Title: Are Prices Paid to Cooperative Members for Products Hurting the Bottom Line?

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When cooperatives pay prices to their producers that signal production that is other than optimal, the cooperative makes less than it could and in turn passes has less income to pass on to its producers. This paper looks at the possibility of using a linear programming model to analyze the optimality of the prices and incentives paid to producers in a closed cooperative.

Introduction

Cooperatives pay producers for various products. They may or may not also pay additional incentive payments for production of various products with desired characteristics. This in turn sends a signal to the producer. Producers, who are profit maximizers, respond to these signals and produce the products that maximize their profit. If the cooperative sends the wrong signals to the producer, then the cooperative is not encouraging optimal production. This could hurt the profitability of both the cooperative and the producer. This is especially true for producers that do not have outside sales opportunities, but market all their production through the cooperative. In this case the producer would get the price the cooperative pays for the product and then some annual dividend that is a percentage of the cooperatives profits. If the prices are not structured correctly than the cooperative is not as profitable as it could be. Ways of analyzing the optimality of incentives paid to producers are needed. Below an attempt is made to: 1) Develop a method for analyzing the optimality of prices paid to producers in a cooperative, 2) Use a turkey processing cooperative in Utah as a case study for the method, and 3) Determine the implications of such an analysis from both the perspective

of the cooperative executive and producers. Below the methodology section discusses the methods developed to analyze the problem. Background information is given on Moroni Feed a cooperative that processes and sells turkey meat, preliminary results of the optimality of Moroni Feed's prices paid to producers, and implications of the findings. Full results of the analysis of Moroni Feed will not be available until later this summer. The results here are preliminary, but can show the sensitivity of optimal production to the pricing structure.

Literature Review

Little information exists on the turkey industry. Only two studies with turkeys as a keyword exist in the economic literature. One dealt with turkeys' diet (Klein, Salmon, and Larmond 1979), and the other dealt with supply dynamics (Chavas and Johnson 1982). Both of these studies are dated and unrelated. A large literature on transfer pricing within an organization exists and the authors will not try to summarize it here. The transfer pricing is similar to prices paid to members of a cooperative where the cooperative is the only market for the product. Still they are different in that transfer pricing deals with transferring products within an organization and here we are dealing with prices paid to customers of a cooperative.

Methodology

This paper only focuses on a cooperative where producers must sell all of their production through the cooperative. No outside sales opportunities exist. If outside sales opportunities did exist then the prices paid to producers would have to match the outside sales prices for producers to sell through the cooperative. Here producers must market their product through the cooperative. Because of this the whole cooperative can be

treated as one company. So if the net profit (the revenue received from the final product less the cost of production and processing) were maximized and distributed in an equitable manner everyone would be better off than if the net profit were less. The profit is distributed to producers through the prices paid for production, any extra incentives, and dividends.

To solve this problem a set of mixed integer programming models are developed and solved. The first step in solving this problem is to find out what generates the most profit (the optimal production). To find this out a model that includes the cost of producing the product (in this case turkeys), the cost of processing the products, and the revenue associated with selling the final products are maximized based on production and processing capabilities. This combines the cost of the farmer, and the cooperative and nets it against what can be sold to the outside buyers. This will maximize the total net income available. It will not say how that profit should be distributed among the individual producers.

The next step is to determine if the current pricing structure that producers face is optimal. If it is, then what was optimal for producers to do in step one would also be optimal in a model the just considers the producers standpoint. A tableau of a producer level model is given in table 1. This mean solving a model that includes the cost of the producers production and capabilities netted against the revenue the producer receives from the cooperative. This is the producer's net income. If the individual producers optimal response is not the same as the optimal response in step one, then the pricing structure is not optimal.

The next step would look at how the prices at the producer level would need to change to get the producer to respond in an optimal manner. These prices would be an optimal, but not unique, set of prices. The method proposed here would only determine if the prices are an optimal set, not if there are others that are also optimal. A mixed integer programming model that determines the producers optimal production where the individual producers net income is maximized is developed and solved for a variety of pricing schedules.

This methodology is used on a cooperative in Utah that is described in the next section.

Company Background

Moroni Feed Company was incorporated in 1938 to provide feed for turkey producers in Sanpete County, Utah. Today the cooperative is vertically integrated supporting it own breeding farms, hatchery, feed purchasing and mixing, turkey processing, cold storage, and turkey marketing (Carpenter p. iv). Figure 1 shows the linkages of the various departments within Moroni Feed Co. and the turkey production on the farms. In the past most of its producers grew turkeys in a range setting that was limited to the summer months. Today some producers have fully confined operations with year-round production. The production of turkeys during the off-season helps to keep the processing plant going and defray part of the costs.

After some difficult years when turkey prices dropped to their lowest level in five years, alternatives to increase profitability were examined. One study by Bailey and Baker found that the processing plant was only operating 8-9 months out of the year. By operating the plant during a greater part of the year, average costs of production could be

lowered. This would necessitate some of the growers switching to a confined operation where turkeys could be produced the whole year. (Bailey and Baker 1998)

Following the advice in the study by Bailey and Baker Moroni Feed Co. provided incentives for producers to provide turkeys during the off-season. These incentives were in the form of decreased processing charges, decreased poult prices, and increased prices for turkeys. Some of the growers have taken advantage of these incentives. This switch has made it more complex for Moroni Feed Co. to set the prices. Some growers have said the incentives are too high and others have thought they were low. A method of analyzing these costs from both the company and producer standpoint was needed.

Results

A farm level model has been built and is used here to give some likely results. A model incorporating both Moroni Feed processing capabilities and farm level production is being built and should be ready by the end of the summer. Some data was not readily available and slowed the process down.

The results presented here are based on a typical confined turkey operation that averages about 1.1 million pounds of turkey per year. Moroni Feed Co. currently imposes some restrictions on growers. They force the growers to take half hen poults and half tom poults. The hen poults cost around $1.15 and toms are $1.85. The differential is supposed to make them about equal in value of production. The restriction is because at the breeding facilities turkeys naturally produce half toms and half hens. Table 2 shows how optimal production changed when this restriction was relaxed. Without the restriction it was more efficient to produce almost all hens and very few toms. This was because instead of 4 flocks, the farm could now produce 7 flocks during the year. Hens

have a shorter life span allowing a quicker turnover. Heavy hens are killed at 17 weeks and heavy toms are killed at 23 weeks. The quicker throughput on having mostly hens increased net income by 27.4% while the number of turkeys increased by over 50%. This means that each turkey was less profitable, but the increase in the number of turkeys made up for it. While there is still the problem of having half hens and toms produced at the hatchery, it does show here that the signal the cooperative thinks it is sending, that hens and toms are equal, may not be the signal it is actually sending.

Another restriction on turkey production is splits between the light, medium and heavy turkeys. Moroni feed forces the light hens to be 50% of the total hens and light toms to be 45% of total toms. There is some leeway between the medium and heavy turkeys. Prices and other incentives are supposed to be set so that the various classes of turkeys are about even. Table 2 shows how production changed when this restriction was relaxed. Net income rose by 11.1% but the pounds of turkey produced only rose by 3.1%. Fewer turkeys were produced (about 93% of the base production), but they were heavier. Light hens were about a fourth of what they were before and light toms were half of the earlier production. Both medium and heavy hen production increased and heavy tom production increased. These results show that the incentives currently in place are not doing what the cooperative thinks they are. This may be in part because of when setting the pricing schedule the cooperative may be focusing on a single flocks production and not examining the entire years income.

Currently the poult prices are less for certain times of the year to increase turkeys produced during the off-season. When the poult prices were fixed to the same amount the entire year little changed. The cost of the poults went up by about $23,500 and the

net income went down by about the same amount. The same number of turkeys were produced and in the same types. One of the flocks was pushed 4 weeks later than it was previously, indicating that the poult incentives did change the timing somewhat.

Incentives are used on the processing costs to try to get turkeys produced during off seasons. The processing cost is $0.18 per pound of turkey processed. The incentives range from $0.03 per pound to $0.0025 per pound. These incentives were doubled. The number of turkeys produced went up slightly for the third flock. The turkeys were started 2 weeks later in each flock. This changed the net income by about $7,200. The processing costs decreased by about 1 cent per pound and a few more turkeys were produced.

Without any incentives the flocks were started a week later than they were under the current incentive program. The same numbers of turkeys were produced. Processing costs increased by about .85 cents per pound or $9,600. The net income went down by $10,300. The rest of the drop in income came from differences in the timing of the turkeys. They were now being produced in a slightly more costly manner.

This information shows that the incentives are working to shift production of turkeys slightly. A more detailed analysis would show the levels that are needed to shift production.

Implications

For the managers of the cooperative the implications shown here are that the incentives on different splits of turkeys and hens versus toms production costs are not doing what they are thought to do. Meaning that although the incentives were set up to make toms and hens equally profitable, hens are more profitable. This is because of the

shorter life and the greater number of turkeys that can be produced. Such results may reflect looking at a yearly income rather than income from one flock.

The objective of the current incentives was to make the producer indifferent between toms and hens. The incentive structure did not do that. This highlights the need to have a system that can look at the whole picture. Before trying to set up the incentives, the managers need to know what they want to accomplish and what types of turkeys and the timing of those turkeys is optimal. A model that encompasses both the capabilities of the cooperative and the costs of the producer would be able to looks at what is in the best interest of everyone. Then the incentives can be tailored to match those objectives. Currently although the management has some idea of what they would like, they are not completely sure. Setting incentives is an iterative process based on guesses and other assumptions. They have no way of testing the optimality of the incentives without doing it and then seeing what happens. While these results are not complete they do highlight how the current incentive system is flawed and the need for a more comprehensive analysis system.

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Figure 1: Flow of products from Moroni Feed Cooperative to farmer members and back to Moroni Feed.

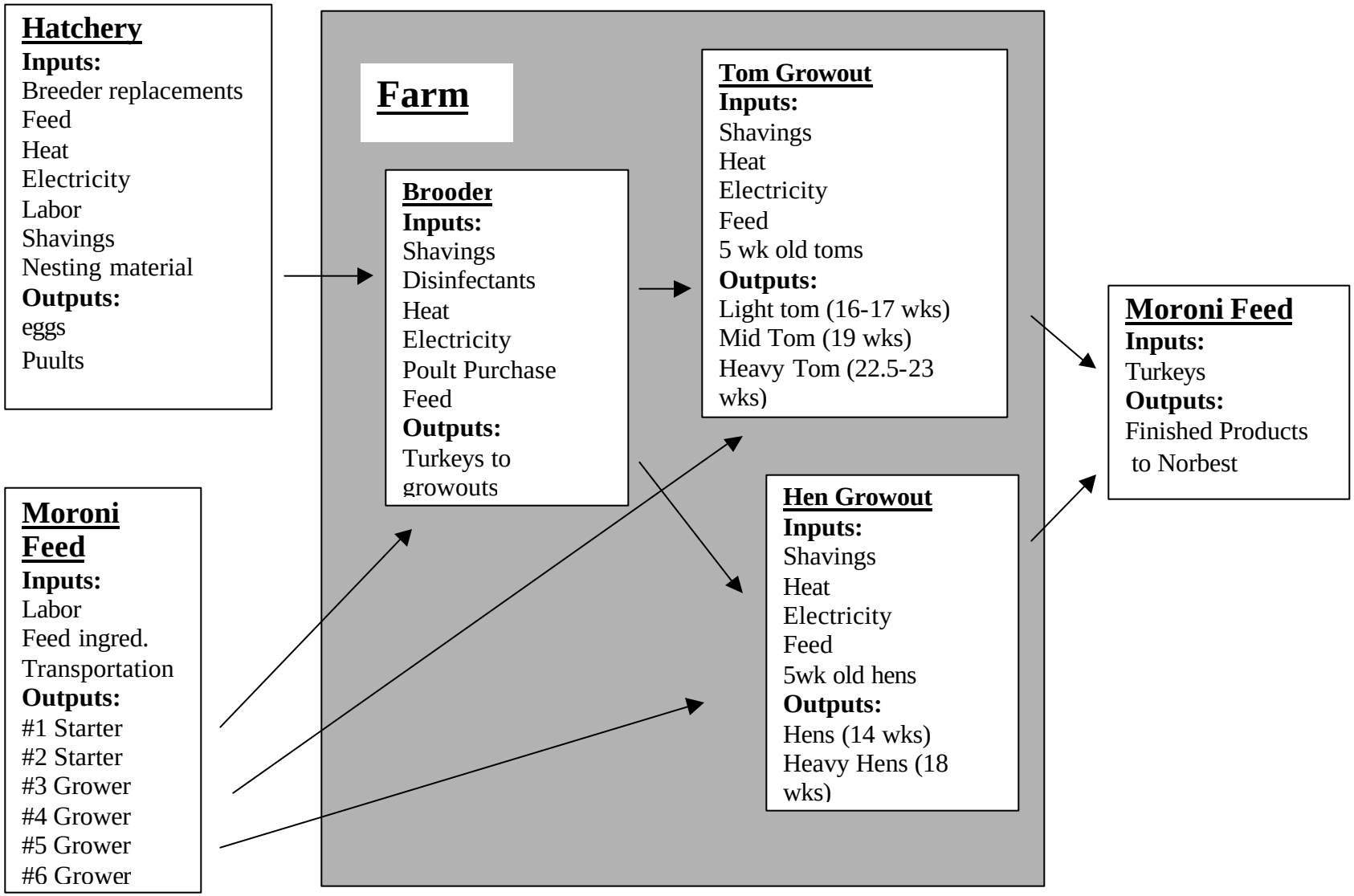

Table 1: Linear programming model to maximize farm profits of Moroni Feed cooperative member, 2001.

Constraints	Activities										RHS
	Heavy toms	Medium toms	Light toms	Heavy hens	Medium Hens	Light Hens	Flock	Tom Poults	Hen Poults	Buy feed	
Obj function	+[a]	+	+	+	+	+	-	-[a]	-	-	maximize
Subject to Capacity [b]											
Brooder								+	+		<= Space
Growout 1[c]	+	+	+	+	+	+					<= space
Growout 2 [c]	+	+	+	+	+	+					<= space
Balance											
Poults								+1	-1		= 0
Hens				+	+	+			-		<= 0
Toms	+	+	+					-			<= 0
Flock							-99999[d]	+1	+1		<= 0
Flock eq.[e]							+1				<= 1
Split tom 1	-	+									= 0
Split tom 2		+	-								= 0
Split hen 1				-	+						= 0
Split hen 2					+	-					= 0

[a] The + and – notations in the table indicate the signs of the coefficients in the model.
[b] The capacity constraints limit the space used by turkeys to the space available in the buildings.
[c] Growout 1 limits the spaced used by turkeys in any week to the total available space in all buildings. Growout 2 limits the space used by turkeys that are older than 7 weeks to be less than the space in the growout sheds. This is because turkeys less than 8 weeks old may stay in the brooder or the growout sheds.
[d] This is a linear programming convention where flock is a binary variable and if it is a 1 the poults placed are not limted by this constaint. When flock is 0 no poults may be places.
[e] There is a flock variable for every week. This equation limits the number of flocks started during any 5 week period to be less than or equal to 1.

Table 2: Sensitivity of farm level production to various restrictions imposed by Moroni Feed, 2001.

	Base		No Fixed % on Sex[a]		No Splits Required[b]	
				increase		increase
Net Income	135,108		172,064	27.4%	150,164	11.1%
Pounds of turkey	1,126,017		1,256,451	11.5%	1,160,822	3.1%
Number of turkeys	60,988		92,714	52.0%	57,523	-6.1%
Number of Flocks	4		7		4	
Turkeys Produced:	#	%	#	%	#	%
Light Hens	15,948	26.1	43,441	46.9	3,697	6.5
Medium Hens	9,569	15.7	26,065	28.1	13,718	24.0
Heavy Hens	6,379	10.5	17,376	18.7	13,735	24.0
Light Toms	13,091	21.5	2,624	2.8	6,163	10.8
Medium Toms	11,637	19.1	2,333	2.5	9,020	15.8
Heavy Toms	4,364	7.2	875	.9	10,919	19.1

[a] This relaxes the restrictions forcing hen and tom poults to equal each other.
[b] This relaxes the restrictions on percentages of different types of turkeys.