Economics of Margins and Federal Milk Marketing Order Pricing Rules.

An economic exposition on processor margins in Federal Milk Marketing Orders

by
Cameron Thraen
State Specialist, Dairy Markets and Policy
The Ohio State University Extension
Agricultural, Environmental and Development Economics
The Ohio State University

Introduction

"*Recent spikes in energy costs have resulted in escalating cheese manufacturing costs. Because of product formula pricing of milk, cheesemakers are largely unable to offset these costs. If they reduce the price paid to dairy farmers, then they violate federal order minimum pricing rules. If they charge customers more for cheese, then the higher cheese price is immediately translated by the Class III pricing formula back to a higher milk cost*."

> Jesse, E. and B.W. Gould, 2005. *Federal Order Product Price Formulas and Cheesemaker Margins: A Closer Look*, Marketing and Policy Briefing Paper, 90, Department of Agricultural and Applied Economics, College of Agricultural and Life Sciences, University of Wisconsin-Madison Cooperative Extension, University of Wisconsin-Extension.
> http://www.aae.wisc.edu/future under Publications)

Stated as directly as possible, the 'make-allowance' issue in Federal Milk Marketing Order pricing is the following. With the new milk and milk component (butterfat, protein, other solids, and nonfat solids) pricing rules, implemented with the reform of Federal Milk Marketing Orders, and made effective on January 1, 2000, the gross margin, or 'make-allowance' available to processors of cheddar cheese, grade AA butter, nonfat dry milk and dry whey, is set at a fixed value per pound of dairy product manufactured. These pricing rules apply only to (1) plants participating in the Federal Milk Marketing Order program, and (2) very specific types and package size commodities. Any change, on a month-to-month basis, in the wholesale selling price for these specific products, is credited back to dairy producers as a change in the value of the milk components used to manufacture these specific products. Setting the 'make-allowance' at a fixed value is equivalent to fixing the price for all non-milk inputs used to manufacture the product.

This fixed price or margin at the manufacturing sector level was a new addition to Federal Order rules instituted with Federal Order reform 2000. As stated by Jesse and Gould, rising cost for non-milk component inputs, such as energy or labor, processing plant management cannot recoup these higher costs because the 'make-allowance' for these inputs is fixed by rule and can only be changed through the Federal Order hearing

process. Any attempt (and there has been at least one such action by adding an energy surcharge to the product price) to increase the effective 'make-allowance', results in a direct transfer of this amount back to dairy producers in the form of higher component pay prices.

Economics of Margins

In the field of economics, the study of the relationship between the production of food products, the demand and supply for farm and non-farm inputs used in that production, and the relative wholesale to farm price ratio, is known as *margin analysis*. For example, in the current situation, where it is being argued that rapidly rising energy costs are increasing the actual plant cost well beyond the stipulated ''make-allowance'', this increased processing margin should be shared by all in competitive markets. In the simplest of cases, a share of this increase should be passed through to the final consumer by way of the downstream wholesale market and a share passed back upstream to the farm level milk producer.

How much or what share of the total increase is absorbed by each segment depends on how sensitive each is to the change in the price for these inputs. At the wholesale (consumer) level, the greater the sensitivity to the price increase, the less of the change in the required margin will be absorbed at that level. In the extreme, if the price sensitivity at the wholesale level is great all of the change will be passed back down to the farm level. With the current Federal Order pricing rule structure, the implicit assumption is that the price sensitivity at the wholesale level is infinite which means that all changes must be absorbed by the farm level input suppliers.

Insulating the final consumer from changes in the cost of manufacturing milk components into final consumer products is not good economics. If processing margins need to be higher to cover increased energy costs the final consumer needs to know this in the form of higher product price. If processing margins should be smaller because new plants coming on-line are more efficient in scale and scope, then the consumer should see this signal in the form of lower product prices. Unfortunately this will not happen with the current Federal Order pricing structure and this will lead, over time, to distorted signals, and continued misallocation of resources. The following exposition will help you understand the economic relationships involved in this debate.

Normal Market adjustment to Processing Margin changes.

The role played by margins in both competitive and non-competitive markets has been extensively investigated and discussed and is well understood by agricultural economists. Seminal work in this area includes the published work of Gardner (The Farm-Retail Price Spread in a Competitive Food Industry, American Journal of Agricultural Economics, Vol.57, No.3, 1975), Holloway (The Farm-Retail Price Spread in a Non-Competitive Food Industry, American Journal of Agricultural Economics, Vol.73, No.4, 1991); Fisher (The Impact of Changing Marketing Margins on Farm Prices, American Journal of Agricultural Economics, Vol.63, No.2, 1981). Most economic textbooks on agricultural

pricing contain material on this topic (Helmberger and Chaves, The Economics of Agricultural Prices, 1996).

Economic models which incorporate the margin into the analysis share a number of common points. One, margin is represented as the marketing margin and includes all of the transformation services which take place between the farm gate and the final retail consumer. Margin can be defined at any stage between the farm input and the final consumer. This includes the current situation where margin is synonymous with 'make-allowance' and is defined between the farm level and the wholesale level. Two, the margin is a *price* for a good or service just like any other price, i.e., the margin is the price in the marketplace for processing (transformation) and marketing services. Three, there is a *demand* and *supply* for these marketing services. The demand for these services is a *derived demand* and exists as the difference between the downstream demand, such as the wholesale market, and the upstream supply of the farm commodity. Four, the supply of marketing services depends on the underlying cost structure of the service industry. The supply curve for an individual plant is the plants marginal cost curve. The supply curve for the industry is the aggregation of the individual plant supply curves.

A useful drawing taken from Helmberger and Chaves, page 136, shows the relationship among these concepts for a typical farm to wholesale market.

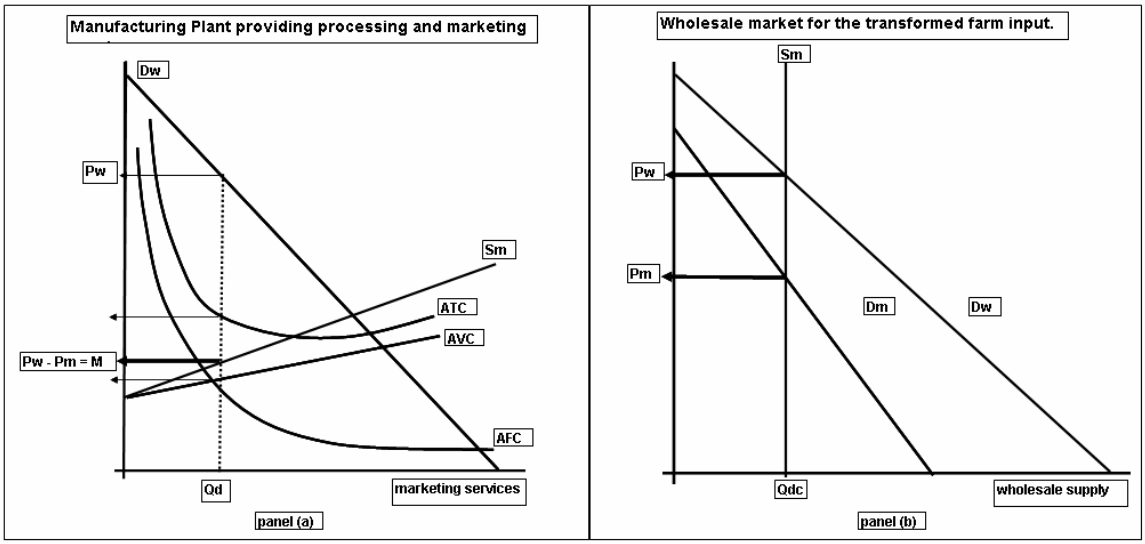

Figure 1. Marketing Margin and Derived Demand.

In Figure 1, panel (a) depicts the derived demand and plant cost structure for a typical plant. The curve labeled **Dw** represents the demand curve for the plant's services. The curve labeled **Sm** depicts the plant level supply curve for services. The curves labeled ATC (average total cost), AVC (average variable cost), and AFC (average fixed cost) represent the plant cost structure. Panel (b) depicts the supply of milk input labeled **Sm**, the demand at wholesale, **Dw**, and the demand for the farm input of milk, **Dm**. A basic economic fact is that the demand for the farm level input, **Dm**, is derived from the demand at wholesale, which of course is derived from the demand at retail, and the cost of transforming the farm input into the wholesale product. The intersection of farm level supply and the derived demand **Dm** determines the farm level price, **Pm**. This price plus the cost of the marketing services, determines the wholesale price, **Pw**. In this figure, panel (a), this margin is labeled **Pw – Pm = M**. Notice that at the current equilibrium as depicted in Figure 1 panel (a) , this margin equal marginal cost of providing the marketing services, but does not cover the average total cost of providing these services (ATC).

Figure 1, panels (a) and (b) depict the situation as experienced by those plants petitioning for a change in the Federal Order pricing rules. With the margin **Pw – Pm = M** representing the ''make-allowance'' for a dairy product, it is easy to conceive of a new plant with a cost structure significantly below that represented in the figure, for which the margin fully covers all costs, and in fact may return an economic profit, i.e, **Pw-Pm=M** > ATC.

Now, consider what happens with a change in the Federal Order pricing rules to incorporate an increase in the cost of a non-milk marketing service input, e.g., energy. This change is represented by a shift upward in the two curves, **Sms**, and AVC. This situation is depicted in Figure 2, panels (a) and (b).

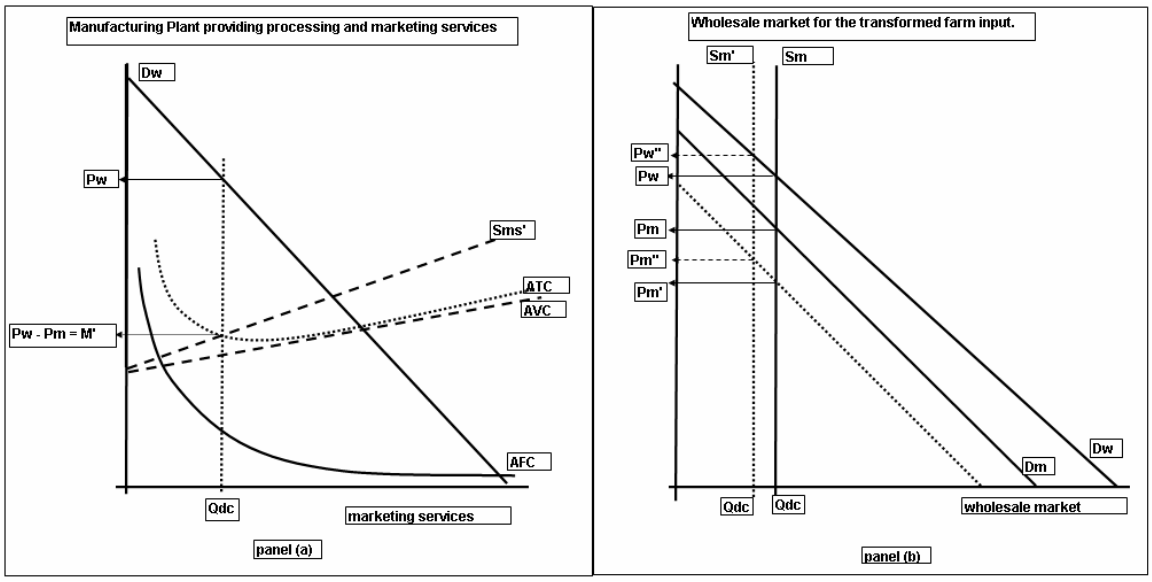

Figure 2. Increasing the Price of non-milk inputs.

In Figure 2, panel (a), the short run cost structure represented by **Sms'** and AVC have been shifted upward to represent an increase in the margin (or 'make-allowance'). In the short term, the impact of this change is to cause a shift in the derived demand for the farm input, shown as the dotted line to the left of Dm in Figure 2 (b), and as a decrease in the farm price for the input, from Pm to Pm', panel (b), Figure 2. If we assume fixed supply of the farm input, then this would be the end of the story. All of the increase in the margin would be a 1:1 decrease in the farm level price. The new margin, labeled **Pw-Pm =M'** in panel (a), now covers both the marginal cost and the average total cost ATC. It should be recognized, that if a plant did not actually experience an increase in its cost structure equivalent to that depicted in panel (a) this change will result in that plant receiving excess profits, i.e., a return greater than the total economic cost incurred in performing the transformation function.

Now consider what happens as the farm level supply has an opportunity to adjust to the new lower price. This is also illustrated in Figure 2, panel (b). In this panel, the assumption of a fixed farm level input is relaxed. The increase in the margin which reduces the farm price is followed by a shift to the left in the farm level supply. This is depicted as a shift from **Sm** to **Sm'**. Given time to adjust these lower farm prices will result in reduced milk production. Dairies will cull cows, and some dairies will exit the industry. The new farm level supply **Sm'** determines a new set of prices at the wholesale and the farm level. This reduction in farm level input reduces the amount by which the farm price declines and shifts some of the added marketing services cost onto the

wholesale market. This is shown in Figure 2, panel (b) as a farm level price of **Pm''** and a higher wholesale price of **Pw''**.

Disequilibrium with FMMO pricing rules

Now, with current Federal Order pricing rules, these market equilibrium changes cannot take place. As a given firm's marketing services supply curve shifts upward to reflect higher non-milk input costs this will push their cost structure above the Federal Order 'make-allowance', and losses will be incurred. They will have to either accept these losses or pass these losses back to their milk suppliers in the form of a lower price or a surcharge to cover the loss. For these plants and their milk suppliers, the farm supply will shift to the left, induced by a reduction in the milk input price. With the margin fixed by Federal Order rule, none of the higher costs can be transmitted forward to the wholesale market as a higher wholesale price. In this situation, all of the increase in the margin must come from the raw milk input supply side of the market in the form of lower prices. For those firms whose cost structure is such that the current Federal Order 'make-allowance' exceeds their marginal cost of processing, rising non-milk input cost is absorbed by the firm which does not have to pass losses back to the milk-input suppliers.

A matter of elasticities

In a 1975 paper, The Farm-Retail Price Spread in a Competitive Food Industry, American Journal of Agricultural Economics, Vol.57, No. 3, Bruce Gardner examines the implications of simultaneous equilibrium in three related markets: retail food, farm output, and marketing services. Gardner shows that market equilibrium places constraints on the pricing within the food marketing firms in a competitive industry. In his paper Gardner derives the total equilibrium relationship between the retail prices and farm prices, retail to farm margins, and changes in the supply and demand curves. The relationship illustrated graphically in Figures 1 and 2 can be expressed algebraically using the Gardner framework. By adopting Gardner's algebraic representation we can explore a wider range of implications of this fixed make allowance issue.

Gardner's method allows us to consider the relationship between changes in the wholesale cheese price and the farm milk price as consequence of some exogenous event, such as a shift in the marketing input supply. Equation (1.1) is the total elasticity of the wholesale cheese price and the milk input price:

$$E_{P_c P_m} = \frac{(\sigma + e_m)}{(\sigma + \eta)} \tag{1.1}$$

Where P_c and P_m are the wholesale cheese price and the milk input price, σ is the elasticity of substitution of the milk input for non-milk input; e_m is the elasticity of supply for the milk inputs; η is the own-price elasticity of demand for cheese at the wholesale level. This total elasticity will be negative when $\sigma < |\eta|$. It is not

unreasonable to assume that σ is close to zero and this $\sigma < |\eta|$ condition holds for manufactured dairy products. A shift in the marketing input supply will result in a simultaneous fall in the farm price for milk and an increase in the wholesale price for cheese. Connecting the Gardner expression (1.1) back to the current make-allowance issue tells us that any indexing approach which modifies the current Federal Order pricing rules, by changing the 'make-allowance' on a periodic basis, is equivalent to a shift in the marketing services supply curve, and this will result in a decline (increase) in farm price for milk and an increase (decrease) in the wholesale price for cheese.

The framework laid out by Gardner can be used to provide a more general assessment on this issue. The indexing of input costs is equivalent to the application of a tax on non-farm inputs at the processing level which raises the level of the non-milk input price. The algebraic example derived by Gardner serves well to evaluate the impact of any indexing rule that might be proposed as a solution to the current Federal Order pricing issue. Making obvious substitutions in notation the central expression is (for a complete derivation see the Gardner article):

(1.2) $$E_{P_c/P_m.T} = \frac{e_T S_b e_b \left(e_m - \eta\right)}{D}$$

Where $E_{P_c/P_m.T}$ is defined as the total elasticity of the *percentage margin* between the price of cheese and the price of the milk input; e_T is the elasticity of the non-milk inputs with respect to T (a price increasing tax on non-milk inputs); e_b is the elasticity of supply for the non-milk inputs; e_m is the elasticity of supply for the milk inputs; η is the own-price elasticity of demand for cheese at the wholesale level; and S_b is the relative share (bP_b / cP_c) of the non-milk input in the production process. D is a complex term which is generally positive in value. The total elasticity is an equilibrium concept and expresses the relationship between the percentage margin after allowing for all adjustments in the wholesale, farm supply and non-farm supply markets to take place. In Gardner's work, T is a tax applied to all non-farm inputs. Indexing, under the proposed changes to the Federal Order pricing rules, would operate exactly as a tax, raising the non-milk input price by a factor of 1+T. Using any reasonable set of value for each of these terms in (1.2) the percentage margin between P_c and P_m will increase when P_b rises as a result of an indexed increase in the price of non-milk inputs. This means that if an indexing rule is adopted, the percentage margin between P_c and P_m will grow or shrink over time as the changes in the 'make-allowance' are passed back to the farm level or moved forward to the processing level as T increases or declines. Given that the general longer term trend is for T to increase, it can be expected that the percentage margin between P_c and P_m will increase over the longer term. Thus 'indexing' may not be an acceptable solution to the Federal Order 'make-allowance' problem from the producers perspective.

The farm input share of margin changes

An equally enlightening approach can be found in the paper by Brian Fisher, The Impact of Changing Marketing Margins on Farm Prices., American Journal of Agricultural Economics, Vol.63, No.2., 1981. Building on the work of Gardner, Fisher derives the expression for the *share of a margin change absorbed by the farm input* given a change in the non-farm input price. The expression derived by Fisher is:

(1.3) $$S_f = 1/(1+\varepsilon_m/\alpha\eta_w)$$

Where S_f is the farm share of any change in the margin price resulting from a change in non-farm inputs, such as energy or labor wage rates; ε_m is the direct price elasticity of supply of the farm input; η_w is the direct price elasticity of demand for the processed farm product; α is the ratio of the farm price to the processed product price. This expression (1.2) holds if we make the assumption that there is no substitution of non-farm inputs for farm input in the processing and marketing activity. For agricultural products this is a reasonable assumption. From this expression it is apparent that at least four limiting cases can be identified. These are shown in Table 1.

Table 1. Limiting Cases for Impact of a change in Margin.

	Product Demand	Farm Input Supply	Farm price share of margin change
Case	Elasticity η_w	Elasticity ε_m	S_f
1	--	0	1.0
2	0	--	0.0
3	--	∞	0.0
4	∞	--	1.0

Case 1: Here the supply of farm input is completely inelastic. This represents the case where farm input supply is fixed and unresponsive to changes in the price received at the processing level. Regardless of the values for η_w and α, any change in the margin price is reflected in the farm price, e.g., the farm share of the change is 1.0.

Case 2: Here the demand for the processed product is completely inelastic. This represents the case where the consumer is unresponsive to changes in the price charged for the processed product. Regardless of the values for η_w and α, any change in the margin price is reflected in the processed product price, e.g., the farm share of the change is 0.0.

Case 3: Here farm level input supply is completely elastic. At this limiting value the farm supply curve is horizontal and any change in farm price stops production.

Regardless of the values for η_w and α, any change in the margin price is reflected in the processed product price, e.g., the farm share of the change is 0.0.

Case 4: Here the demand for the processed product is completely elastic. The demand curve is horizontal and represents extreme price sensitivity by consumers. Any processed product price change drives away all consumers. Regardless of the values for η_w and α, any change in the margin price is reflected in the farm price, e.g., the farm share of the change is 1.0.

In competitive markets for food products these elasticities and farm-to-processed product price ratios take on values which lie between these extremes. Chart 1 illustrates the relationship between the *percent share of the change in the processor margin passed back to the farm input level* for a range of assumed values of the elasticity of demand at the wholesale level. The fixing of the make-allowance under Federal Orders has the effect on the farm share of a margin change equivalent to assuming the elasticity of demand at the wholesale level is extremely large, i.e., infinite. Any change in the make-allowance will be absorbed 100 percent at the farm level.

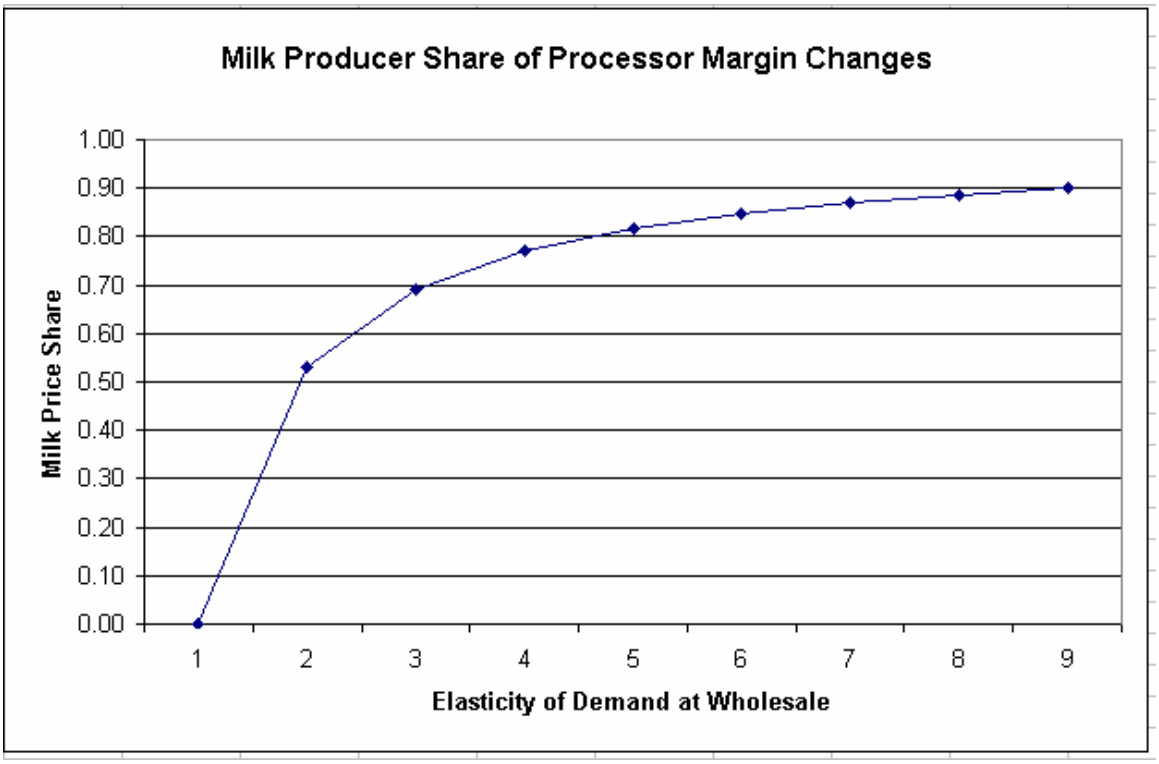

Chart 1. Farm Share of Margin changes with the Elasticity of Demand at Wholesale.

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