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Abstract

This paper develops the generalised Nash bargaining solution for a bargaining co-operative selling its raw output to a single processor. Three assumptions for co-operative member behaviour are examined: profit maximisation, co-operative surplus maximisation and maximising members' price. Solutions are compared and comparative statics presented for these alternative assumptions and two model types, price bargaining with a given quantity and simultaneous price and quantity bargaining. The most striking feature of the results is that the objective of maximising members' price does not necessarily lead to the highest members' price. Even in the exogenous quantity model, reducing output does not necessarily increase members' price. These findings question the relevance of co-operative members seeking to maximise members' price when trading with a single processor.

Contents

1. Introduction

There exists a body of literature on the neo-classical theory of the co-operative firm. Two streams of literature exist, one examines agricultural supply and marketing co-operatives, see for example Helmberger and Hoos (1962), Ladd (1974) and LeVay (1983). The other stream focuses upon worker co-operatives or labour managed firms, see for example, Ward (1958) and Meade (1974). In part, the literature focuses upon price and output solutions under varying market conditions and differing behavioural assumptions for co-operatives and their members. One circumstance which has received relatively little attention in the theoretical literature however, is the bilateral monopoly case where a co-operative bargains with a single trader over sale conditions. This paper attempts to fill this gap and seeks to provide a thorough theoretical examination of the bargaining co-operative.

In particular, we focus on agricultural bargaining co-operatives and associations who negotiate, on behalf of member farmers, with food processors over price and quantity for raw agricultural output. Numerous examples of bargaining co-operatives exist in U.S. agriculture for products such as: wine grapes, potatoes, poultry, sugar beet and milk, (Hueth and Marcoul, 2003). In Australia bargaining occurs for milk, chicken meat, tobacco leaf and wine grapes, (Oczkowski, 2004). Recent changes in Australian trade practices legalisation are likely to see the further development of collective bargaining over agricultural produce.

This paper develops the generalised Nash bargaining solution for a bargaining co-operative selling its raw output to a single processor. Consistent with the neo-classical co-operative literature (Bateman, Edwards and LeVay, 1979), various solutions are developed and compared for differing behavioural assumptions for the co-operative and its members.

In the next section we setup the theoretical framework by describing the relations between the co-operative and its members, and then outline the generalised Nash bargaining model. Section three examines the specific case of price bargaining with a given quantity, comparing various solutions and outlining the comparative statics results. Section four considers the more general case of price and quantity bargaining. Section five draws some conclusions.

2. Co-operative Theoretical and Bargaining Framework

Bateman, Edwards and LeVay (1979) describe and compare the various behavioural assumptions which have been employed for developing theoretical models of co-operatives. Assumptions are made for the behaviour of both the co-operative and its members. The dominant body of literature stems from the seminal Helmberger and Hoos (1962) who consider the marketing co-operative as one who processes raw farmer output and then sells the processed output to the market. In contrast, we abstract from processing co-operatives and assume that the co-operative acts only as a bargaining agent. This permits us to focus on issues relating to bargaining only and is consistent with many U.S. and Australian agricultural bargaining co-operatives and associations. Effectively members produce the output for which the co-operative negotiates sale conditions.

Following Helmberger and Hoos (1962) assume that the co-operative only exists for the members and hence makes no profit ($\Pi C = 0$). All of the co-operative surplus (CS) is returned to members ($CS = P_M Y$), where Y is output and P_M is the per-unit price returned to members[1]. The co-operative faces fixed bargaining costs (B) which members incur if negotiations reach agreement. Bargaining costs typically relate to the hiring of specific expertise to conduct negotiations and hence are unrelated with output. The comparative statics analysis which will be presented, investigates how changes in these costs impact on solutions.

With these assumptions define the co-operative profit function as:

$$\Pi C = P_Y Y - B - P_M Y = 0 \qquad (1)$$

where, P_Y is the market price for the output.

Define the co-operative surplus function as:

$$CS = P_Y Y - B = P_M Y \qquad (2)$$

which implies, $P_M = P_Y - (B/Y)$, that is, the members' price is the market price less the average bargaining cost.

Define the members' profit function as:

$$\Pi M = P_M Y - C(Y,W) = P_Y Y - B - C(Y,W) \qquad (3)$$

where C(Y,W) defines total production costs which depend on output and factor input prices W.

Define the processor's profit function as:

$$\Pi P = R(Y) - P_Y Y \qquad (4)$$

where R(Y) defines the processor's revenue function.

The alternative behavioural assumptions relate to members' behaviour. We consider three of the most common assumptions employed in the literature, see Bateman, Edwards and LeVay (1979) for a motivation for these assumptions: 1) maximise members' profits (ΠM); 2) maximise the co-operative surplus or members' total revenue (CS); 3) maximise the average per-unit return to members (P_M = CS/Y). In a broad sense, assuming the co-operative sells into a competitive market with a downward sloping demand curve, objective 3) produces the lowest output level but highest market price, objective 2) the highest output level and lowest price, while output and price fall in-between these extremes for objective 1). Effectively, maximising members' price is achieved by restricting output, while maximising co-operative surplus is a growth objective producing a larger output level and a consequence lower price.

In all subsequent models we make use of the generalised Nash bargaining model (Binmore, Rubinstein and Wolinsky, 1986). In addition to the standard axomatic foundation of the Nash (1950) program, solutions from the generalised framework are also consistent with various strategic models of bargaining with alternative offers (Rubinstein, 1982). In particular, asymmetric bargaining strengths are permitted and these can be related to players' traits such as their levels of risk aversion and impatience (Muthoo, 1999, chs 3-4).

For all bargaining models we assume the Nash disagreement point is a zero payoff for both the co-operative and processor[2]. The impasse point is the status quo, players will not trade if it makes them worse off given their objective. We assume that outside options, available during negotiations, are available but these are not attractive. That is, the outside options are worse positions than the Nash solution and hence will not constrain the Nash solution (Muthoo, 1999 ch 5).

We consider two general classes of models. First models where only price bargaining occurs for a given fixed output. Second, we consider the longer-run situation where bargaining occurs over both price and quantity. For each of these model classes we consider the three alternative members' objectives and assume that the processor always maximises profit.

3. Price Bargaining with Fixed Quantity

A survey of U.S. bargaining co-operatives and associations (Iskow and Sexton, 1992) showed that while all associations negotiated price, only 25% of associations negotiated on the quantity of the commodity. For more than 70% of associations, quantity is determined prior to price negotiations and either the processor purchases all the association's production or quantity is based on the processor's needs. Given this recognition we initially consider the generalised Nash program for a fixed output

(Y) to determine the bargained P_Y. Assuming a zero disagreement point and maximising members' profits (ΠM), the Nash bargaining program is:

$$Max \quad F = (\Pi M)^{\tau}(\Pi P)^{(1-\tau)} = \{Y(P_Y - ATC)\}^{\tau}\{Y(AR - P_Y)\}^{(1-\tau)} \tag{5}$$

where τ $(0 \le \tau \le 1)$ measures the bargaining strength of the co-operative and τ = 0.5 implies equal bargaining power. AR (= R(Y)/Y) is average revenue and ATC (= {B + C(Y,W)}/Y) is average total cost.

The solution to (5) is:

$$P_Y = \tau\, AR + (1-\tau)ATC \quad \text{and} \quad P_M = \tau\,(AR - AB) + (1-\tau)AC \tag{6}$$

The generalised Nash framework predicts that price is indeterminate. The bargained price falls between an upper limit determined by the processor's average revenue and a lower limit determined by the co-operative's average total cost, the latter includes both bargaining and production costs. Determinate price depends upon the bargaining strength of players.

As previously indicated the solution encapsulates Nash's (1950) axioms of, Pareto-optimality, rational and fully knowledgeable players. The measure of the co-operative's bargaining strength (τ) however, can be related to some of the co-operative's relative (to the processor) traits. These predictions are based on game theoretic strategic models of bargaining. Some theoretical findings (Sexton 1994, Muthoo 1999) include: the more patient the co-operative the higher the price; the more risk adverse the co-operative the lower the price; if the co-operative makes the first offer price is higher; and bargaining strength is unaffected by the existence of less attractive outside voluntary outside trades.

If we next assume members wish to maximise the co-operative surplus (CS) the program is:

$$Max \quad F = (CS)^{\tau}(\Pi P)^{(1-\tau)} = \{Y(P_Y - AB)\}^{\tau}\{Y(AR - P_Y)\}^{(1-\tau)} \qquad (7)$$

where AB (=B/Y) is average bargaining cost.

The solution to (7) is:

$$P_Y = \tau\ AR + (1-\tau)AB \quad \text{and} \quad P_M = \tau\ (AR - AB) \qquad (8)$$

Here the solution is identical to (6) but for the average costs determining the co-operative's lower limit. In this case average bargaining costs determine the lower limit, production costs play no role. Here members' price is equal to the proportion of the available per unit bargaining pie (AR – AB) going to the co-operative.

Finally, if we assume members wish to maximise average returns (P_M) the program is:

$$Max \quad F = (P_M)^{\tau}(\Pi P)^{(1-\tau)} = \{P_Y - AB\}^{\tau}\{Y(AR - P_Y)\}^{(1-\tau)} \qquad (9)$$

The solution to (9) is also given by equation (8). This is expected, since for a given fixed quantity, maximising members' total revenue is equivalent to maximising member price.

It is clear that for a given Y and τ (since ATC > AB) the bargained output price is higher for maximising ΠM than for maximising CS or P_M. This also implies that the price returned to members is also higher for maximising ΠM than for maximising CS or P_M. The fact that the objective of maximising P_M does not result in the highest P_M for members appears perverse and is the outcome of the bargaining process. It results from the absence of production costs in the explicit $P_M = P_Y$ -AB objective. For the ΠM maximising objective, both production and bargaining costs determine the lower limit from which bargaining is bound, this results in a higher output price and hence a higher members' price. Even though the maximising P_M objective seeks to gain the highest member per unit returns, it does not because the objective implies it will trade as long as only average bargaining costs are covered[3]. In the standard model, where the co-operative can sell its output anywhere along a downward sloping demand curve (Bateman, Edwards and LeVay, 1979) a higher P_M results from maximising P_M rather than ΠM because quantity varies and is smaller for the maximising P_M assumption. In this bargaining model quantity is exogenous, and is assumed to be equal in these comparisons.

We present in table 1 the comparative statics[4] for the key endogenous variables, ΠM, CS, P_Y and P_M given changes in the exogenous variables, τ, B, Y and W. Where possible, the signs for the partial derivatives have been provided. Irrespective of optimising objective, increasing the bargaining strength of the co-operative increases the objective value and market and member prices. Interestingly, higher bargaining costs, decrease objective values and members' prices, but increase market prices. Effectively, the burden of higher bargaining costs is shared by co-operative members and the processor. Similarly, higher factor input prices lead to a lower profit for members but higher market prices for the processor.

Table 1: Comparative Statics for Price Bargaining Models*

Objective Max ΠM	**τ**	**B**	**Y**	**W**
ΠM	$Y(AR-ATC)>0$	$-\tau<0$	$\tau(R_Y-C_Y)$	$-\tau C_W<0$
P_Y	$(AR-ATC)>0$	$(1-\tau)/Y>0$	$[(C_Y-P_Y)+\tau(R_Y-C_Y)]/Y$	$(1-\tau)C_W/Y>0$
P_M	$(AR-ATC)>0$	$-\tau/Y<0$	$[AB+(C_Y-P_Y)+\tau(R_Y-C_Y)]/Y$	$(1-\tau)C_W/Y>0$
Objective Max CS	**τ**	**B**	**Y**	**W**
CS	$Y(AR-AB)>0$	$-\tau<0$	$\tau R_Y>0$	0
P_Y	$(AR-AB)>0$	$(1-\tau)/Y>0$	$(1/Y)(\tau R_Y-P_Y)<0$	0
P_M	$(AR-AB)>0$	$-\tau/Y<0$	$(1/Y)(AB+\tau R_Y-P_Y)$	0

* Results for Max P_M are identical to those for Max CS.

The impact of changes in output are generally less clear. For the profit maximising objective, comparative statics result depend, among other things, upon the output level. For low output (MR > MC) higher Y leads to lower profits, a lower market price and (if B < $Y(\tau(C_Y - R_Y) + P_Y - C_Y)$) a lower member price. Conversely, for high output levels (MR < MC) higher Y leads to higher profits and possibly lower market and member prices. For the maximising CS and P_M objectives, a higher Y does increase the objective value for CS and reduce market prices, and (if B < $Y(P_Y - \tau R_Y)$) reduce member prices.

The most interesting aspects of the comparative statics results is that reducing output does not necessarily increase the price returned to members, for all objectives. For maximising profits, a lower output produces a higher member price only if the current output level is relatively high and the bargaining cost is relatively low. For the CS and P_M objectives, a lower output produces a higher member price only if the bargaining cost is relatively low.

4. Price and Quantity Bargaining

In the longer term it is clear that some type of agreement on quantity must also be reached by players to support an ongoing trading relationship. One cannot expect, for example, a processor to continually purchase more than it desires given a prolonged period of excess supply for the processed output in the market. To this end it is important to consider the generalised Nash program for jointly determining the bargained output (Y) and price (P_Y).

For maximising members' profits (ΠM) the program is defined by (5) with a price solution given by (6) and quantity given by:

$$Y = (AR - ATC)/(ATC_Y - AR_Y) \quad \text{or} \quad C_Y = R_Y \tag{10}$$

where, the Y subscripts on the cost and revenue variables denote partial derivatives with respect to Y.

Thus, price remains indeterminate lying between average revenue and average total cost, but AR and ATC are now evaluated at a quantity consistent with the intersection of the marginal revenue and marginal cost curves. This is the standard bilateral monopoly solution, see for example, Blair, Kaserman and Romano (1989).

For maximising co-operative surplus (CS) the Nash program is (7) with a price solution of (8) and quantity solution of:

$$Y = (AR - AB)/(AB_Y - AR_Y) \quad \text{or} \quad R_Y = 0 \tag{11}$$

Again the only difference between the profit and surplus maximising models is the average total cost in the profit maximising model and the use of only average bargaining costs in the surplus maximising model. Here, setting marginal revenue to zero determines quantity.

Finally, for maximising P_M the Nash program is (9) with a price solution of (8) and a quantity solution of:

$$Y = (1-\tau)(AR - AB)/(AB_Y - AR_Y) \quad \text{or} \quad R_Y = \tau(AR - AB) \tag{12}$$

In this case $P_Y = R_Y + AB$ and $P_M = R_Y$. Interestingly, for maximising members' price, both the price and quantity are indeterminate and depend upon the bargaining strength of players (τ). If τ = 0 and no co-operative bargaining strength, then $R_Y = 0$ determines Y, and if τ = 1 the co-operative has complete bargaining strength then no trade occurs Y = 0.

Direct comparisons between the price and quantity solutions are not possible given that a general closed form solution for quantity does not exist for (10) - (12). However, we will consider a specific functional form for costs and revenues, to illustrate a closed form quantity solution and to make comments about the relative positions of price and quantity solutions for the three alternative assumptions.

Consider the following quadratic forms for production costs and revenues:

$$C = c_0 Y + c_5 Y^2 \qquad R = r_1 Y + r_2 Y^2$$
$$where,\ c_0 = c_1 + c_2 w_1 + c_3 w_2 + c_4 w_1 w_2 + c_6 w_1^2 + c_7 w_2^2 \qquad (13)$$

It is assumed that there exist two normal factor inputs and given the other standard properties (see the appendix) of the cost and revenue functions we have: $c_0 > 0, c_4 > 0, c_5 > 0, c_6 < 0, c_7 < 0, r_1 > 0, r_2 < 0.$ These functions imply linear average and marginal revenue and production cost curves.

The closed form quantity solutions for equations (10), (11) and (12) respectively are: Y(ΠM) = $(r_1 - c_0)/2(c_5 - r_2)$; Y(CS) = $-r_1/2r_2$; and Y(P_M) = $-(1-\tau)r_1/2r_2$. Simple comparisons confirm that, Y(CS) > Y(ΠM) and Y(CS) ≥ Y(P_M), but the relation between Y(ΠM) and Y(P_M) depends upon bargaining strength. At the extremes τ = 0 ⇒ Y(ΠM) < Y(P_M) and τ = 1 ⇒ Y(ΠM) > Y(P_M). Thus output is highest with maximising co-operative surplus, but is not necessarily lowest for maximising members' price, for very weak co-operative bargaining strength ($\tau \to 0$) output is lowest for profit maximisation.

For market prices and a given τ, $P_Y(CS) < P_Y(\Pi M)$ and $P_Y(CS) \le P_Y(P_M)$, but again the relation between $P_Y(\Pi M)$ and $P_Y(P_M)$ depends upon bargaining strength. At the extremes τ = 0 ⇒ $P_Y(\Pi M) >$ $P_Y(P_M)$ and τ = 1 ⇒ $P_Y(\Pi M) <$ $P_Y(P_M)$. Thus market price is lowest with maximising co-operative surplus, but is not necessarily highest for maximising members' price, for very weak co-operative bargaining strength ($\tau \to 0$) market price is highest for profit maximisation. The relations between members' prices for the three solutions are the same as for market prices, that is, P_M is lowest for the maximising CS objective and the highest price depends upon bargaining strength, with high τ implying $P_M(P_M) > P_M(\Pi M)$ and low τ $P_M(P_M) < P_M(\Pi M)$.

For illustrative purposes we present the solutions graphically. Figure 1 depicts the output solutions and limits (P_U upper limit and P_L lower limit) for market price bargaining. The output solutions are consistent with MC = MR for Y(ΠM) and MR = 0 for Y(CS). The depicted circumstance assumes that τ is suitably low so that Y(ΠM) < Y(P_M). The upper and lower bargaining limits reflect: $P_Y(\Pi M) > P_Y(P_M) > P_Y(CS)$.

Figure 1: Price Bargaining Limits

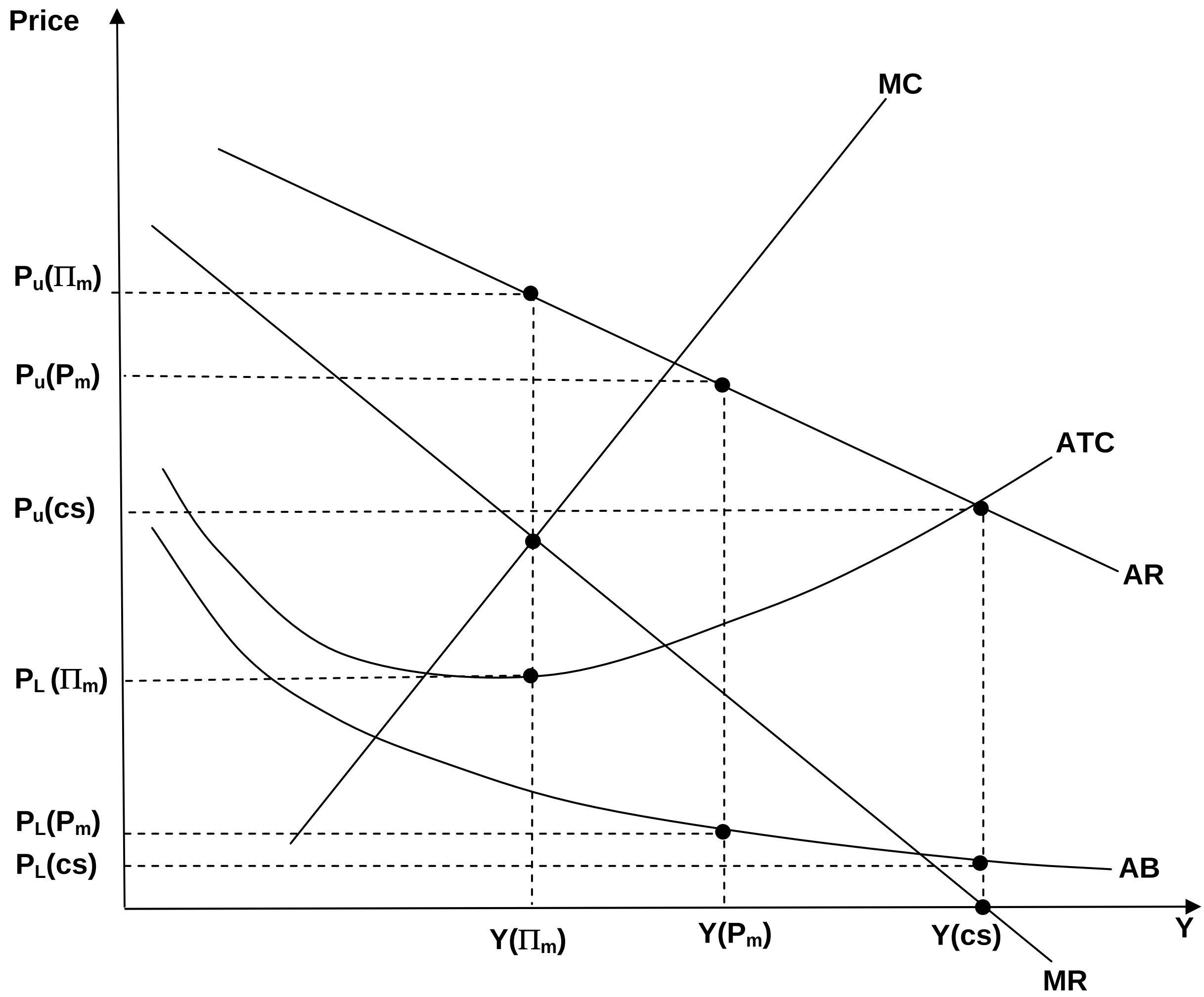
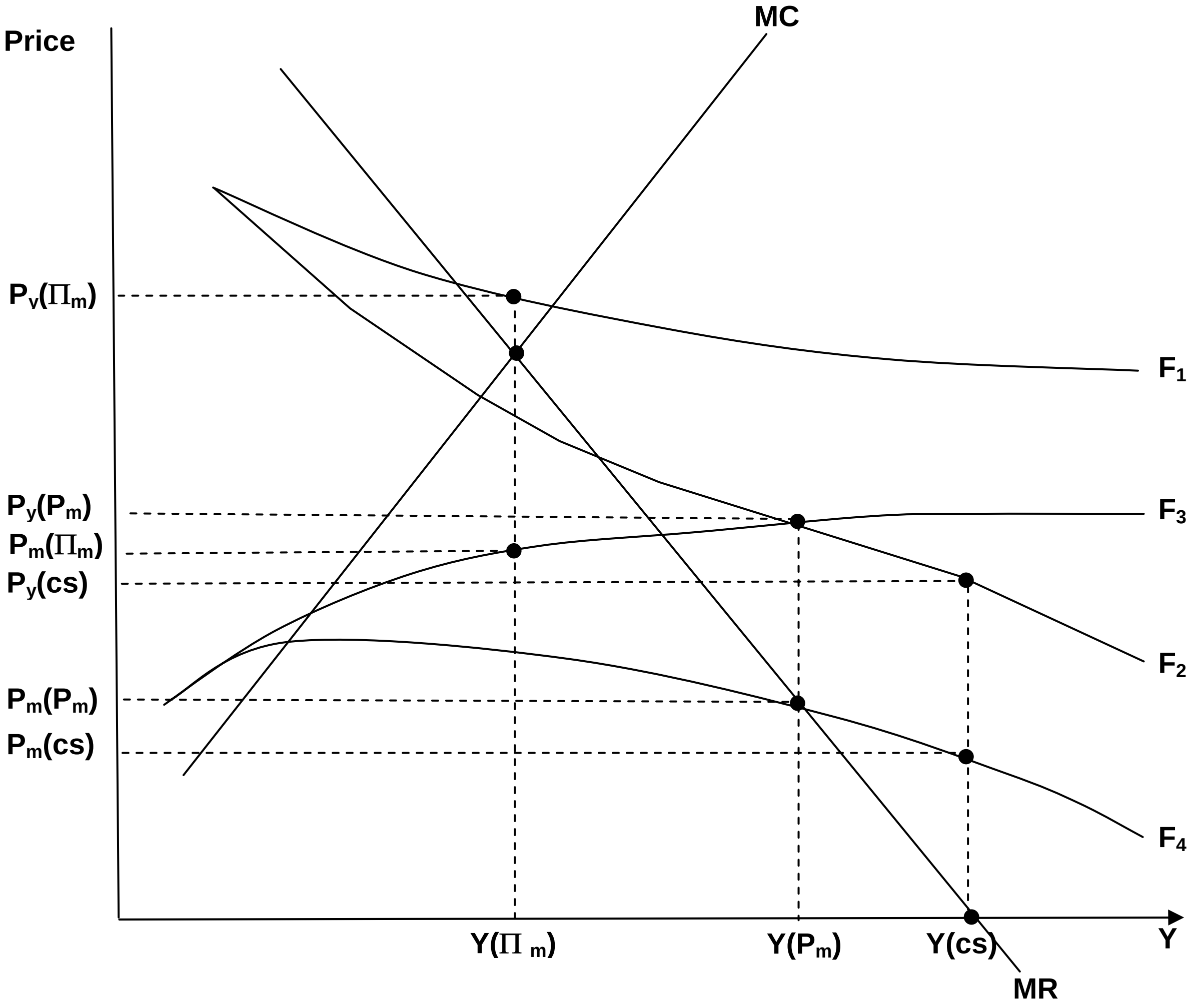


Figure 2 presents a comparison of market and members' prices for the three solutions for a given τ. The F functions are employed to depict the various price solutions: $F_1 = F_4 + AB + (1-\tau)AC$, $F_2 = F_4 + AB$, $F_3 = F_4 + (1-\tau)AC$ and $F_4 = \tau(AR - AB)$. F_1 determines $P_Y(\Pi M)$, F_2 determines $P_Y(CS)$ and $P_Y(P_M)$, F_3 determines $P_M(\Pi M)$, and F_4 determines $P_M(CS)$ and $P_M(P_M)$. Since (1 – τ) AC > 0 and AB > 0, then F_1 is the highest curve, F_4 is the lowest curve and F_2 can be above or below F_3. Again the depicted circumstance assumes that τ is suitably low so that Y(ΠM) <

Y(P_M) but here using equation (12), Y(P_M) is determined by the intersection between MR and F_4.

Figure 2: Bargaining Market and Member Prices



In summary, for maximising members' profits, Y is determined by MC = MR and F_1 and F_3, determine market and members' price respectively. For the co-operative surplus maximising objective, Y is determined by MR = 0 and F_2 and F_4, determine market and members' price respectively. For the members' price maximising objective, Y is determined by the intersection of MR and F_4,and F_2 and F_4, determine market and members' price respectively.[5]

We present in table 2 the comparative statics for the key endogenous variables, ΠM , CS, Y, P_Y and P_M given changes in the exogenous variables, τ, B and W. Where possible, the signs for the partial derivatives have been provided. As with the exogenous output case, increasing the bargaining strength of the co-operative, increases objective values and prices for all maximising objectives. For the maximising P_M objective, a higher τ reduces output. The impact of bargaining costs is similar to the exogenous quantity case for the ΠM and CS objectives, but differs for the P_M objective where the impact of higher bargaining costs on market prices depends upon the level of bargaining costs with low costs (B < $(Y^2/\tau)R_{YY}(\tau-1)$) leading to higher market prices. Conversely, for a high level of bargaining costs, increasing bargaining costs further reduces market prices. Higher bargaining costs increase output levels for the P_M objective only.

Table 2: Comparative Statics for Price and Quantity Bargaining Models

Objective Max ΠM	**τ**	**B**	**W**
ΠM	$Y(AR - ATC) > 0$	$-\tau < 0$	$-\tau C_W < 0$
P_Y	$(AR - ATC) > 0$	$(1-\tau)/Y > 0$	$\{(1-\tau)C_W / Y\} + \{C_{YW}(P_Y - C_Y)/Y(C_{YY} - R_{YY})\}$
P_M	$(AR - ATC) > 0$	$-\tau / Y < 0$	$\{(1-\tau)C_W / Y\} + \{C_{YW}(P_Y - C_Y - AB)/Y(C_{YY} - R_{YY})\}$
Y	0	0	$-C_{YW} /(C_{YY} - R_{YY}) < 0$
Objective Max CS	**τ**	**B**	**W**
CS	$Y(AR - AB) > 0$	$-\tau < 0$	0
P_Y	$(AR - AB) > 0$	$(1-\tau)/Y > 0$	0
P_M	$(AR - AB) > 0$	$-\tau / Y < 0$	0
Y	0	0	0
Objective Max P_M	**τ**	**B**	**W**
P_M	$(AR - AB) + \{\tau(AR - AB)/J\} > 0$	$-(\tau / Y) - (\tau^2 / Y.J) < 0$	0
P_Y	$\frac{(AR - AB)(-R_{YY} - AB_Y)}{-R_{YY} - \tau(AB_Y - AR_Y)} > 0$	$\frac{-R_{YY}(1-\tau) + \tau AB_Y}{J(1-\tau)(AR - AB)}$	0
Y	$\frac{(AB - AR)}{-R_{YY} - \tau(AB_Y - AR_Y)} < 0$	$\frac{\tau}{J(1-\tau)(AR - AB)} > 0$	0

where $J = \{-R_{YY} - \tau(AB_Y - AR_Y)\}/(AB_Y - AR_Y)$

Changes in factor input prices again only affect the profit maximising objective. Higher factor prices reduce member profits and increase prices if bargaining strength is relatively high. Increasing W, leads to higher market prices if τ is such that $P_Y > C_Y$ and to higher member prices if $P_Y > (C_Y + AB)$.

5. Conclusion

This paper has analysed bargaining co-operatives price and quantity solutions under alternative behavioural assumptions employing the generalised Nash bargaining solution. The most striking feature of the results relate to the objective maximising members average returns P_M. The bargaining strength of the co-operative impacts upon both output and prices for this objective. For this objective, higher bargaining strength reduces output, while higher bargaining costs increases output. Perversely, for both exogenous and endogenous quantity models, maximising members' prices does not necessarily lead to the highest average return to members. Only for high co-operative bargaining strength will pursing the maximising P_M objective lead to an average return to members higher that that produced by pursuing profit maximisation. Even in the exogenous quantity model, reducing output does not necessarily increase member prices. These findings question the relevance of seeking to optimise member prices as an objective for members facing a bilateral monopoly structure.

Only under the profit maximising objective do factor prices have any impact on prices and output levels. Higher input prices reduce profits to members and hence should be avoided. For all three objectives, higher bargaining costs reduce objective values and hence should also be avoided. In essence, the burden of both higher factor and bargaining costs are shared by co-operative members through lower returns and by the processor through higher market prices.

In conclusion, the level of prices for all objectives and quantity in the P_M maximising endogenous quantity model, depend upon the co-operative's relative bargaining strength. Inferring from the results of strategic bargaining models, one probably expects this strength to be relatively low. Given the typical financial, physical and human resources of investor-owned firms such as large food processors and the relatively small resources of farmer bargaining co-operatives, it is expected that members would be more impatient (less able to hold-out) in negotiations. Further there is a general expectation that farmers exhibit a relatively greater degree of risk aversion compared to the entrepreneurial focused investor-owned corporate processor. The consequences of a low τ are relatively low levels for co-operative objective values, and market and member prices.

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Appendix: Model Notation

Y:	total output of all members
P_Y :	unit price of output in the market
P_M :	unit price returned to members
ΠC:	co-operative profits
CS:	co-operative surplus
ΠM:	members' profits
B:	co-operative fixed bargaining costs
AB:	average bargaining costs: AB = B/Y
C(Y,W):	members' production cost function, with input prices W
	properties: MC = $C_Y > 0$, $C_{YY} > 0$, $C_{YW} > 0$, $C_W > 0$, $C_{WW} < 0$, $C_{WY} > 0$.
AC:	average production costs: AC= C/Y
TC(Y,W):	total cost: TC= B + C
ATC:	average total costs: ATC = TC/Y
R(Y):	processor's revenue function, with MR = $R_Y > 0$, $R_{YY} < 0$.
ΠP:	processor's profit function

Endnotes

[1] A list of all notation and definitions for variables appears in the appendix. All subscripts in this paper denote respective partial derivatives except for price, where the subscript distinguishes the market and member prices. The analysis assumes a passive co-operative and hence abstracts from issues relating to any possible conflicts between the co-operative and its members. Also, this paper abstracts from individual member differences and hence employs aggregate production quantities and average price returns for all members.

[2] This assumption implies zero costs for no trade, or no fixed costs. For the case of production costs we will employ long-run costs which assume the absence of any fixed factors. For the fixed bargaining costs, we assume that members' incur bargaining costs only if a trade is negotiated. Effectively the co-operative is not paid if it fails to reach agreement for members. An alternative is to assume a fixed bargaining cost differential of: $B = (B_1 - B_2) > 0$, with B_1 being the cost if agreement is reached and B_2 if disagreement occurs. On the other hand, if the same fixed bargaining cost is also incurred in the case of disagreement, then these costs will have no impact on bargaining outcomes.

[3] Interestingly, this implies that for the P_M and CS objectives, members' profits can be negative if the level of bargaining strength is such that: $\tau < (AC)/(AR - AB)$, where AC is the average production cost. In other words even though bargaining ensures price cannot fall below AB it can fall below ATC.

[4] Comparative statics results are determined by implicit differentiation and are verified by numerical example.

[5] Figure 2 and the F functions can also be used to establish some of the relations between the solutions. Comparing the profit and surplus maximising objectives: since MR is downward sloping and MC is positive then $Y(\Pi M)$ < Y(CS), since F_3 lies above F_4 then $P_M(\Pi M) > P_M(CS)$ and since F_1 lies above F_2 then

$P_Y(\Pi M) > P_Y(CS)$. Comparing the members' price and surplus maximising objectives: since MR is downward sloping and F_4 is positive then $Y(P_M)$ < Y(CS), since both F_2 and F_4 are downward sloping (from the first order conditions) then $P_M(P_M) > P_M(CS)$ and $P_Y(P_M) > P_Y(CS)$. Finally, for varying values of τ all the F functions shift (upwards for increasing τ) while MR and MC remain unchanged, this implies that the relations between output and prices for the profit and members' price maximising objectives depends upon bargaining strength.