargaining and Cournot solutions. Because of unenforceable contracts, the welfare analysis suggest that Nash-bargaining may be preferred to competition.

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1 Introduction

Contract farming has become one of the major tool for agricultural development in many developing countries over the past three decades. It typically involves an agribusiness to provide quality inputs, a set of extension and other agricultural services, and, or, credit to individual or farmers' groups. In exchange, farmers have a marketing arrangement with a fixed price and outlet for their output on high-value markets (mostly cash crops, organic and horticultural products) and must follow a particular production method. Reciprocal obligations entail the provision of agricultural services and commitment on purchase prices on the firm's side, and quality requirements and exclusive purchase rights on the farmers' side. Participating to these outgrower schemes has been emphasized in the empirical literature as a strong potential for development and linking smallholder to high-value markets when farmers face an incomplete market environment such as severe credit, risk, or input market failures. The impact on potential rural development and poverty reduction in developing countries (Glover, 1984; Glover and Kusterer, 1990) is discussed according to the dominant position of the firm-and its ability to extract surplus to farmers (Watts, 1994)- and the outside option of farmers on spot markets, and credit and risk markets. Key and Runsten (1999) clearly show that market conditions are affecting particular outgrower characteristics and the scale of outgrower production. The kind of market imperfections determines the industrial organization of contract farming (contract-out, vertical integration, or spot markets) and the profit-sharing between farmers and processors (and traders). Increasing rural credit and insurance markets would strengthen their bargaining power, enabling them to derive more income from their contractual arrangements. Another solution is through collective action of farmers' groups or participation as credible actors in the industry (as for cotton in West Africa, see Tefft, 2008). For the latter case however, Delpierre (2008) shows that the relaxing of the liquidity constraint has ambiguous effects on input use and income.

A dominant position has been shown to be profitable for long-term investments in research and extension services (Coulter et al., 1999, Warning and Key, 2002) in the course of declining public investments and private market failures. In addition, a lack of competitors avoids the risk of farmers' side-selling their output to small traders with short-termist rent-seeking interests. This is the enforcement problem. Hence, private traders or agribusinesses face lower incentives to provide input credit and other services. Poulton et al. (2004) highlights the trade-off between output prices, competition, and input provision. A solution is to promote coordination among traders, with a restricted number of players but others (Badiane et al., 2002) favor a competitive market with institutional building for loan recovery and private investments. . The former solution is observed in several cash-crop sectors with oligopolies or cartels and associated sustainable outgrower schemes. Fierce competition is often associated with low levels of input uses and investment in agricultural research and extension, as for Zimbabwean cotton (Gibbon, 1999) or Tanzanian coffee (Winter-Nelson and Temu, 2002). The main problem is shown to be the collapse of the input credit scheme strategic defaulting on credit is a viable option for farmers.

In theory, outgrower schemes pertain to interlinked agreements among rational economic agents arising in a very fragmented and incomplete market environment (Mitra, 1983) wherever agents are isolated with barriers from entry to some markets (Basu, 1983). However, interlinking was first seen as a "semi-feudal" organization of peasantry exploitation in the literature of development economics (Bhaduri 1977). Indeed, non-personal characteristics of markets are not respected and more powerful principals could reduce their agents to their subsistence level. But this argument has been disproved by many theorists such as Braverman and Stiglitz (1982), Basu (1983), Bell (1989a), Gangopathyay and Sengupta (1986 and 1987). They argued that peasants are never restricted to their subsistence level because they possess some bargaining power[1]. Braverman and Stiglitz (1982) showed that the creation of efficient surplus was improved when interlinkages occur, but depending on the environment, peasants can be worse off. Interlinkages makes enforcing transactions easier and allows for information, enforcement and monitoring costs savings.

In this respect, outgrower schemes mostly involves agribusinesses and groups of farmers, instead of individual farmers. The two main reasons involved are important savings on transaction and information costs-through the delegation of monitoring to groups' peers-, and using group's joint-liability as a collateral, when farmers face substantial cash constraints. Indeed, the lack of physical collateral for poor farmers is a rationale for the

[1] Indeed, at least farmers have exclusive informational power about their actions.

group's joint-liability use as a guarantee on credit repayment and is an essential theme in microfinance[2]. Our paper want to understand the mechanisms of outgrower schemes when we specify the group's functioning. A particular attention need to be focused on the role of group design for contract farming performance. This is particularly missing in the aforementioned literature. What is missing is the game played within farmers' groups, once terms of contract farming have been set. Group mechanisms may support credit recovery through social mechanisms and informal norms by peer-monitoring. Moral hazard is taking place within groups, even if external monitoring exist. So far, the literature has not focused on understanding contract farming as interlinkages with groups within which strategic interactions occur. This is precisely the aim of this paper.

In the group lending literature, group formation allows positive assortative matching by affinities (Ghatak and Guinnane, 1999), thereby reducing *ex ante* moral hazard (the risk type of the project or individuals: probability of success). According to Besley and Coate (1995), the joint liability provides two opposite repayment incentives, one positive coming from the mutual insurance of the group and one negative because expected marginal profit depends not only on individual effort but also on the effort of others. This negative effect from joint liability can be mitigated by the use of credible social sanctions if farmers' actions can be observable *ex post* with a costly monitoring effort from the group. This will enforce cooperative behaviors within groups and will discourage opportunistic behaviors[3]. Efficient peer-monitoring can be induced by credible social sanctions imposed on defaulters, available individual information on creditors to impose individual debt thresholds[4], good governance of farmers groups and risk management systems. Armendariz de Aghion (1999) uses these ingredients in a group lending repayment game with a monitoring decision level stage. For a monopolist lender, it is proven that joint liability brings even more profit than individual creditors, on condition that social sanctions are sufficiently credible and monitoring costs are not too high. Correlated risks among farmers will increase extraction for the lender because of monitoring improvement but it

[2] See Morduch (1999)

[3] They invove strategic defaulting due to *ex post* moral hazard (after the project's outcome is realized), that is, the strategy leading a borrower to default on credit repayment while being able to reimburse.

[4] Experiences in microfinance have clearly show that information based on the situation of the whole credit group was far from being sufficient to ensure viable schemes (see Morduch, 1999; for instance).

will result in least risk diversification[5]. In this literature, the probability of the project's success is exogenous and the moral hazard problem is only explored through the project choice or the *ex post* behavior of agents. For contract farming, we propose a group repayment game that is linked to a production activity (the project) under the supervision of a principal. The production activity is undertaken according to an endogenous effort which can be only be observable by other peers (at some cost) and that determines the probability of success.

Our contribution is to replace contract farming as a specific interlinked agreement accounting for group mechanisms, bridging the gap between the literature on interlinkages and group lending. The group functioning for credit repayment is treated as endogenous, so we can disentangle the effects of contract farming on both individual and group production incentives. Under market failures or incompleteness and unenforceability, it is also possible to analyze the effect of market structure on welfare and to have a more detailed examination of the competition-coordination trade-off (Poulton et al., 2004).

Our results highlight that Nash-bargaining can be welfare-improving and a solution to overcome enforcement problems in competitive environments. Hence, focusing on the empowerment of farmers' groups and the emergence of bargaining co-operatives is a substantial issue. The design of farmers' groups is also essential since the composition and size of the groups are associated to different incentive structures. Political implications are the emerging importance to foster the formation of professional organizations of farmers with viable local structures but also bargaining capacity-building, and the need to invest on extension rural services to ensure flexible group formation and improve local governance.

The remainder of this paper is as follows. Section 2 presents the basic model of a two-symmetric farmers' group playing a credit-repayment game with joint and limited liability where the repayment probability is endogenously determined by private levels of effort that are observable *ex post* through costly peer-monitoring. This group contracts with a monopsonistic agribusiness for production marketing and we look at the pricing rule under complete and full information. Section 3 relaxes assumptions about information and market power. We first derive a Principal-agent model with asymmetric information about

[5]. Under risk-aversion, this rule could lead to the exclusion of the most risk-averse farmers.

farmers' group's characteristics, and then we examine the solution of a Nash-bargaining game formulation in the case of a bilateral monopoly. Last, we allow several agribusinesses and traders to compete in quantities in a Cournot-game. Section 4 is devoted to welfare analysis where we compare the solution of Nash-bargaining and competition with respect to the Pareto-optimal pricing rule. Section 5 discusses the robustness of the results according to several points: group's size and heterogeneity, risk-aversion, timing and structure of the game. We also discuss how results would change under enforceable contracts and institution building. Section 6 concludes.

2 The basic model

In the basic framework, a group-the agent-is composed by two symmetric farmers who contract with a monopsonistic agribusiness (hereafter denoted as the principal). First, the principal sets the terms of the contract defining the purchase price of the cash crop p and provide input credit. The cost of one physical unit of input is normalized to unity and the principal face a marginal receipt at farm gate $\widetilde{p}$[6]. We assume that all farmers who participate to contract farming are cash-constrained and cannot access rural credit markets, so they have no alternative to access inputs: seeds, fertilizers, and pesticides. In the basic model, we also assume that the principal gets all the bargaining power and is a monopsony over crop purchases, making a take-it-or-leave-it offer. Second, the principal has perfect information about farmers and group characteristics. Third, the two farmers play a credit repayment game in group, that is, they are jointly-liable for the repayment of their peer. The structure of this sub-game is the same as Armendariz de Aghion (1999) except that probability of repayment is endogenous in our model, and depend upon an effort production variable. In addition, there is no strategic defaulting (ex-post moral hazard). This is because in the case of contract farming with a monopsony, there is no opportunity for side-selling the cash crop, assuming no parallel market. Hence, farmers simultaneously choose a level of individual production effort e and collective peer-monitoring γ, which are assumed to lie on the interval $[0, 1]$. The individual effort is a private information but can be observed ex-post with probability γ. The level of effort

[6] This is basically the FOB price of crop production from which transport and processing costs are deducted.

represents a labor effort and the quality of input application. Effort is assumed to have a quadratic cost $C(e) = ce^2/2$ and peer-monitoring a linear one $C(\gamma) = d\gamma$.

We model effort as a moral hazard variable, that is, the observed production outcome is realized with a probability which increases with effort. For sake of simplicity, we assume that farmers can reach two levels of production, when using one unit of input:

$$\begin{aligned} &\overline{Y} \text{ with probability } e \\ &\underline{Y} \text{ with probability } 1-e \end{aligned} \tag{1}$$

The lower production outcome does not allow the principal to recover the input loan, while this is the case for the higher one. In the latter case, the farmer gets a positive profit, while he is defaulting in the second case:

$$(\overline{p} - p)\overline{Y} > 1 > (\overline{p} - p)\underline{Y} \text{ and } p\overline{Y} > 1 > p\underline{Y} \tag{2}$$

Defaulting farmers have a limited liability, so in case of defaulting, they get zero profit. In the basic model, the principal has market power, so side-selling cannot occur. If the group defaults, we assume that accessing credit is lost for the future and any produced cash crop is seized[7] Since we are interested in the case of joint-liability, we allow for a group of two symmetric farmers to be able to repay if one of the two farmers defaults, such that:

$$p\overline{Y} + p\underline{Y} > 2 \tag{3}$$

When playing in groups, farmers choose their individual-maximizing effort, which drives an individual optimum level of effort. If farmers can observe the other farmers' efforts, they know that there is a desirable cooperative level of effort e^c that they want to induce (maximizing the joint-profit of the group). If they observe *ex post* that the other farmer has not respected this commitment and plays its individual maximizing-profit level of effort e^{nc}(non-cooperative), they will impose him a social sanction (common in the literature of group lending) W. Incentives to invest in peer-monitoring thus depend

[7] We assume limited liability of farmers as no more than the produced cash crop can be seized by the monopsony.

on its efficiency, that is, the relative level of W compared to d, and the additional profit moving from non-cooperative to cooperative production efforts.

Once production occurs, farmers learn their peer's effort with some probability and punish cheaters. If the group repays its global debt, then it will be refunded for the next period. The exogenous value of accessing credit in the next periods is denoted $V > 0$[8]. All parameters are common knowledge within the group. The timing of the game can be stated as follows:

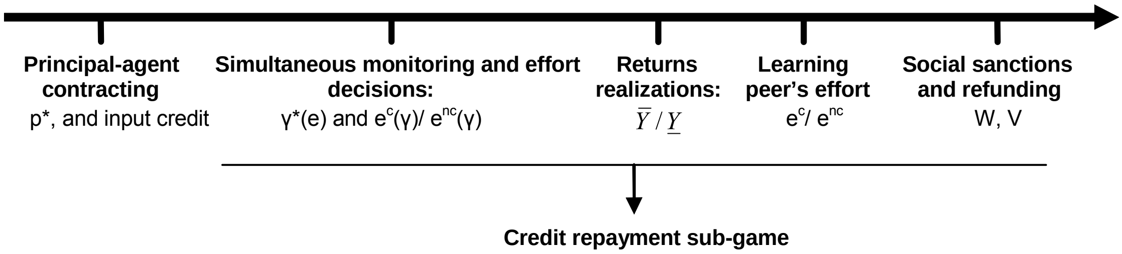


Figure 1: Principal-group game under joint-liability

2.1 The credit repayment sub-game

Assuming risk-neutrality, we can write the objective function of an individual farmer under a joint-liability agreement if same efforts are undertaken by players:

$$E\pi - d\gamma - \mathbf{1}\gamma W = e^2[p\overline{Y} - 1] + e(1-e)[p(\overline{Y} + \underline{Y}) - 2] + Ve(2-e) - ce^2/2 - d\gamma - \mathbf{1}\gamma W \tag{4}$$

where $\mathbf{1}$ is a boolean variable and equals 1 if $e < e^c$ and 0 otherwise. e^2 is the probability that both farmers repay their credit and $e(1-e)$ is the probability that the individual farmer repays but has to finance the debt of his peer. Finally, $e(2-e)$ is the probability that at least one farmer repays its credit, so that the group can be refunded in the next period. We solve the game by backward induction. First, we compute the cooperative and non-cooperative production effort levels, then we look at equilibria, according to peer-monitoring decisions. We notably define parameter intervals where cooperative and

[8] V can be interpreted as a reputational loss for the farmer in his community, but also as earnings losses from not accessing future credits. In the latter case, V should be endogenized in a repeated game framework (see Armendariz de Aghion, 1999). However, an exogenous V is robust to our results.

non-cooperative effort levels are equilibria. Second, according to cooperative and non-cooperative effort levels, we derive optimal peer-monitoring investment. Third, we look at the optimal strategy of the monopsonistic agribusiness when accounting for expected effort reaction from the group.

To get the optimal cooperative effort level, we maximize (4) with respect to effort under the participation constraint that expected profit is non-negative and treating the peer's effort as endogenous. Note that this is sufficient since farmers are symmetric. First-order conditions entail:

$$e^c = \frac{p(\overline{Y} + \underline{Y}) - 2 + 2V}{c + 2p\underline{Y} - 2 + 2V} \tag{5}$$

To have interior solutions, we assume that $c > p\Delta Y = p(\overline{Y} - \underline{Y}) => c/2 > 1 - p\underline{Y}$ because of (3).

The non-cooperative effort is the optimal individual effort, treating the peer's effort as exogenous, such as:

$$\max ee'[p\overline{Y} - 1] + e(1 - e')[p(\overline{Y} + \underline{Y}) - 2] + V(e + e'(1 - e)) - ce^2/2 \tag{6}$$

where e' stands for the exogenous effort of the other player. First-order conditions yield the best-response function of each farmer:

$$e^{nc}(e') = \frac{p(\overline{Y} + \underline{Y}) - 2 + V}{c} - e'\frac{(p\underline{Y} - 1 + V)}{c} \tag{7}$$

Now, we look at the effort equilibria according to peer-monitoring levels. In the credit repayment game, there are two pure strategies: play cooperatively or not. Here is the table of all possible effort equilibria:

Strategies	Cooperative	Non-cooperative
Cooperative	(e^c, e^c)	$(e^c, e^{nc}(e^c))$
Non-cooperative	$(e^{nc}(e^c), e^c)$	$(e^{nc}(e^{nc}), e^{nc}(e^{nc}))$

(e^c, e^c) is an equilibrium if the expected profit of playing cooperatively is greater than deviating minus the expected social sanction, that is $E\pi(e^c, e^c) > E\pi(e^{nc}(e^c), e^c) - \gamma W$. Similarly, $(e^{nc}(e^{nc}), e^{nc}(e^{nc}))$ is an equilibrium if and only if the return from cooperative behavior is not offset by the additional profit of deviation minus the expected social sanction. In other terms, $E\pi(e^{nc}(e^{nc}), e^{nc}(e^{nc})) - \gamma W > E\pi(e^{c}, e^{nc}(e^{nc}))$. After some calculations, we find that the cooperative effort level is a symmetric equilibrium if

$$\gamma > \gamma^{c} = \min(\frac{c(\Delta e)^2}{2W}, 1) \tag{8}$$

and that the non-cooperative one is a symmetric equilibrium as soon as:

$$\gamma < \gamma^{nc} = (\min(\frac{c(\delta e)^2}{2W}, 1) \tag{9}$$

where $\Delta e = e^{c} - e^{nc}(e^{c}) > 0$ and $\delta e = e^{c} - e^{nc}(e^{nc}) > 0$ because of (5) and (7) when efforts are interior solutions. When $V < 1 - p\underline{Y}$, $\delta e > \Delta e => \gamma^{nc} > \gamma^{c}$, and this is the reverse for the other case. For large V, when peer-monitoring level is between these two thresholds, $(e^{c}, e^{nc}(e^{c}))$ occurs[9] because $\gamma^{nc} < \gamma^{c}$. However, for low V, the intermediary peer-monitoring levels induce the occurrence of both cooperative and non-cooperative equilibria. The cooperative one Pareto-dominates the latter. This can be represented as in the following graph:

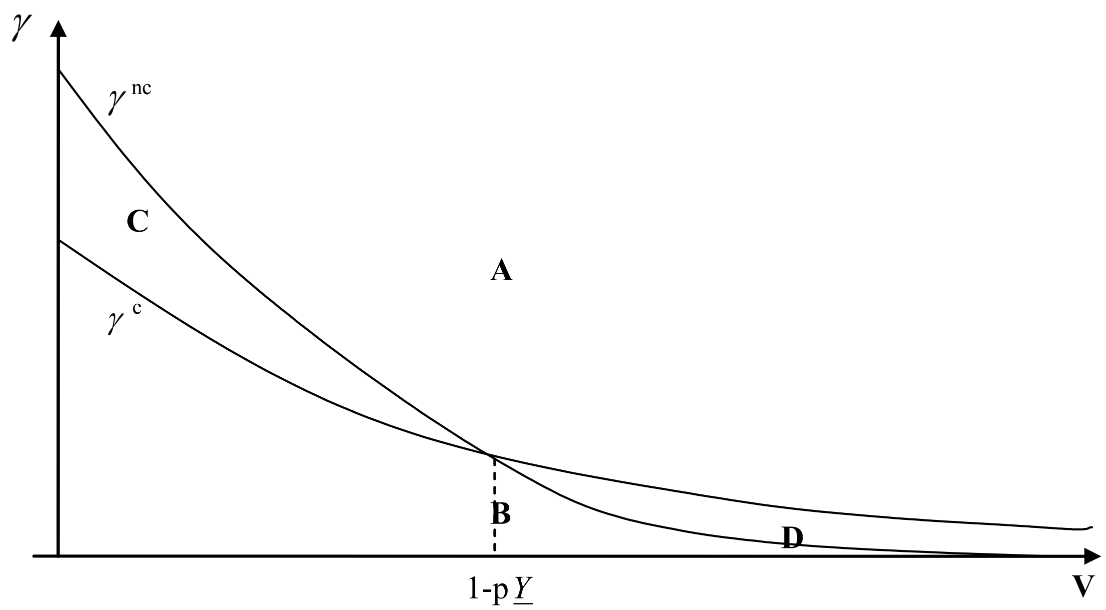


Figure 2: Effort equilibria according to peer-monitoring levels

[9]This equilibria is called the asymmetric equilibria hereafter.

From (8) and (9), we can compare the pattern of each peer-monitoring threshold above or below which cooperative and non-cooperative efforts are equilibria of the credit repayment sub-game. In zone A, the cooperative effort is the only pure-strategy Nash equilibrium. In zone B, the non-cooperative one is the Nash equilibrium. In zone D, only the asymmetric equilibria occurs because it is not profitable to cooperate when profits from deviation are not offset by a too low expected social sanction. However, it is still better to avoid to be punished if the other player plays non-cooperatively. In zone C, there are two pure-strategy Nash equilibria but the cooperative one Pareto-dominates the other one. Finally, we define $\gamma^{cc} = \frac{E\pi(e^c,e^c)-E\pi(e^{nc}(e^{nc}),e^{nc}(e^{nc}))}{W} = \min(\frac{(\delta e)^2}{W}[c/2+p\underline{Y}-1+V],1)$ and $\gamma^{nc,c} = \min(\frac{E\pi(e^{nc},e^{nc})-E\pi(e^c,e^{nc}(e^c))}{W},1)$.

The last step of solving the credit-repayment sub-game is to solve for optimal peer-monitoring. Peer-monitoring is profitable when it helps farmers undertake cooperative effort instead of non-cooperative one, but not to improve profit levels. As it is costly, optimal peer-monitoring is the minimum level of peer-monitoring that can trigger a profitable shift in effort equilibria. Hence, farmers choose between:

- $\gamma^* = 0$ if $E\pi(e^{nc}(e^{nc}),e^{nc}(e^{nc})) > \overline{E\pi(e^c,e^{nc}(e^c))} - d\gamma^{nc} - W\gamma^{nc}/2$ and if $E\pi(e^{nc}(e^{nc}),e^{nc}(e^{nc})) > E\pi(e^c,e^c) - d\gamma^c$

- $\gamma^* = \gamma^{nc}$ if $\overline{E\pi(e^c,e^{nc}(e^c))} - d\gamma^{nc} - W\gamma^{nc}/2 > E\pi(e^{nc}(e^{nc}),e^{nc}(e^{nc}))$ and if $\overline{E\pi(e^c,e^{nc}(e^c))} - d\gamma^{nc} - W\gamma^{nc}/2 > E\pi(e^c,e^c) - d\gamma^c$

- $\gamma^* = \gamma^c$ if $E\pi(e^c,e^c) - d\gamma^c > E\pi(e^{nc}(e^{nc}),e^{nc}(e^{nc}))$ and if $E\pi(e^c,e^c) - d\gamma^c > \overline{E\pi(e^c,e^{nc}(e^c))} - d\gamma^{nc} - W\gamma^{nc}/2$

  where $\overline{E\pi(e^c,e^{nc}(e^c))} = \frac{E\pi(e^c,e^{nc}(e^c))+E\pi(e^{nc}(e^c),e^c)}{2}$ the average profit when deviation occurs, because we do not know which player is deviating. In this case, the expected sanction is equal to $W\gamma^{nc}/2$. The solutions of the credit-repayment game can be stated in the following proposition and represented in the below graph. Figure 3 displays the zones of effort equilibria according to parameter values, in the case where the asymmetric equilibrium exists.

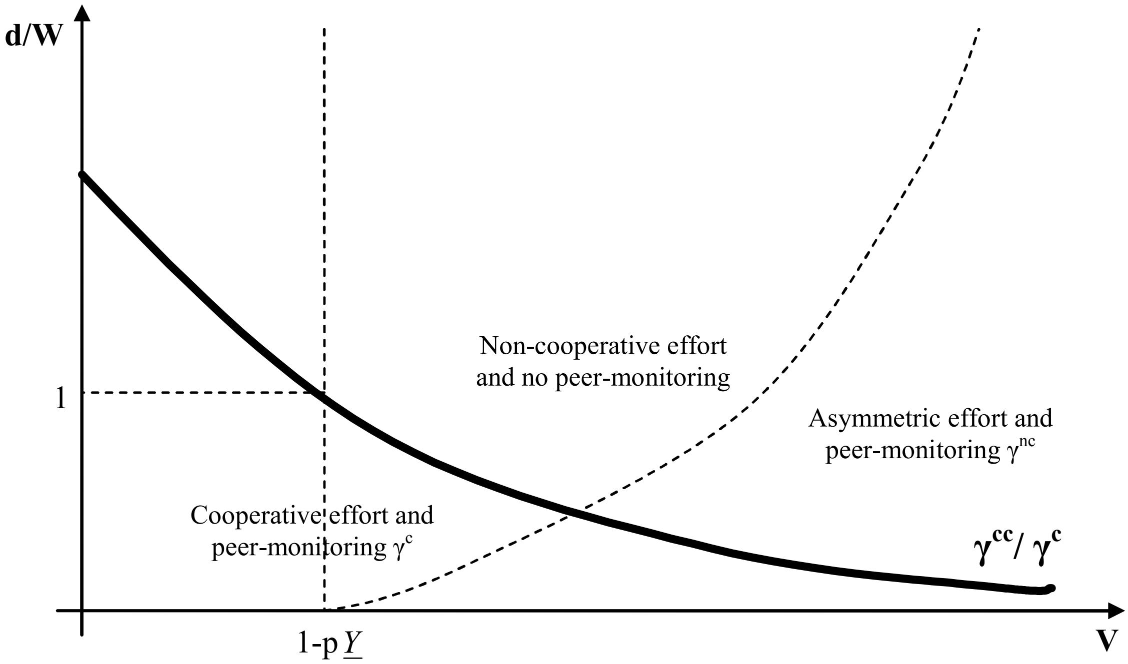


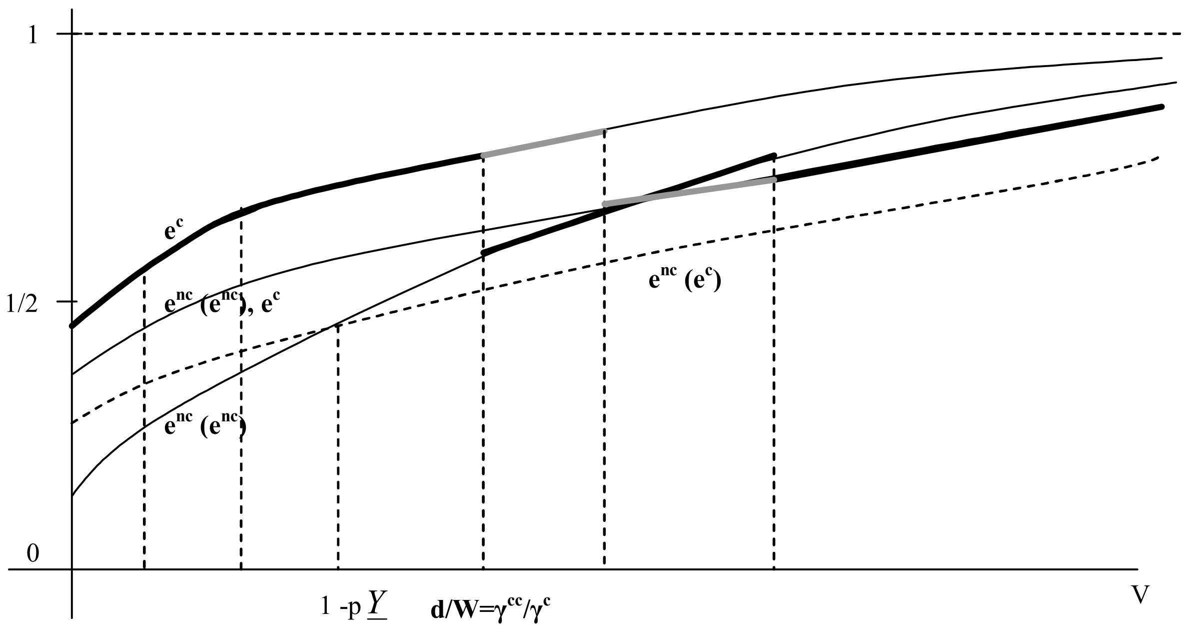
Figure 3: Effort equilibria and optimal peer-monitoring decisions

Proposition 1 *In the credit repayment sub-game with two symmetric farmers under moral hazard, simultaneous individual effort and collective peer-monitoring decisions entail:*

- *Farmers play cooperatively with* $\gamma^* = \gamma^c$ *if and only if* $\frac{d}{W} < \frac{\gamma^{cc}}{\gamma^c}$
- *Farmers play* $(e^c, e^{nc}(e^c))$ *or* $(e^{nc}(e^c), e^c)$ *with* $\gamma^* = \gamma^{nc}$ *if and only if* $\frac{\gamma^{cc}+\gamma^{nc,c}-\gamma^c/2}{\gamma^c-\gamma^{nc,c}} < \frac{d}{W} < \frac{(\gamma^{cc}+\gamma^c)/2-\gamma^{nc,c}}{\gamma^{nc,c}}$ *when* $V > 1 - p\underline{Y}$
- *Farmers play non-cooperatively with* $\gamma^* = \gamma^{nc}$ *if and only if* $\frac{d}{W} > \frac{\gamma^{cc}}{\gamma^c}$ *and* $\frac{d}{W} > \frac{(\gamma^{cc}+\gamma^c)/2-\gamma^{nc,c}}{\gamma^{nc,c}}$
- *The occurrence of cooperative effort is increasing with* W *and decreasing with* d*,* p *and* V*. This is the reverse for the non-cooperative effort. The asymmetric equilibria occurs for intermediary values of* d/W *and the largest values of* V*. All effort equilibria have increasing levels with* V *and* p

Proof. See in the appendix for solving and comparative statics. ■

Intuitively, when V becomes large, cooperative and non-cooperative effort becomes so close that it is not profitable anymore to peer-monitor since the marginal gain of shift in effort equilibrium is too low. However, the difference between the asymmetric level of effort and the non-cooperative one becomes profitable to invest in a lower level of peer-monitoring. With respect to the value of d/W, we represent in this graph the sequence of effort equilibria as a function of V.



Note : The black line is the effort equilibrium when d/W is above 1. This trajectory is replaced by the grey one when d/W is of lower values.

Figure 4: Sequence of effort equilibria along V

In the remainder of this paper, we will only consider cases were cooperative and non-cooperative effort are equilibria. We exclude the case of very high levels of V where both levels of effort equilibria coexist.

2.2 The contracting stage

Assuming that the agribusiness is a monopsony having perfect information about farmers' characteristics, it will optimize its own profit accounting for farmers' reaction within their groups, as it has been solved for the credit repayment game. In a first step, the monopsony maximizes its own profit, according to effort levels. We first solve this optimization problem for both effort levels, cooperative and non-cooperative ones. Then, we look at the indifferent price level for which farmers are indifferent playing either cooperatively or not. Comparing the indifferent price $\widehat{p}$ to optimal pricing for cooperative and non-cooperative effort will allow us to define a rule of optimal contracting for a monopsony.

According to the effort reaction of farmers e^x, then the monopsony

$$\max_p \Pi^m(p) = (\widetilde{p} - p)(\underline{Y} + e^x \Delta Y) - 1 + (e^2 + 2e(1-e)) \tag{10}$$

where the x subscript refers to the type of effort equilibrium (either $x = c$, or $x = nc$). We assume that the participation constraint of farmers is not binding at optimum. We obtain the following first-order condition:

$$[\frac{\widetilde{p} - p}{p}]^m = \frac{1}{\varepsilon_{EY^x/p}} - \frac{2(1-e^x)}{p\Delta Y} \tag{11}$$

which is the optimal margin for a monopsonistic agribusiness, and where EY^x is the expected production level when effort is x and $\varepsilon_{EY^x/p}$ is the individual price elasticity of supply. Note that the monopsonistic margin is below the standard Ramsey rule since the monopsony internalizes the credit repayment by farmers and the complementariness between interlinked input and output markets.

We then look at the indifferent price level $\widehat{p}$ such that farmers are indifferent between cooperative and non-cooperative strategies. According to our computations in previous subsection, it means that $\frac{d}{W} = \frac{\gamma^{cc}}{\gamma^c}$. This must satisfy the following equation:

$$\begin{aligned} \underline{Y}^2\widehat{p}^2 + 2(V-1)\widehat{p} + (c-1+V)(d/W(c-1+V) - 2c) &= 0 \\ \text{such that } \widehat{p} &> 0 \end{aligned} \tag{12}$$

The solution exist if d/W is low,

$$\widehat{p_2} = [(1-V) + \sqrt{(1-V)^2(1-\underline{Y}d/W) + \underline{Y}^2c(c-1+V)(2-d/W)}]/\underline{Y}^2 \tag{13}$$

and two solutions exist when $V < 1$: $\widehat{p_2}$ and

$$\widehat{p_1} = [(1-V) - \sqrt{(1-V)^2(1-\underline{Y}d/W) + \underline{Y}^2c(c-1+V)(2-d/W)}]/\underline{Y}^2 \tag{14}$$

Then, the optimal solution of the monopsony would then account for change in effort type of producers, according to the parameters of the group, and notably d/W and V. The decision set can be illustrated in the below figure, knowing that the price elasticity of production is larger for cooperative effort than for the non-cooperative one, and denoting $\Pi^c(p)$ and $\Pi^{nc}(p)$ the respective profit of the agribusiness under cooperative effort (resp. non-cooperative effort). These profit curves have an optimal point according to (11).

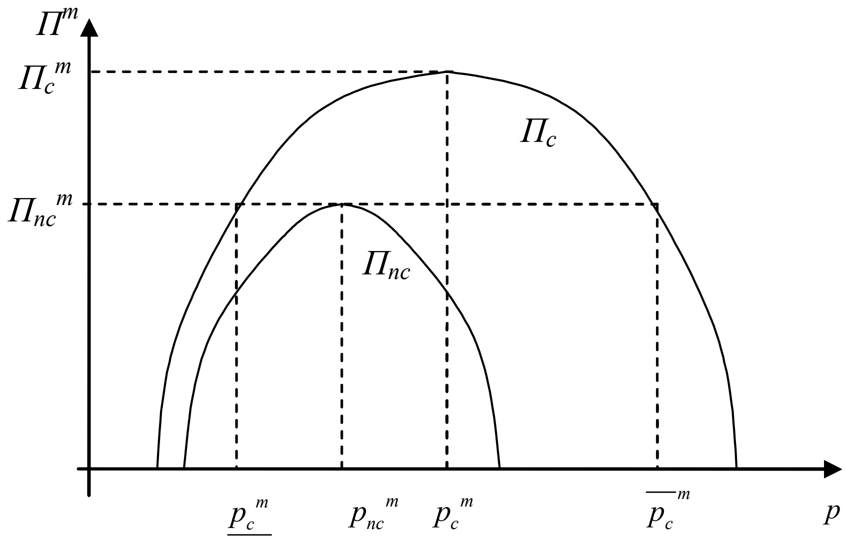


Figure 5: Profit maximizing for a fully informed monopsony

Optimal behavior of the monopsony will depend on the particular points displayed in the above figure, and on the level of $\widehat{p_1}$ and $\widehat{p_2}$, if they exist. Then, the following proposition can be stated:

Proposition 2 *Optimal pricing for a monopsonistic agribusiness entail:*

- *When d/W is high, $p^m = p^m_{nc}$ and this decision induces a non-cooperative behavior among farmers*
- *When d/W is low and $V > 1$, $p^m = p^m_{nc}$ if $\widehat{p_2} < \underline{p_c}$; $p^m = \widehat{p_2}$ if $\underline{p^m_c} < \widehat{p_2} < p^m_c$; and $p^m = p^m_c$ otherwise*
- *When d/W is low and $V < 1$, $p^m = p^m_{nc}$ if $\widehat{p_2} < \underline{p^m_c}$; $p^* = \widehat{p_2}$ if $\underline{p^m_c} < \widehat{p_2} < p^m_c$; $p^m = p^m_c$ if $\widehat{p_1} < p^m_c < \widehat{p_2}$; $p^m = \widehat{p_1}$ if $p^m_c < \widehat{p_1} < \overline{p^m_c}$; and $p^m = p^m_{nc}$ otherwise*

Hence, according to parameters relating to farmers and group's characteristics, optimal pricing can change and will induce different effort equilibria in the repayment game with peer-monitoring. Note that the monopsony can achieve optimal profits along the $[\Pi_{nc}^{m}(p_{nc}^{m}); \Pi_{c}^{m}(p_{nc}^{m})]$ interval. In addition, an increase in $\widetilde{p}$ does not necessarily ensure the monopsony to achieve higher profits since it will shift the curves of Π_{nc}^{m} and Π_{c}^{m} to the right (figure 5 above) and cooperative effort might be less likely to hold in equilibrium. Hence, optimal profits are a non-monotonic function of $\widetilde{p}$. The assumptions of perfect information and pure dominant position now need to be relaxed. The pricing rule also is not a monotonic function of farmers' or groups' characteristics.

Private information about their own characteristics can allow farmers to get informational rents. Better organized farmers may lead to a Nash-bargaining game in a context of bilateral-whether balanced or not-monopoly. The existence of potential entrant traders (even with fixed costs of entry) will also reduce the bargaining power of the incumbent agribusiness. First, it might lead to a Cournot-game in quantities, and in input provision. Second, it can force the monopsony to leave more rents to farmers in order to deter entry. For these next developments, we will only consider cases where $V > 1$ and of intermediary values.

3 Imperfect information, Nash-bargaining, and competition

3.1 Asymmetric information on the group's type: a Principal-agent model

Looking at the asymmetric information issue between the Principal and the group of farmers is the first way to take into account the difficulties for a principal monopsonist to set price formulae in the terms of the outgrower arrangement. One interesting case is when the Principal gets no idea about the ability of the group to enforce cooperative behavior at a given price, or not, that is, if $\frac{d}{W}$ is of high or low level.

Let us assume that the Principal faces two potential groups of farmers: with probability μ, the group has $\underline{\frac{d}{W}}$ and is able to enforce cooperative equilibrium under the price $\widehat{p}$, with probability 1− μ the group has $\overline{\frac{d}{W}}$ and can only reach at non-cooperative equilibrium such as characterized as above. To be able to screen farmers' groups, the Principal can use a two-part payment scheme with a pricing rule p and fixed payment F so as to propose a menu to the two potential groups. Let us state that the fixed payment would occur *ex post*, according to the observed production effort. The program can be written:

$$\max_{\overline{p},\underline{p},\overline{F},\underline{F}} \mu\Pi^m(\underline{p}) + (1-\mu)\Pi^m_{nc}(\overline{p}) - \mu\underline{F} - (1-\mu)\overline{F} \tag{15}$$

where subscripts refer to the group's type. Assuming the participation of both groups of farmers, the maximization program is subject to the following constraints:

$$\begin{aligned} \underline{E\pi}(\underline{p}) + \underline{F} &\geq \underline{E\pi}(\overline{p}) + \overline{F} \\ \overline{E\pi}(\overline{p}) + \overline{F} &\geq \overline{E\pi}(\underline{p}) + \underline{F} \\ \underline{F}, \overline{F} &\geq 0 \end{aligned}$$

Only the second constraint is binding at equilibrium so that:

$$\underline{p} \geq \overline{p} \text{ and } \overline{F} = \overline{E\pi}(\underline{p}) - \overline{E\pi}(\overline{p}) \geq \underline{F} = 0$$

We replace the binding constraints in the objective function of the Principal:

$$\max_{\overline{p},\underline{p}} \mu\Pi^m(\underline{p}) + (1-\mu)\Pi^m_{nc}(\overline{p}) - (1-\mu)(\overline{E\pi}(\underline{p}) - \overline{E\pi}(\overline{p})) \text{ s.t. } \underline{p} \geq \overline{p} \tag{16}$$

with λ the associated Lagrange multiplier of the price constraint, so that:

$$\begin{aligned} \Pi^{m\prime}_{nc}(\overline{p}) &= -\overline{E\pi}'(\overline{p}) + \lambda \\ \Pi^{m\prime}(\underline{p}) &= \frac{1-\mu}{\mu}\overline{E\pi}'(\underline{p}) - \lambda \end{aligned}$$

We obtain two kind of equilibrium: a pooling equilibrium with $\lambda > 0$ when $\underline{p} = \overline{p} = p$ and a sorting equilibrium with $\lambda = 0$ when $\underline{p} > \overline{p}$. Then, we state the following proposition

Proposition 3 *If the monopsony has imperfect information about the group's ability to enforce cooperative equilibrium of effort for a given pricing rule, then it exists two optimal pricing rules for two groups of farmers among which one can enforce cooperative effort but not the other:*

- *When $\widehat{p}$ is sufficiently high as well as μ, it exists a sorting equilibrium menu $(\overline{p}, \underline{p}, \overline{F}, \underline{F})$ composed by a pricing rule and a fixed payment for both types of groups such that:*

$$\begin{aligned}
\Pi_{nc}^{m\prime}(\overline{p}) &= -\overline{E\pi}'(\overline{p}) \\
\Pi^{m\prime}(\underline{p}) &= \frac{1-\mu}{\mu}\overline{E\pi}'(\underline{p}) \\
\underline{p} &> \overline{p}, \overline{F} = \overline{E\pi}(\underline{p}) - \overline{E\pi}(\overline{p}) > \underline{F} = 0
\end{aligned}$$

- *Otherwise, only a pooling equilibrium menu exists (p, F) such that*

$$\begin{aligned}
\Pi^{m\prime}(p) + \Pi_{nc}^{m\prime}(p) &= \frac{1-2\mu}{\mu}\overline{E\pi}'(p) \\
F &= 0
\end{aligned}$$

Proof. See in the appendix ■

Graphical representation (to add): Note that, for the sorting equilibrium, the pricing rule for the low-efficient group is larger than under complete information case, with a fixed payment. In addition, the pricing rule for the high-efficient type might be lower than under the full-information case. In the pooling equilibrium however, prices can be lower for both types. The pricing rule is always suboptimal compared to the first-best solution

3.2 A Nash-bargaining theoretic approach

The Principal-agent representation has received many criticisms in the literature on co-operatives, because it is very unlikely that a Principal can get all the bargaining power in contracting with groups of farmers. Hence, Nash-bargaining theoretic approaches were developed, starting with Bell and Zusman (1976) and applied to issues of sharecropping or tenancy contracts (see also Bell, 1989b). Nash-bargaining occurs when farmers' organizations are more structured and can act as an influential player on the decision-making process in contracting with agribusiness or governments (when they contract with parastatals).

To represent in simplified terms the Nash-bargaining problem, we use the Oczkowski (2004) theoretical approach of the bargaining cooperative in a case of bilateral monopoly. This approach is particularly relevant since the co-operative has only a bargaining role for its producers (as it could be the case in contract farming) and does not engage in processing or marketing. As Ozckowski (2004), we use the generalized Nash-bargaining model (Binmore, Rubinstein, and Wolinsky, 1986), which is consistent with the standard axiomatic approach of Nash (1950) but also with other strategic models of bargaining with alternative offers (Rubinstein, 1982).

The key assumptions are as followed. We assume that the Nash disagreement point is null for both the co-operative and the agribusiness. At the status quo, the two players will not trade if it is worsening their original position and their objectives. Outside options are assumed to be unattractive, and will not constrain the Nash solution. According to the literature, behavioral assumptions about the co-operatives involve that it may optimize the member's price, i.e., the average per-unit return price to individual members composed of the bargained market price minus the average bargaining cost. The second option is to maximize member's profit or third, to maximize the co-operative surplus or members' total revenue[10].

Holding output constant, then we use the standard results of the Nash-bargaining model to apply them to our framework. Let us assume that the co-operative has a bargaining power τ comprised between 0 and 1 and fixed bargaining cost of B, and the agribusiness has a bargaining power of $1-\tau$. Then, we can get:

$$p^{NB} = \tau(\widetilde{p} - \frac{1}{EY(e(p,\gamma),\gamma(\frac{d}{W},V))}) + (1-\tau)(\frac{ce^2(p,\gamma(\frac{d}{W},V))/2 + B}{EY(e(p,\gamma),\gamma(\frac{d}{W},V))}) \tag{17}$$

under profit maximization of co-operative members, or

$$p^{NB} = \tau(\widetilde{p} - \frac{1-(e^2+2e(1-e))}{EY(e(p,\gamma),\gamma(\frac{d}{W},V))}) + (1-\tau)\frac{B}{EY(e(p,\gamma),\gamma(\frac{d}{W},V))} \tag{18}$$

under the maximization of co-operative surplus or average returns for members, given a fixed output. Note that this price is lower under these two rules than the former one when τ is not too high . For now, we will only consider the former solution.

Obviously, it exist two price solutions, according to the final effort equilibrium of the group-repayment sub-game (see previous section). Because of the assumptions made in the basic model, namely that $c > p\Delta Y$, then we obtain that the Nash-bargaining game has

[10] See Bateman, Edwards, and LeVay (1979) for a motivation for these assumptions.

two solutions, that corresponds to the cooperative and non-cooperative effort equilibria. These two solutions correspond to higher prices than under the Principal-Agent solution under complete information (see previous section), but here again, according to the level of $\widehat{p}$, the Nash-bargaining pricing rule will not be continuous and there are some intervals where the purchase price equilibrium might be lower than under the perfectly informed monopsony.

Proposition 4 *In the Nash-bargaining generalized game between a bargaining co-operative with bargaining strength τ and a monopsonistic agribusiness with bargaining strength $1-\tau$, the pricing rule at equilibrium is (assuming that the co-operative maximizes the profit of its members):*

- *When d/W is high, $p^{NB} = \tau(\widetilde{p} - \frac{1}{EY(e^{nc})}) + (1-\tau)(\frac{ce^{nc2}/2+B}{EY(e^{nc})})$ and only non-cooperative effort is undertaken by farmers*
- *When d/W is low, $p^{NB} = \tau(\widetilde{p} - \frac{1}{EY(e^{nc})}) + (1-\tau)(\frac{ce^{nc2}/2+B}{EY(e^{nc})})$ for the lowest values of $\widehat{p}$, then $p^{NB} = \widehat{p}$ for the intermediary values of $\widehat{p}$, and then $p^{NB} = \tau(\widetilde{p} - \frac{1}{EY(e^{c})}) + (1-\tau)(\frac{ce^{c2}/2+B}{EY(e^{c})})$ when $\widehat{p} > \tau(\widetilde{p} - \frac{1}{EY(e^{c})}) + (1-\tau)(\frac{ce^{c2}/2+B}{EY(e^{c})})$*

Graphical representation (to add): Nash bargaining can be Pareto-improving from the Principal-agent solution but because of discontinuity, it can be Pareto-worsening. Note that our particular case-which is the accounting for cooperative and non-cooperative effort equilibria from the farmers' group repayment game-may involve a discontinuous Nash bargaining set in the bargaining game.

3.3 Competition and side-selling problems

Here, we still consider, as above, the effort equilibria of farmers according to their individual and group characteristics but we introduce a Cournot-game in quantities among I traders. Our goal is not to theoretically explore the competition-coordination issue, as in Delpierre (2008). We just want a framework where we can compare the welfare gains of competition with respects to the lower incentives for farmers on effort because of side-selling and unenforceability.

We assume that in the case of competition, traders cannot prevent farmers from side-selling. So only spot transactions take place on the output market. Let us also assume that traders are symmetric so they have to provide $1/I$ quantities of input to the representative group of producers. That is, the agribusiness just finance input provision through the margin she makes on the final output marketing and/or processing. In contrast to the Principal-agent formulation, the cost of inputs is not deducted from the purchase value of output. As side-selling is possible, then V decreases with the number of traders who can decreasingly information with the level of competition. Let us assume that $V(I) = V\exp^{1-I}$ as a decreasing and convex function of I and tends to zero when I tends to infinity. Incentives for effort hence decrease with competition, everything equal. However, because V is lower, then cooperative effort may be more easily enforceable because of more incentives for peer-monitoring. Hence, the overall effect of competition on the final effort outcome is ambiguous. Let us try to encompass this when traders compete in quantities. Each trader i's profit is:

$$\Pi_i^I(p) = (\widetilde{p} - p)EY_i^I - 1/I \tag{19}$$

such that:

$$\underline{Y} + e^x \Delta Y = EY = \sum EY_i^I$$

The reaction function of trader i can be derived from the maximization of (19) with respect to individual quantity EY_i:

$$EY_i^I(\sum_{j\neq i} EY_j) = \frac{\partial EY}{\partial p}[\widetilde{p} - p(\sum_{j\neq i} EY_j + EY_i^I)]$$

that yields (by aggregation)

$$EY(e(I), p) = I\frac{\partial EY(e(I,p)}{\partial p}[\widetilde{p} - p] \tag{20}$$

which is the standard Cournot solution. When competition is higher, we already argued that both levels of effort equilibria are lower, but cooperative effort can be enforced by the group more easily. As a result, there are intervals where $EY(I)$ increases with I (because of discontinuity). The reverse trend holds for $\frac{\partial EY(I)}{\partial p}$. As a result, it is not clear if the optimal margin of the trader will reduce proportionally to the degree of competition, as it is the case for standard Cournot equilibrium. Rather, it is likely that the decrease of the traders' margin would be slower because of the counter-effect of competition on $V(I)$ and, in turn, on $e(V(I))$.

Another point needs to be done about discontinuity. Because there is an inherent threshold $\widehat{p}(I)$ above which cooperative behavior is not enforceable, then the pricing rule will not be a monotonic and continuous function of the degree competition I, nor of the trader's marginal receipt at farm gate $\widetilde{p}$. It was indeed the case in the previous Nash-bargaining and Principal-agent formulations. Note that this threshold is increasing with competition, inducing more incentives for peer-monitoring and less for effort.

To understand what differs here from a traditional Cournot-game in quantities, let us differentiate the pricing optimal rule according to the level of competition I. For the Cournot usual solution, we have

$$\frac{\partial p^I}{\partial I} = \frac{1}{I^2} * \frac{1}{\varepsilon_{EY/p}}$$

Because we have side-selling that involves $V(I) = V \exp^{1-I}$, then the comparative statics is different:

$$\frac{\partial p^I}{\partial I} = \frac{1}{I^2} * \frac{1}{\varepsilon_{EY/p}} - \frac{V \exp^{1-I}}{I {\varepsilon_{EY/p}}^2} \frac{\partial \varepsilon_{EY/p}}{\partial e} \frac{\partial e}{\partial V} \tag{21}$$

It means that the convergence to the competitive market equilibrium is slower in our case, but note that the negative effect weakens with competition. As $\widehat{p}(I)$ also changes with I, we need also to account for the cutting point above which the cooperative effort could not be enforced by the group:

$$\frac{\partial \widehat{p}}{\partial I} = -V \exp^{1-I} \frac{\partial \widehat{p}}{\partial V} > 0 \tag{22}$$

Note also that competition weakens the effect of V on $\widehat{p}$ because $\frac{\partial \widehat{p}}{\partial V} < 0$ if we differentiate (13). Overall, we are able to derive the discontinuous optimal pricing rule according to competition, such as represented in the following graph, displayed after our proposition.

Proposition 5 *When several traders compete in quantities while contracting with farmers, and that side-selling is possible, then the effect of competition is weakened by side-selling, inducing lower prices for farmers than under a standard Cournot-game. The* *likelihood of cooperative effort increases with the level of competition if d/W is sufficiently low.*

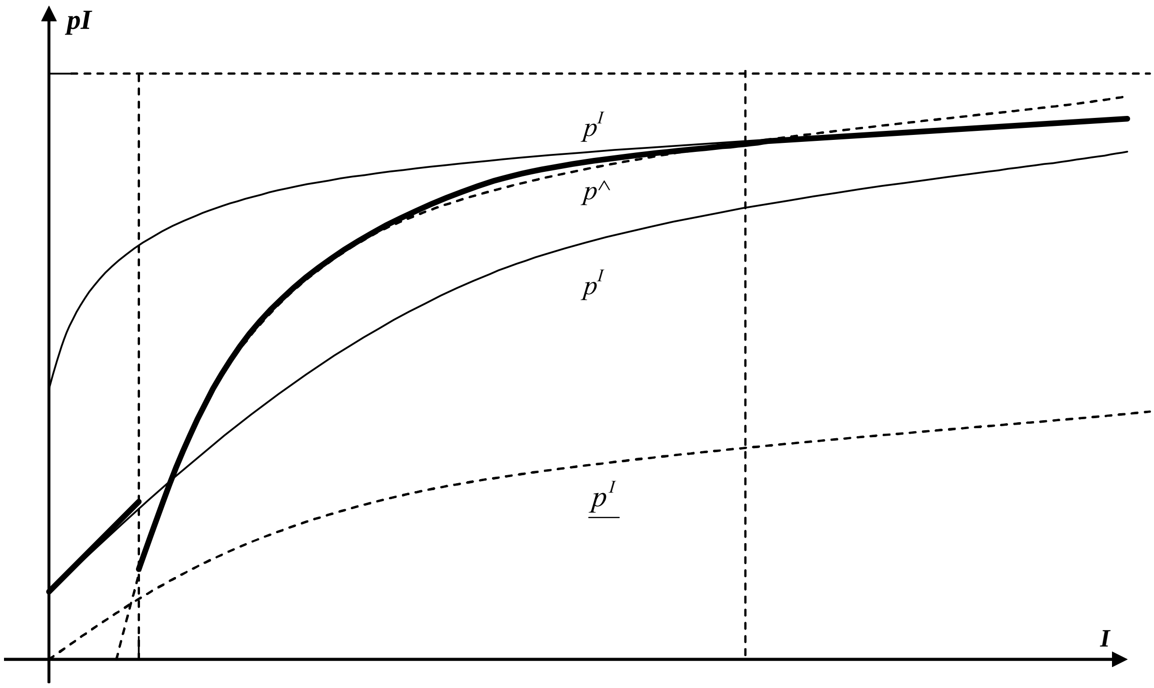


Figure 6: Optimal pricing rule under competition

Hence, traders strategically retain a surplus on their margin, internalizing the higher farmers' non-repayment rate on input credit whenever side-selling is possible and increases with competition.

4 Welfare analysis

4.1 The social optimum

A non-benevolent social planner will maximize the welfare surplus, as being the sum of producers' and agribusiness' surpluses. Hence, the program can be written as followed:

$$\max_{p} W = (\widetilde{p} - p)(\underline{Y} + e^{x}\Delta Y) - 1 + e^{2}p\overline{Y} + e(1-e)p(\overline{Y} + \underline{Y}) + Ve(2-e) - ce^{2}/2 \quad (23)$$

such that

$$\widetilde{p} \geq p \text{ and } E\pi - d\gamma - \mathbf{1}\gamma W \geq 0$$

to ensure participation of both agents. The latter constraint is ensured since we assumed that farmers participated even in the monopsonistic basic case. First-order conditions entail:

$$[\widetilde{p} - p]^* = \max(\frac{\underline{Y} - \underline{Y}e^x(2 - e^x)}{\Delta Y \frac{\partial e^x}{\partial p}} + \frac{ce^x - p(\overline{Y} + (1 - 2e^x)\underline{Y}) - 2V(1 - e^x)}{\Delta Y}, 0) \quad (24)$$

We do not look at the optimal level of effort or peer-monitoring because these decisions pertain to farmers' groups and cannot be managed by the agribusiness. Rather, according to farmers' group characteristics, it might exist two Pareto-optimal pricing rules, whether cooperative or non-cooperative efforts are undertaken by farmers at equilibrium. Since the Pareto-optimal pricing rules are higher than the ones under monopsony Principal-agent contracting, then cooperative equilibrium is less likely to be enforced. However, with higher prices, the difference between both effort equilibria is rather small. The final optimal choice of a social planner is the optimal rule such as described above under either cooperative, either non-cooperative, effort equilibria, or $\widehat{p}$. The choice is the same than for the monopsony, except that the social welfare function is much higher than agribusiness profits, and so cooperative effort is less likely to be enforced. This holds whenever the group has the ability to enforce it, at least partly (d/W sufficiently low). If not, the only solution is the social optimal rule under the non-cooperative effort.

4.2 Competition or bilateral monopoly?

The analysis is quite difficult here because of discontinuous pricing rules under different conditions: Principal-agent, Nash-bargaining, competition, and social optimality. Hence, a careful identification of the key parameter intervals should be done.

Let us first try to see if the Pareto-optimal solution can coincide with a particular level of competition or bargaining configuration. For the Nash-bargaining case, we solve the price equality conditions to derive a set of bargaining powers closer or lying to the Pareto-optimal pricing curve.

$$[\widetilde{p} - p]^* = (1 - \tau)(\widetilde{p} - \frac{ce^2/2 + B}{EY}) + \frac{\tau}{EY}$$

If it exists, this corresponds to an optimal level of the cooperative bargaining power τ-provided that it lies on the $[0, 1]$ interval-such as:

$$\tau^* = \frac{\frac{ce^2/2+B}{EY} - p^*}{\frac{ce^2/2+B+1}{EY} - p^*} \tag{25}$$

Existence is ensured as soon as c and B are sufficiently high. A necessary and sufficient condition is:

$$c > 2\frac{p^*EY - B}{e^2}$$

According to the former assumptions made in the model at the beginning, a sufficient condition is

$$B > p^*[EY(1 - e/2) + \underline{Y}e/2] \tag{26}$$

That means that, if bargaining is not very costly for producers, and if their marginal cost of effort is not high enough, no Nash-bargaining solution could be Pareto-optimal. Note however, that even if the Nash-bargaining game can yield to the Pareto-optimal pricing rule, the derived social welfare would not be Pareto-optimal because of fixed bargaining costs. In brief, Pareto-optimal pricing can correspond to an outcome of a specific Nash-bargaining game but social welfare would be smaller.

For the case of competition, the coincidence of the Pareto-optimal pricing rule to the Cournot solution exist if and only if:

$$[\frac{\widetilde{p} - p}{p}]^* = \frac{1}{I^*} * \frac{1}{\varepsilon_{EY^I/p}} < \frac{1}{\varepsilon_{EY^1/p}} \tag{27}$$

Remember that the elasticity of supply decreases with I through V, so even if the Pareto-optimal pricing rule exist for a particular level of competition, then optimal social welfare will not be reached because farmers will experience lower values of V.

Last, if optimal pricing exist for both Nash-Bargaining and competition through τ^* and I^*, then the Nash-bargaining solution will Pareto-dominates competition if and only if:

$$B < V(1 - \exp^{1-I^*})(2 - e)e \tag{28}$$

Note that, however, the second-best pricing rule under competition does not necessarily correspond to the Pareto-optimal one, since V decreases with I. According to (24), the Pareto-optimal price margin will increase if V decreases with competition levels, everything kept constant. So, the second-best level of competition should be lower than in (27). Let us denote it I^{**}. In this case, the condition stated in (28) is necessary but not sufficient to ensure a Pareto-domination of Nash-bargaining over competition. A sufficient condition would be that $B < V(1 - \exp^{1-I^{**}})(2 - e)e$. Let represent this in the following graph:

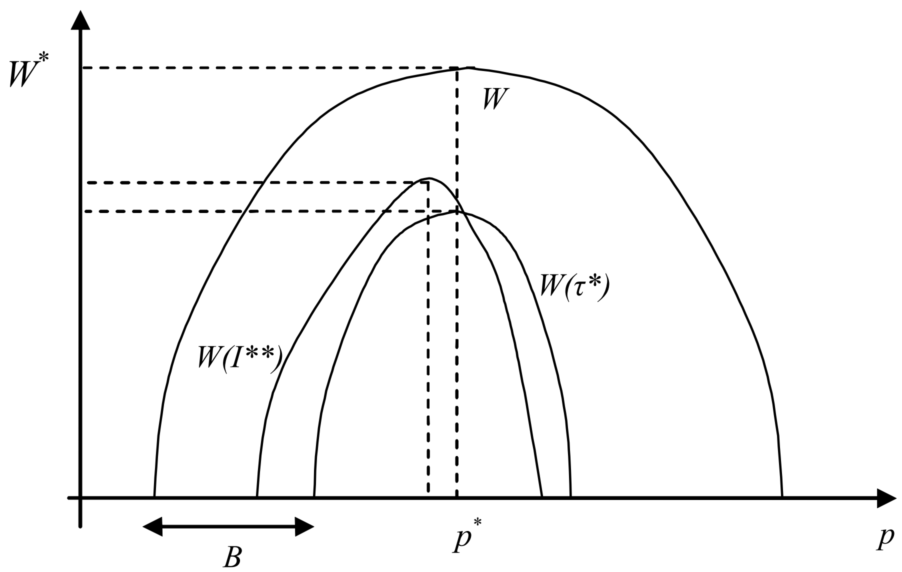


Figure 7: Second-best solutions of Nash-bargaining and competition

This graph shows that competition may be favored to Nash-bargaining under (28) because of the reasons invoked above. There are also cases where (25) corresponds to unfeasible bargaining configurations. In this case, only corner solutions exist: $\tau^* = 0$ or 1 that do not entail pricing p^*. It exists an implicit function $\tau(I)$ above which Nash-bargaining

Pareto-dominates competition such as $W(\tau) > W(I)$. Note that $\tau = 0$ and $I = 1$ are equivalent.

This welfare analysis can hold, following figure 7, whenever $p^* = p_c^*$ or $p^* = p_{nc}^*$. However, if at equilbrium $p^* = \widehat{p}$, the second-best pricing rules for competition and Nash-bargaining will not be necessarily the same.

- Derive the function $\tau(I)$ under several assumptions about B, c, and V.

5 Robustness

- Within-group heterogeneity: What happens if we relax the assumption of symmetric farmers? Implications for the credit-repayment sub-game. Effort levels change with farmers' heterogeneity (the cooperative one remains the same, but not the non-cooperative one) and peer-monitoring levels needed to enforce cooperative equilibrium would be larger. Hence, it is more difficult to enforce cooperative equilibrium, but the average non-cooperative level of effort can be larger when heterogeneity is of intermediary scope. Overall, the effect is ambiguous, but large heterogeneity is likely to induce lower effort equilibria for all parameters.

- Group size: What happens if the group is composed by n farmers instead of two? Implications for credit-repayment sub-game outcomes. The non-cooperative level of effort would decrease, but it can be the reverse for the cooperative one. If we account for a positive correlation between group size and group heterogeneity, then it may exist an optimal intermediary size.

- Implications for Nash-bargaining and Cournot solutions. According to group size and heterogeneity, pricing rules will change and must be more favorable to farmers that are better organized in more efficient groups.

- Timing of the game: the timing of the game is indeed crucial. If peer-monitoring decision occurs before effort one, then multiple equilibria exist as well as mixed strategies. We think that simultaneous decisions are a much simpler and more realistic way to represent the credit-repayment game among farmers.

- One-shot vs. repeated game: the repetition of the game leads to endogenize the value of V but results would stay robust to other specifications.

- Risk-aversion: Risk-aversion would lead farmers to invest more effort to avoid debts, then the monopsony could contract with the farmers' group through higher purchase prices, since the price elasticity of supply would be higher.

- The enforcement problem: side-selling and reneging... How institutional building would change the results? How it would favor competitive market structure for Pareto-improving contractual arrangements? Of course, if institutional building solve the problem of enforcement and side-selling, then competition will end up being Pareto-optimal. However, there are some public good provision issues...

- Input provision as a public good provision coordination problem and the role of extension services with a role of external monitoring. In the contract farming arrangements, extension agents often assist farmers, and this also can be viewed a positive monitoring externality for credit repayment. Because there are issues of public good provision in contract farming, then only institutional building can foster coordination for public good optimal provision. However, the scope of competition will discourage several firms to invest in these activities. Hence, competition should be restricted to a certain level, or public-private partnerships should be developed to tackle this issue.

6 Conclusion

This paper has shown that the current literature on contract farming and group lending needed a specific framework to account for the role of cooperatives in contract farming. In addition, the theoretical framework we proposed also enabled us to consider agricultural production as a specific and endogenous activity for group lending schemes.

The results highlight that there are several ways to make contract farming more socially desirable under several market failures, namely, through the ability of farmers' cooperatives to bargain, or through competition. However, these solutions need a regulatory framework for several reasons. Bargaining involves cost and farmers' empowerment through a long-term process of capacity-building. Competition involves problems of public good provision and side-selling. Then, two policy implications are the scaling-up of programs aimed at empowering farmers' groups through bargaining, and institutional capacity-building to foster the regulation of agricultural markets (market structure) and agribusinesses' coordination. There is also a room for more public-private partnerships in key public goods such as agricultural research, extension services, or quality grading, as it is currently experienced in African cotton producing countries.

Last, if an optimal group size exist, then farmers' group should be made free to self-select members in order to make effective the matching by affinities process. In several developing countries though, most of farmers' groups are still established on a village mandatory basis.

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7 Appendix