Macro Pricing: A Comprehensive Product Development Process

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Abstract

In general, current life insurance pricing techniques rely on the calculation of unit profits using a "cost-plus" pricing paradigm. Over the past decade, it has become increasingly obvious that this methodology is not well suited to decision-making in a competitive environment. This paper outlines the limitations inherent in current actuarial pricing techniques and describes a product development process that can produce optimal decisions in competitive environments.

I. Traditional Pricing Models

Although actuarial literature describes a multitude of product-pricing methodologies, current techniques exhibit three characteristics:

1. Product profitability is measured on a per-unit basis.
2. The product price[1] is determined by using a "cost-plus" algorithm.
3. The "cost of goods sold" is determined by using an expense assumption that artificially allocates non-marginal costs on a unit basis.

Not all current pricing algorithms exhibit all these characteristics. However, a great majority of pricing techniques use one or more of these methods. Use of any one of these techniques can undermine the effectiveness of a pricing methodology, as discussed in the following sections.

A. Unit-Based Analysis

Many traditional algorithms depend on financial analysis at the unit level. The unit of measurement may be death benefit, premium, policy, or other division of the whole. The total profitability or economic impact of the decision to offer a particular product at a certain price generally is not considered.

In simple terms, the profitability of a particular product equals the profit per unit multiplied by the number of units sold. To the extent that a company wishes to maximize profitability (or equally relevant, to minimize losses), the observation of unit profits tells an incomplete story. The desirability of offering a product at a particular price can be determined only by also considering the volume of business likely to be sold.

For all homogeneous products, the level of sales moves inversely with price.[2] Analysis of unit profits without consideration of the effect of price level on future production ignores this fundamental law of economics and in large part hinders the ability to make optimal pricing decisions.

B. Cost-Plus

A cost-plus algorithm can be characterized by the following relationship:

price = cost of goods sold + profit requirement

Many pricing methodologies implicitly use a cost-plus algorithm through the use of a profit goal. For

example, calculating product rates and values to expect a present value of profits equal to 5 percent of premium involves a cost-plus determination of price.

In a competitive market, a provider cannot choose a particular level of profit with any certainty that such a profit level will be realized. Profit may be maximized, but not chosen. For example, when increasing the unit profit goal, there comes a point at which total profitability decreases as the unit goal is increased. This happens when the negative effect on production of the increased price (caused by the increase in profit goal) outweighs the increase in unit profit. At that point, the unit profit goal ceases to be correlated with the more fundamental goal of total profitability.

C. Allocated Nonmarginal Costs

Most current pricing methods artificially allocate nonmarginal costs. This arises when expenses that do not relate to the sale of an additional policy (or to the inception of a new project) are divided into amounts per unit[3] and treated as marginal costs. It can be demonstrated mathematically, however, that nonmarginal costs have no impact on determining optimal price levels. Consider the following representation of the profitability of a venture:

$$\text{Total profit} = P \times Q - ME \times Q - NME$$

where

P = the price per unit
Q = the quantity expected to be sold
ME = the marginal expense per unit sold
NME = nonmarginal expenses.

If we assume that the quantity sold is related to price by the function $Q = f(P)$, then

$$\text{Total Profit} = P \times f(P) - ME \times f(P) - NME.$$

To maximize total profit, we take the derivative with respect to P and set the result to zero:

$$0 = f(P) + f'(P) \times (P - ME).$$

The above equation can be solved for the price that results in the greatest total expected profit. More important, however, the quantity NME (the nonmarginal expense) is nowhere to be seen and therefore is irrelevant to the determination of price. Admittedly, this example is an oversimplification, because some marginal costs are not a simple function of units sold. However, further sophistication of the example does not alter the irrelevance of nonmarginal expenses—the principle remains sound.

On a more conceptual level, it should be evident that the consideration of nonmarginal costs in any decision leads to less-than-optimal decisions. The value of any particular action can be considered only in relation to other alternatives. Consideration of nonmarginal costs in assessing the desirability of a particular action implies that these nonmarginal costs can be saved by choosing against this action. However, this is true only if the costs were indeed marginal. Therefore, consideration of nonmarginal costs exaggerates the cost of a particular action, resulting in an inaccurate assessment of the value of that course of action.

D. An Example

The flaws of traditional pricing techniques can best be demonstrated with a simple example involving a tangible product. Consider a company that manufactures microchips.[4] During 1989, the company sold 1,000 MM (1,000 million) microchips. For each microchip sold, the marginal cost of production and delivery was $0.15. The company spent $300 MM in nonmarginal expenses.

It is instructive to apply traditional actuarial pricing techniques to determine the price for which the company will sell each microchip in 1990. First, an expense study is done to determine the unit expense assumption. A simple study might involve the determination of a unit expense based upon a projection of 1990 experience. For example, we might assume that nonmarginal expenses will increase approximately 13 percent, while production is expected to increase 30 percent:

Unit expense =
marginal expense + $340 MM / 1,300 MM,

or

Unit expense = $0.41,

where $340 MM and 1,300 MM represent the projections of 1990 nonmarginal expenses and production, respectively.

Second, we apply the cost-plus algorithm on a unit basis to determine price. We assume that the unit profit requirement for the company is $0.10 per microchip (we will soon show that this assumption is immaterial to the fallibility of the approach). The unit price can now be calculated according to the cost-plus algorithm:

Cost of goods sold	0.41
+ Profit requirement	0.10
= Product price	0.51

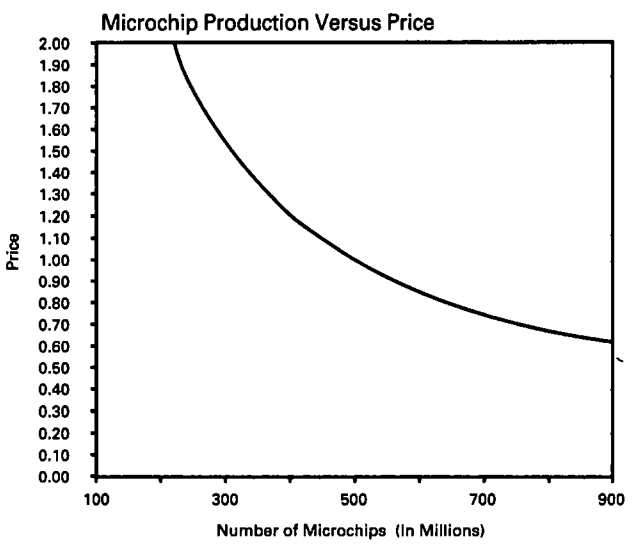
Note that this price was arrived at by using a method exhibiting the three characteristics described earlier: analysis on a unit basis, cost-plus price determination, and an expense assumption that allocates nonmarginal expenses.

To evaluate the success of this pricing methodology, we compare total profitability at differing price levels. As above, total profitability can be described in the following equation:

$$\text{Total Profit} = P \times f(P) - ME \times f(P) - NME.$$

Assume that $f(P) = 500\text{MM}/P^{1.2}$. In other words, the quantity expected to be sold is equal to 500,000,000 divided by the price raised to the power of 1.2.[5] Figure 1 illustrates this demand curve.

FIGURE 1



Substituting $f(P)$ into the total profit equation yields

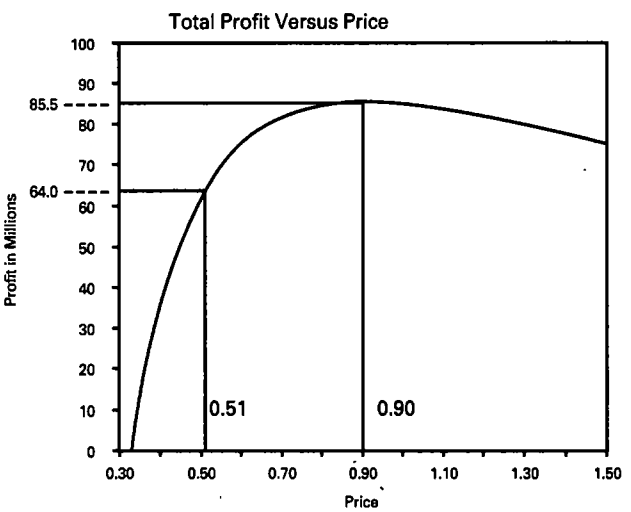
$$500\ \text{MN}/P^{0.2} - 75\ \text{MM}/P^{1.2} - 340\ \text{MM}.$$

Now expected total profitability can be determined at a variety of possible prices and graphically depicted as in Figure 2.

The price level expected to yield the greatest total profit is \$0.90 per microchip, for a total expected profit of \$85.5 MM. An examination of total profit at the previously determined price of \$0.51 shows a total expected profit of \$64 MM.

The flaws in the traditional algorithm are evident. Although the microchip company would likely have been profitable selling microchips at \$0.51 apiece, far more profit could have been expected by increasing the price to \$0.90.

FIGURE 2



However, with the traditional approach, the information to make this decision would not have been available.

It might be argued that the company chose the wrong profit goal; that is, the chosen \$0.10 per microchip was too small. This argument misses the point. Certainly, if the company had chosen a unit profit goal of \$0.49, the unit-based, cost-plus algorithm also would have resulted in the optimal price of \$0.90. However, this would have been the result more of coincidence than superior pricing technique, because the information necessary to choose the optimal profit goal is not generated through the traditional analysis.

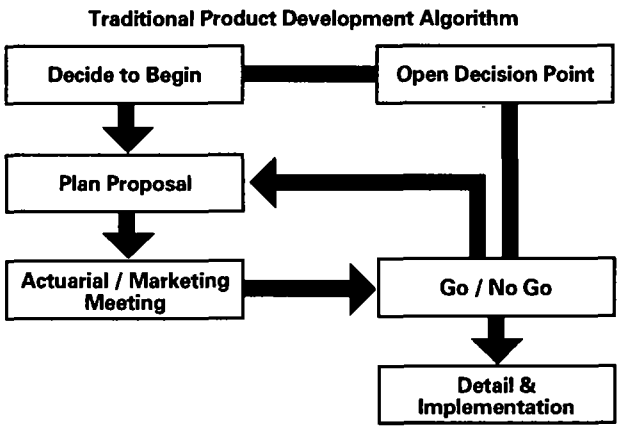
E. The Concept of "Open Decision Points"

The traditional algorithm has a further problem that is somewhat less tangible. Because it does not generate the information necessary to make optimal decisions, the entire product development process often reaches a standstill, with no clear direction for continuing the task. The standstill generally occurs when those responsible

for the financial integrity of the product (the product development actuaries) and those responsible for delivery of the product (the marketing department) disagree about the product's price.

This can best be shown by an examination of the product development process. Many insurers make use of a product development process similar to that outlined in Figure 3.

FIGURE 3



After determining desired design features and competitive goals, the product development actuary constructs an initial "plan proposal." Both the profitability and the competitive profile of the proposed plan are analyzed.

When the plan proposal is complete, the product designers (actuarial) and the product distributors (marketing) meet to discuss the plan proposal and to determine whether to proceed with the design or to assemble another plan proposal. In general, such a discussion focuses on the issue of price. The measure of price may differ from meeting to meeting, sometimes involving cash values, commissions, death benefits, or some other measure or combination of measures describing the value of the product either to the agent or to the consumer.

At this point problems typically surface. Those responsible for production generally desire more value to the consumer and/or producer (that is, a lower price). Conversely, the actuary, responsible for expected product profitability (according to the unit measure under consideration), generally desires a higher price. A standoff usually develops. The actuary is uncomfortable with the price desired by the marketing representative, because such a price is not expected to meet the unit profit goal. Marketing is uncomfortable with the price desired by the actuary, because such a price is not expected to meet sales or production goals. Faced with this situation, neither party has incentive to compromise its position. In fact, the goals set by each party may be mutually exclusive.

There is, however, a more serious and elusive problem than the fact that this sought-after price may not exist—that is, that neither party knows that such a price does not exist. In a constant search for a price that satisfies both parties, the product development process falls into the "loop" shown in Figure 3. Plan proposal after proposal is trotted out and rejected. In practice, the looping process seems to end only when one (or more) of the following conditions is met, none of which is conducive to optimal decision-making:

1. Time constraints dictate that the looping process must end.
2. Actuaries become more aggressive with pricing assumptions and as such are able to show greater unit profit at a lower price.
3. Either side compromises through fatigue.
4. Either side triumphs through use of political power within the organization.

The loop inherent in this algorithm is a result of a conflict for which there is no logical methodology for resolution. These circumstances are referred to within this paper as "open decision points." As demonstrated in practice, open decision points often lead to seemingly infinite human capital loops.

To understand the concept of the open decision point, we must examine the decision process itself. Decisions involve three broad steps. The first step is identifying the available alternatives, which we refer to as the "decision set." The second step is evaluating the expected consequences of choosing each element of the decision set. In business decision-making, the consequences are generally evaluated according to financial effect. These financial consequences may involve both tangible and intangible costs.[6] The third step is choosing one of the alternatives.

An open decision point occurs when the first two steps in the decision-making process are not explicitly analyzed. How does this apply to our traditional product development algorithm? Consider each step in the decision-making process. The first step is identifying the available alternatives. Because the purpose of our

algorithm is to determine the product price, our available alternatives are various price structures. The traditional algorithm does not usually lead toward an exploration of various price structures, primarily because the cost-plus paradigm rests on the assumption that a price can be determined directly.

The second step, evaluating the financial effect of each choice, is rarely attempted. A unit-based analysis is inadequate when comparing alternative price levels, because it largely ignores the effect of price on production. With traditional analysis, it is not known whether the lower price sought by marketing is likely to increase or decrease total profitability. As a result, the financial effect of each choice is unknown, and there are no criteria upon which to decide—an open decision point.

F. The Failure of the Traditional Approach

Growing dissatisfaction with the traditional product development algorithm stems from evidence of failure in practice. Many insurers find themselves caught in a product "ratcheting" cycle, in which each product must be more competitive than the last. Lack of a rigorous basis for pricing decisions leads to irreconcilable conflicts during the product development process, resulting in frustration for the decision-makers. Finally, the looping process caused by open decision points results in an unpredictable and lengthy product lead time.

II. The Macro Pricing Concept

We now describe a pricing process intended to eliminate the problems discussed previously. The foundation of the approach comprises two sweeping changes from traditional methods. The first involves a change in the method of financial analysis, and the second involves a restructuring of the decision process surrounding that analysis. This methodology is referred to as macro pricing.

As discussed previously, traditional analysis generally exhibits three characteristics: unit-based analysis, allocated nonmarginal expense assumptions, and use of a cost-plus price determination. Our first change is to replace these characteristics with techniques more suited to the real world.

1. Rather than analyzing profits on a unit basis, financial measurements must focus on the entire project or venture. In new product development, for example, the profit analysis considers the entire block of business likely to be sold.
2. Rather than using a cost-plus paradigm to determine price, we must consider and evaluate a full range of prices. This explicitly recognizes that the objective is to optimize price from a range of choices.
3. Rather than using allocated nonmarginal expense assumptions, only costs that are purely marginal must be brought into the analysis. In this way the most accurate picture of the financial impact of each decision can be developed.

The second sweeping change is in the structure of the decision process. With the traditional approach, plan proposals are made and accepted or rejected, without an evaluation of the total anticipated financial effect of each proposal. The remedy is a systematic analysis of a range of possible prices. By using the analysis techniques discussed above, a range of product prices is examined. For each product price, a broad range of production scenarios is considered, and total profitability, given each price and each production scenario, is determined. The resulting information is used to construct a graph from which the product price can be optimized.

The changes in the method of analysis and in the decision process are supported in detail in the following sections.

III. Project-Based Analysis

The primary reason for project-based, rather than unit-based, analysis is the former's ability to take into account the law of demand; that is, the amount sold moves inversely to the price. Without consideration of the likely production at each price level, the financial effects of a change in price are difficult to assess.

How is project-based analysis accomplished? Fundamentally, project-based analysis takes into account the project as a whole, rather than projecting one unit of business. The entire anticipated production over the product's anticipated shelf life is modeled within a single projection. Such an analysis requires assumptions on the likely distribution of business by policy size, age, underwriting category, premium pattern (if a flexible-premium product), and policy option elections.

Estimating the shelf life of a product is difficult, but necessary. "Shelf life" refers to the length of time that the product is salable. If the shelf life is thought to be three years, for example, then the analysis would

include production over a three-year period. (In today's environment, products with useful lives of more than three to four years are rare.)

Anticipated marginal expenses, as discussed below, are also an important part of the analysis. One assumption that need not be made, however, is that of total production. The macro pricing process involves analysis over a broad range of possible production levels. The likely production levels are determined during the decision-making process that leads to the product price.

Once assumptions about distribution of business and product life are made, the entire anticipated book of business is modeled, and the expected profitability for the complete product offering is estimated. Profit projection and modeling techniques are beyond the scope of this paper; thus the actual mechanics of the analysis are not discussed.

As mentioned previously, the most important advantage of project-based analysis is its ability to integrate the law of demand with the price level decision. This important aspect is discussed at length in a later section.

However, three other advantages of project-based analysis, although of lesser importance, are useful by-products. First, project-based analysis enables the actuary to present results in terms of the actual financial impact on the company. Because the numbers are expected to correlate with real world results, they can readily be understood by both upper management and marketing. For example, the present value of expected profits for a certain price structure sold at a particular volume might be $10,000,000. It is far easier to assess the overall desirability of the project with this information than with unit profit data.

Second, project-based analysis allows a more accurate reflection of capital and development costs in expected profit. For example, a particular plan may necessitate the purchase of a $500,000 administrative system. With project-based analysis, this cost can be brought directly into the analysis. With unit-based analysis, the $500,000 would have to be divided into unit amounts. This significantly decreases the accuracy of the calculations, because the division is, at best, arbitrary. Furthermore, development costs are handled more easily in total. For example, actuarial fees for the design and development of a certain new product may be estimated at $100,000. However, these costs are not divisible in actuality; that is, if the *unit* cost of the actuarial development is predicted to be $1.00, this certainly does not mean that one unit of the new product can be developed for the price of $1.00.

Third, project-based analysis allows better application of common sense. For example, under an optimistic production scenario a proposed product might be expected to produce a present value of profit of $100,000. For many companies, this expected level of profit could not justify continuation of the project. However, this might not be seen in unit-based analysis.

IV. Pricing as an Optimization Process

Because the law of demand pervades all business activity, an aggregate profit level cannot simply be chosen.[7] Pricing becomes a process, then, of choosing the price for the product that maximizes aggregate profits. Choosing a price that is greater than this optimum price results (perhaps) in a higher unit profit, but overall profits suffer as a result of decreased sales. On the other hand, choosing a price that is less than the optimum level results in an increase in sales, yet the marginal profit per unit falls such that overall profits again suffer.

To optimize the price of the product, a range of product prices must be considered over a range of possible production scenarios. The optimization process then involves choosing the attainable combination of price and production expected to yield the greatest value to the company.

If the expected profitability from the optimized product price is insufficient to induce the company to embark on the project, a new project or venture must be considered. The lack of expected profitability is not the result of improper pricing, but of the market itself. Once the optimal price is chosen, an increase in price cannot be expected to result in an increase in profit, and in fact, there are sound reasons to expect the opposite.

V. The Necessity of Marginal Expense Assumptions

Business decisions are best made when only those expenses marginal to the course of action are considered. This is likewise true when choosing the optimal price for an insurance product.

We begin with a rather informal definition of "marginal cost": The marginal cost associated with a particular

course of action is equal to the change in expected total company expenses as a result of that action.

The converse of marginal cost is the residual expense, which is referred to as "overhead" in this paper. An expense is considered overhead if it does not vary with the decision to take a particular course of action. In other words, any expense that cannot be saved by forgoing a course of action is considered overhead with respect to the decision to take that action.

To demonstrate the necessity of purely marginal expense assumptions as well as to refine the definition of marginal cost, we must once again examine the decision process itself.

Decision-making involves three overall phases, as follows:

1. Identifying the elements of the decision set (that is, the possible choices)
2. Evaluating the expected consequences of choosing each element within the decision set
3. Choosing the optimal member of the decision set based upon the expected consequences.

The concept of the decision set is quite important to the determination of marginal expense. In fact, the expected marginal expenses cannot be determined without first identifying the elements within the decision set. This becomes clear with a more rigorous definition of marginal expense. Both marginal expense and overhead can be stated specifically in terms of the decision set as follows:

> An expense is considered marginal if it can be eliminated by taking at least one of the courses of action (or no action) contained within the decision set. Conversely, an expense is considered overhead if such an expense exists for each and every element of the decision set.

For a particular decision, all expenses are either marginal or overhead. As an example, consider the decision set illustrated in Figure 4.

This decision set contains four possible actions, including the conscious decision to take no action at all.[8] When choosing among these actions, it is only necessary to rank the outcomes in an ordinal fashion. In other words, the elements of the decision set need only be compared with each other. It is not necessary (nor desirable) to compare any element of the decision set with choices not included within the decision set, because actions not contained within the decision set are not available as possible choices. It is unreasonable to reject an action because it compares unfavorably with a course of action that cannot be selected.

In evaluating the expected consequences of each element of this particular decision set, financial analysis considering only marginal expenses might produce the relationship shown in Figure 5.

If profitability is the decision-maker's criterion, then the obvious choice of action is that displayed as No. 1. Zero expenses would be considered in evaluating the choice of "no action," while only those expenses that are incremental (marginal) to actions 1, 2, and 3 are considered in evaluating these choices.

Figure 4

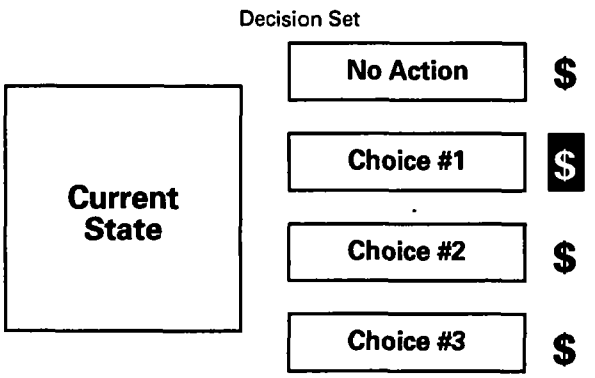
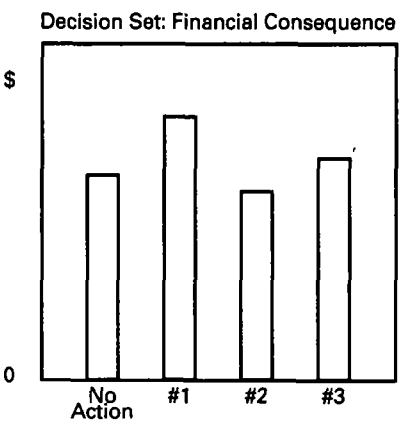


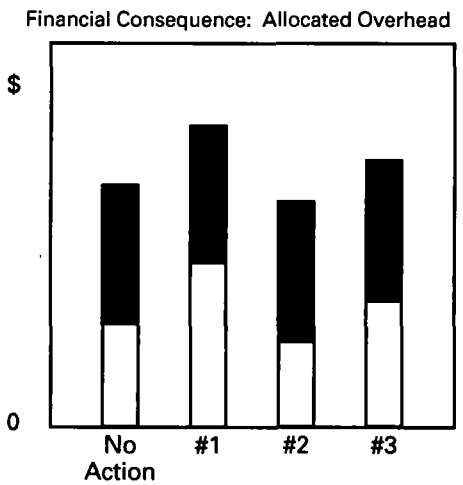
Figure 5



Should the elimination of overhead from the analysis cause doubts about the relevance of the answer, we can compare the decision that results when the analysis utilizes overhead expenses.

Because only marginal expenses were considered in evaluating the possible choices shown in Figure 5, the only modification necessary to reflect all expenses is to further subtract from each expected outcome the total overhead expense. However, by definition overhead does not vary from element to element of the decision set. Therefore, to adjust the results for the effect of overhead, we subtract an identical amount from the evaluation of each possible outcome. The result is illustrated in Figure 6.

Figure 6



Including overhead in the analysis does not alter the ordinal ranking of the various actions. Because by definition overhead is not variable over the elements of the decision set, the inclusion of overhead cannot have an impact on the relative desirability of the various choices. Therefore, we can conclude that overhead is irrelevant to our decision.

Even though overhead is not relevant to the decision-making process, it is folly to consider overhead in determining the *value* of a particular action to the decision-maker (the company). For example, consider once again the decision set containing four possible courses of action. Suppose that after overhead had been deducted, the expected consequences for each element of the decision set were negative. Would it then be appropriate to conclude that course of action No. 1 should not be taken, because the expected financial consequences are negative? As shown in Figure 6, even though the expected consequences of course of action No. 1 are negative (given the deduction of overhead), each of the alternative choices is expected to result in an even less desirable outcome. Therefore, action No. 1 is the logical choice.

The role of overhead expenses in evaluating particular courses of action is often misunderstood. As stated above, overhead is irrelevant in ranking elements of a decision set. However, much information is lost when taking overhead into account. Consider the following example:

A commercial airline has sold 50 tickets for a flight about to leave from New York to Los Angeles. Each ticket was purchased at a price of $200, resulting in a total revenue to the airline for this flight of $10,000. Assume that the cost of flying the airplane on this particular trip can be summarized as follows:

Fuel	$ 8,000
Maintenance	2,000
Crew	2,500
Total	$12,500

Just prior to the departure of the flight, a prospective passenger offers to pay $200 for a ticket. Is it desirable from an economic point of view for the airline to sell the 51st ticket?

We will begin the analysis by identifying the elements of the decision set. In this case, the choices are two: to sell the additional ticket and accept the 51st passenger, or to deny the sale and fly the plane with 50 passengers.

The second step in the decision process is the evaluation of the expected consequences of each choice. Here we assume that the marginal cost of each additional passenger is zero.[9] By using marginal expenses, the expected financial consequence of selling the additional ticket is $200, while the expected financial consequence of turning away the passenger is $0. It seems financially desirable to sell the 51st ticket.

Consider how the results might change if we were to introduce overhead into our analysis. As outlined above, the cost of flying the plane ($12,500) is clearly overhead with respect to our decision, because the airline will spend this amount whether the 51st passenger is accepted or rejected. To include the overhead within our analysis, we must first devise a method of doing so. The flight might be analyzed according to a method similar to that below.

Selling the 51st Ticket for $200		Denying the 51st Ticket	
51 tickets @ 200	$10,200	50 tickets @ 200	$10,000
Expenses	–12,500	Expense	–12,500
Profit	$–2,300	Expected Consequence	$–2,500
Profit per Passenger	$–45.10	Profit per Passenger	$–50

As expected, the inclusion of overhead does not affect the ordinal ranking of the choices. Carrying the 51st passenger is still $200 more advantageous than denying the ticket sale. As long as the analysis is used simply to order the two choices, no harm is done by including overhead. However, if the analysis of the 51st passenger is used in isolation of the alternative choice, suboptimal decision-making may result. It would be folly to consider the profit in the sale of the 51st ticket to be $–45.10 and then to decline the 51st sale.

The use of overhead in analysis, then, is irrelevant to the ordinal ranking of available actions, but misleading in the determination of the *value* of a particular action to the decision-maker. Financial analysis based upon marginal expenses yields a statement of "marginal profit," or the marginal impact on the company's financial position. The use of overhead expenses in analysis yields a statement of profit that may be quite uncorrelated with the value of the action to the company.

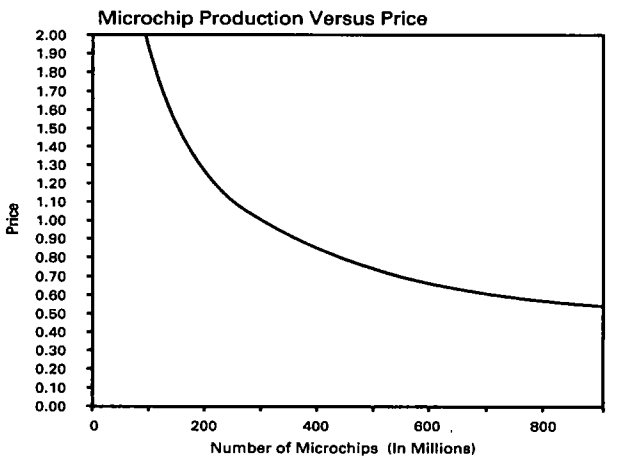
One particular danger in the use of overhead comes about when decision-makers attempt to allocate overhead expense over expected production. Analysis done with expenses allocated in this fashion interferes with the decision-making process through loss of information. This can be best shown by returning to our microchip company example.

Recall that the total expected profitability of the microchip company can be described by the following equation:

$$\text{Total Profit} = P \times f(P) - ME \times f(P) - NME,$$

where $f(P)$ is a function describing the relation between price and production. As before, we solve for the price that yields the greatest expected profit. However, we assume a demand curve with a different shape than that used previously. We now assume that $f(P) = 100\text{MM}/P + 200\text{MM}/P^2$. Figure 7 illustrates the shape of this assumed demand curve.

Figure 7



Substituting $f(P)$ into the total profit equation yields

$$\text{Total Profit} = 185\ \text{MM}/P - 30\ \text{MM}/P^2 - 240\ \text{MM}.$$

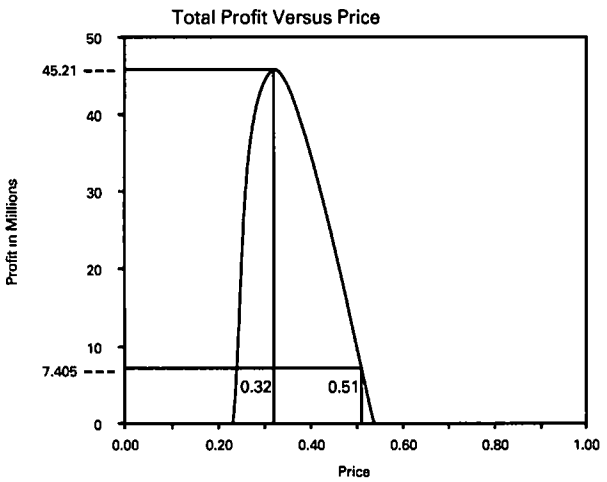
As before, expected total profitability can be determined at a variety of possible prices, graphically depicted as in Figure 8.

Here, the price level expected to yield the greatest total profit is $0.32 per microchip, with a total expected profit of $45 MM. Compare this with the unit-based analysis with allocated overhead:

Cost of Goods Sold	0.41
Profit Requirement	0.10
Product Price	0.51

With the allocation of overhead, the decision-maker assumes that selling microchips at a price of $0.32 results in a loss of $0.09 for each unit sold. This is in spite of the fact that $0.32 is in fact the optimal price, with an expectation of $45 MM profit. It is useful to analyze this situation further.

Figure 8



A problem has been introduced with the inclusion of overhead in the analysis. Recall that the assumed cost of goods sold comprised a $0.15 marginal cost added to a $0.26 unit allocation of overhead. The allocation of overhead on a per-unit basis implies that this "unit" of overhead can in fact be saved by not selling a unit of production.

This assumption is clearly at odds with reality. An additional unit of business does not cause an additional $0.26 of overhead to be spent. Conversely, reducing production by one unit does not save $0.26 of overhead. By allocating overhead we have lost information about the true profitability of an additional unit of production. The analysis exaggerates the cost of selling microchips and leads the decision-maker to inappropriate actions.

At this point several conclusions can be drawn about the use of overhead expenses in decision-making analysis:

1. Overhead expenses are irrelevant to the analysis of various choices within a particular decision set. The inclusion or deletion of overhead expenses does not affect the ordinal ranking of the actions.
2. The allocation of overhead expenses in decision analysis is misleading, potentially dangerous, and necessarily artificial. It exaggerates the true economic cost of any particular action.
3. The use of overhead expenses undermines the determination of the value of any particular action to the decision-maker. Expected profitability calculated using overhead expenses does not correlate well with the desirability of the action in question.

Therefore overhead expenses are best ignored in analysis supporting corporate (or any other) decisions. A question continually arises, however, within the context of selecting the appropriate prices for insurance products: If overhead is ignored in the analysis, how does the decision-maker know whether he/she is "covering the overhead"? This question forms the topic of the next section.

VI. Levels of Decision-Making Within an Insurance Company

To address the issue of "covering the overhead," we must first define what covering the overhead means. When a person speaks of covering overhead, generally the reference is to the profitability of the company in total. In other words, a company is said to cover overhead in a particular year if the profits for the company as a whole for the year are positive.[10] Therefore, "covering the overhead" is correlated to the overall health or viability of the company.

More specifically, among product development actuaries, "covering the overhead" generally refers to the condition in which the anticipated marginal unit profit of a product over time exceeds some allocation of overhead to this unit of business. This test of covering the overhead is usually done by considering the allocated piece of overhead as an expense of issuing one unit of the product.

Considered logically, this procedure can be analyzed as a particular statement of profit goal used within a cost-plus-pricing algorithm. Here the goal is simply the amount of artificially allocated overhead. Using such a profit goal introduces into the analysis all the attendant problems discussed in previous sections. In addition, the use of such a goal does not mean that the overhead will necessarily be covered. The simple statement of a profit goal does not mean that such a goal is attainable. As discussed earlier, the use of a profit goal with a cost-plus, unit-based pricing algorithm does not ensure that such a profit goal will be realized.

How can we be sure that all company expenses are met (covering the overhead)? In short, we cannot be sure. The most that can be accomplished through the pricing process is to attempt to cover as much expense as possible—in other words, to maximize expected marginal profit. However, we can explore the relationship

between the maximization of expected profit as a pricing exercise and the overall health of the company.

We begin by assuming that we have used the macro pricing process to maximize expected profits. Because the price chosen was expected to result in the greatest profit, it then follows that either raising *or* lowering the price reduces profitability.

Now assume that the optimal price is such that the expected unit profit is less than the artificial allocation of overhead. In other words, the pricing actuary might say that the product is not expected to "cover overhead." Is there any particular action we can or should take based upon this information? Several possible actions can be considered: increase the product price, decrease the product price, or abandon the project completely. Consider each in turn.

1. *Increase Product Price.* Because we have optimized the product price to produce the greatest expected profit, then we fully expect that an increase in price will produce lower overall profits. Although an increase in price may allow us to state a greater unit profit margin, the negative impact on production will overshadow this increase. By increasing price, the total profitability of the product is expected to decrease. However, the overhead remains fixed (by definition). The result of a price increase is that even less of the overhead expense will be met through this project.
2. *Decrease Product Price.* Again, because the chosen price is expected to maximize profitability, we would expect a decrease in product price to have a negative effect on total profitability. As total profits decrease, so does the ability to pay for overhead expense.
3. *Abandon the Product.* If the product is not expected to carry its "proportionate" share of overhead expense, it is tempting to abandon the project, declining to bring the product to market. However, if the expected marginal profit of the project is positive, then the product is expected to make a contribution toward the overhead expense. In this case, if the project were abandoned, then the overall profitability of the company would suffer. Once again, even less of the overhead expense would be met.

Interestingly, each of the three intuitive reactions to our hypothetical situation actually exacerbates the "problem." In fact, our problem may not even be a problem at all. By definition, a venture with an expectation of positive marginal profit is desirable to the company. The test of covering a certain allocation of overhead expense is simply a statement of profit goal. As discussed earlier, the use of a profit goal implies that the profit level can actually be chosen. In reality, however, profitability can be optimized, but not chosen. In this context, profit goals do not have practical meaning.

However, under certain circumstances a project with anticipated positive marginal profits should be abandoned. These circumstances arise whenever the project under consideration can be replaced with a project of greater profit potential, that is, a more desirable project. To determine whether an alternative project (or product type) has a greater expected profitability, the alternative project must be analyzed as well. Two projects cannot be compared without first making some judgment on the expected profitability of each. Less evident is the requirement that the macro pricing procedure be followed for each project independently before the expected value of each project can be determined.

Consider the following: A company embarks on a project to introduce a new product. We refer to this endeavor as "project No. 1." The company must decide upon an appropriate price for the new product. Here the decision set comprises the various possible prices for which the product could be offered. As part of the pricing procedure, the company explores a range of prices, comparing the total expected profitability of each. The optimum price is chosen, and the company now has an expectation of the total profitability (or value) of project No. 1, given the chosen price.

Now suppose that the company, for some reason, is dissatisfied with the expected value of this particular project. Should the company abandon project No. 1? Not unless project No. 1 can be replaced with a course of action with a greater expectation of profitability. If the marginal value of the project is negative, then the more profitable action is abandoning the project. If the marginal value of the project is positive, the project must be compared with other ventures. If a project with a greater expected value to the company can be found, then the original project should be abandoned. If not, then proceeding with the original project is likely the healthiest course of action.

In its dissatisfaction with the expected results of project No. 1, the company explores project No. 2. Before the two projects (No. 1 and No. 2) can be compared, the company must develop an expectation of the value of project No. 2. To form such an expectation, the company must determine the price for which the prod-

uct will be offered under project No. 2. Otherwise, there is not enough information to make a judgment about the profitability of project No. 2.

Once again, the decision set comprises a range of product prices, and the optimal price is chosen. With the determination of price, the company gains a picture of the anticipated profit from project No. 2. The two ventures can then be compared, and the project with the greatest value chosen.

Note that the projects could not be adequately compared without first traveling through the pricing exercise with each. Without first determining the price leading to the greatest expected profitability, the potential value of each project is unknown.

Continuing our example, suppose that the company evaluates a variety of projects, chooses the one with the highest potential, yet still remains dissatisfied with the financial picture. Should the company now choose to abandon the entire line of business? Again, the line of business should be abandoned only if it can be replaced with another action that has greater profit potential. Here the decision set would comprise various lines of business, or alternative business ventures. As might be expected, the alternative lines of business cannot be valued without exploring a variety of projects within each, while each project cannot be valued without embarking on the pricing exercise.

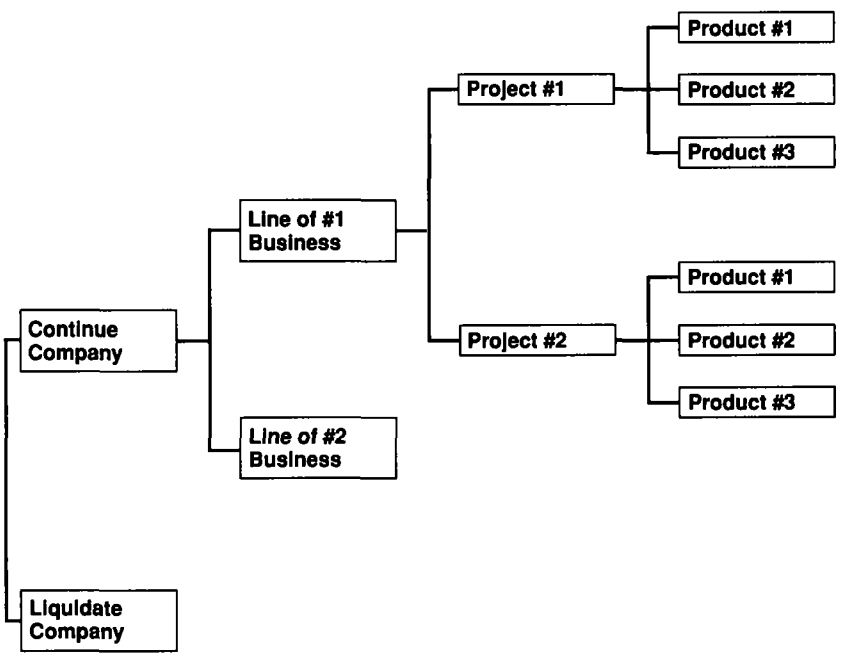
The various levels of decision and analysis suggested by the above example are illustrated in Figure 9.

Note that the analysis must be done "from the bottom up." In other words, no level of decision can be rigorously optimized without first optimizing the choices within the lower levels.

At the lowest level is the product pricing function. Because the pricing function determines an appropriate price for a particular product, the various choices within the decision set comprise the various plan structures, or prices. These choices within the decision set define the division between marginal and overhead expenses. Again, if an expense cannot be eliminated by selecting at least one choice within the decision set, then such an expense is overhead and becomes irrelevant to the analysis.

Figure 9

Decision Levels



At the next decision level, the character of the decision set changes. In fact, the decision set expands as we move left on the decision tree, because each decision level includes the choices inherent in the lower levels. With the change in decision set comes a change in the division between marginal and overhead expenses. As the decision set expands, more expenses can be eliminated by at least one of the possible choices.

For example, consider project No. 1 on our decision tree. Certain expenses may be necessary to embark on project No. 1. Such expenses may take the form of a special administration system, special regulatory or legal work, or the use of specialized consultants. These expenses are completely irrelevant to the determination of product price for project No. 1, because they cannot be eliminated no matter what price is chosen.

However, consider the next decision level, that of choosing between project No. 1 and project No. 2. Perhaps some or all of the special expenses involved with project No. 1 are not necessary for the completion of project No. 2. Now that these expenses can be eliminated by at least one choice within the decision set (choosing project No. 2), these expenses become marginal and are important in the analysis.

This is an interesting result. Expenses that were overhead with respect to a lower-level decision have become marginal with respect to higher-level decisions. Note that the top-level decision is the continuation or dissolution of the company. With the decision to eliminate the company, many expenses can be avoided.[11] At this decision level nearly all expenses become marginal and thus important to the analysis.

What happened to the question of covering the overhead? This cannot be answered except at the decision level for which such "overhead" becomes marginal. In other words, expenses that are overhead to a particular decision level cannot be addressed at that level. At each decision level, only those expenses that are marginal to that level of decision can be properly analyzed.

Many frustrations in product development stem from an assumption that analysis used in the determination of price can also answer the question of overall company health or the ability to meet overhead expenses. *In fact, no such analysis exists.* The pricing actuary cannot simultaneously optimize the price of a product and answer the overhead question. Only at the top-level decision can the overhead question be fully answered. Yet the question becomes answerable not because a method of analysis exists that can deal with overhead, but because those expenses typically thought of as overhead are marginal with respect to the decision at hand.

VII. The Decision Process

Now we can discuss the decision process by which an optimum price is chosen within the product pricing exercise. As mentioned earlier, the macro pricing process (in contrast to traditional pricing procedures) involves both changes in the method of analysis and in the method of decision-making. The changes in the method of analysis are designed to more accurately reflect the real world in assessing the profitability of a venture or product. These changes are:

1. Analyzing profits on a project, rather than a unit, basis
2. Analyzing a range of potential prices for the product
3. Using only marginal expense assumptions.

With these changes in method of analysis, it would seem that we could simply solve for the optimum price directly, as with the microchip manufacturer described in an earlier section. However, in the earlier example we assumed that we could develop an expectation of the shape and character of the product demand curve. Unfortunately, when pricing insurance products, we are generally not privy to such information. It is true, however, that if we had a firm expectation of the shape of the demand curve for the product to be priced, then the selection of optimum price would be nothing more than a mathematical exercise.

Although this idea is theoretically appealing, such an approach generally fails in practice. First, because of the incentive structure within most insurance companies, there are no unbiased players who would be sufficiently rewarded to conjecture about the shape of the demand curve. To make assumptions, one must perceive some reward for the task, or at least impunity if the assumptions are not realized.

Second, and far more important, a broad array of parameters is involved in life insurance product demand, such that demand curve development is all but impossible. As a result of state anti-rebating laws, insurers control both the retail and the wholesale price structure of their products. With both of these independent price structures as variables during the pricing process, the insurer faces, not a demand curve, but a demand surface. As the compensation structure becomes more attractive independently of retail price, production is expected to increase. As the retail price increases independently of the compensation structure, production is

expected to decrease. With one horizontal axis representing the retail price and the other horizontal axis representing the compensation structure, the demand surface might be similar to that shown in Figure 10.

Further, the very concept of price is somewhat nebulous when applied to insurance products. At the retail level, a seemingly infinite array of components collectively determines the "price" of the product. Such items might include premium level and slope, cash value incidence and magnitude, dividend scales, death benefits, cost of insurance rates, credited interest rates, relationship of guaranteed to nonguaranteed elements, and so on. The implied wholesale level is determined by subtracting the seller's compensation from the retail price. Seller's compensation may vary in a great many ways, not only in level and incidence, but also in form as well: percentage of premium, percentage of assets, flat amounts, bonuses, performance rewards, and so on.

As a result of these complications, a method of arriving at the optimum price is unlikely to succeed if it depends on an advance determination of the demand surface. Rather than requiring a predetermined assumption of product demand, our method consists of analyzing a range of possible prices across a range of possible production scenarios. Because the entire reasonable range of product prices is contrasted with the entire reasonable range of production levels, the analysis need not make assumptions of the relationship between price and production.

Using the data from this analysis, we can then construct a graph detailing the value to the company of each combination of price and production. Such a graph might appear as shown in Figure 11. Note that each product "price" forms a "row" on the graph, the vertical component of which represents the value to the company. The information contained on such a graph will be used as the basis for determining optimum price. We refer to this pictorial representation of the relationship of profit, production, and price as the "price-production graph."

There are two techniques for selecting the expected optimum price: one for the updating or refining of an existing product, and one for the entrance into a new market. Both essentially involve the selection of price by the marketing department, with the resulting "marketing goal" driven by that selected price. Each of the procedures has worked well in practice.

Figure 10

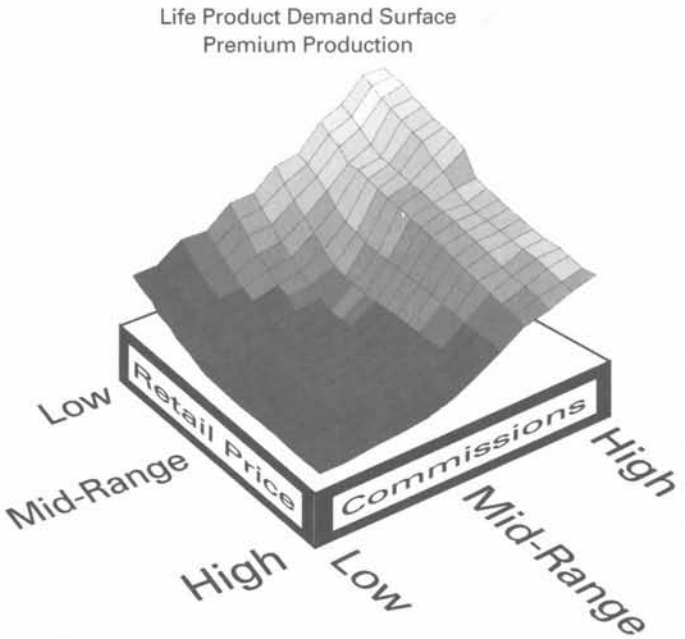
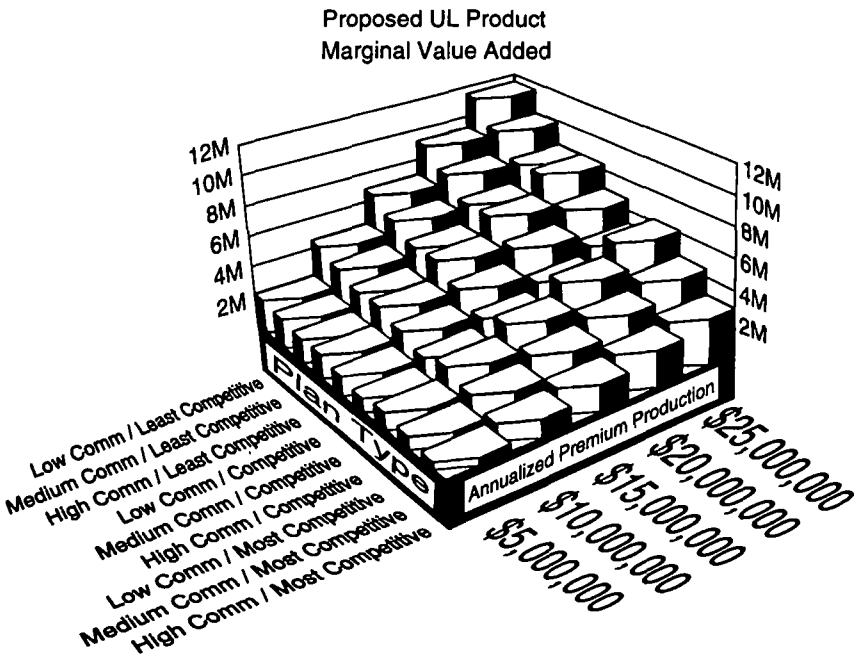


Figure 11



A. Updating an Existing Product Form

In general, products are revised or updated with the hope of presenting a more competitive profile, that is, a more aggressive price. The procedure begins by analyzing a range of prices with which to replace the existing price. Even though the initial goal of the analysis may be to investigate a more competitive profile, a range of prices both more and less competitive than that currently marketed should be examined.

Each of the prices analyzed represents a particular replacement product with a different competitive profile. A model office is developed for each replacement product. Business is assumed to be sold over the replacement product's expected life (perhaps two to three years). The model office is developed for a range of possible annual production levels. For each of the analyzed products, at each of the possible production levels, the expected present value of future profits is calculated. The price-production graph is assembled from these figures.

Before the price is selected, it is useful to begin with a profit "benchmark." This is done by analyzing the existing product in the same manner as the possible replacement products. In other words, the existing product would be assumed to be marketed unchanged over the period of the model office. With the results of such analysis, the existing product can be added to the price-production graph.

Note that each row on the price-production graph represents one choice within our decision set. The row for the existing product represents the choice of refraining from any product modification (that is, no action).

The decision process now begins with an evaluation of the latter choice, that of no action. This evaluation is done be estimating the future sales volume of the existing product. In general, this estimate is based upon previous sales figures. When an estimate is arrived at, the expected value of continuing with the existing plan can be read directly from the graph as the vertical component of the existing product curve. This figure represents the expected financial consequence of one of the choices within the decision set, that of no action.

With an assessment of the marginal profit of continuing the existing product, we have a standard of value with which to compare the other choices of product price. Based on the price-production graph, we can determine the level of production necessary for each product price such that the marginal profit of that choice

is equal to that of no action. In other words, a production level is paired with each product price such that the realization of any one of the production/price pairs would be expected to result in similar value to the company as the realization of any other production/price pair.

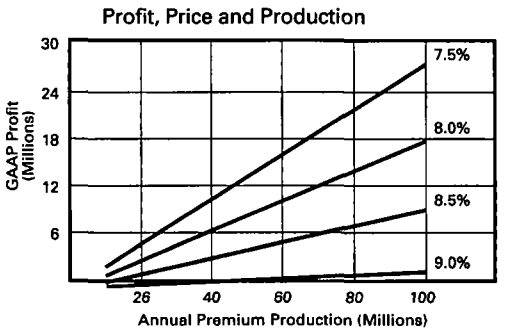
The next step in the process is choosing the desired product price. This is done by allowing those responsible for product production to choose the price, with the condition that the production level paired with that price serve as the marketing goal for the new product.

An example best illustrates this decision process. Consider the XYZ Life Insurance Company, which has been marketing a single-premium life insurance product for the past two years. The current product has no visible expense charges to the policyholder and credits interest to policyholder fund balances at 7.5 percent annually. The product has now been singled out for review and a possible revision of the credited interest rate.

The pricing actuary at XYZ Life examines three alternative product price structures, each differing by credited interest rate, as well as the existing product. The credited interest rates analyzed include 8, 8.5, and 9 percent annually, in addition to the existing credited rate of 7.5 percent.[12] The current product has been selling at the rate of $30.9 MM premium per year, and sales figures show no trend toward declining production. As a result, the pricing actuary analyzes each product price structure at production levels ranging from $20 MM to $100 MM premium per year. The product life is assumed to be two years.

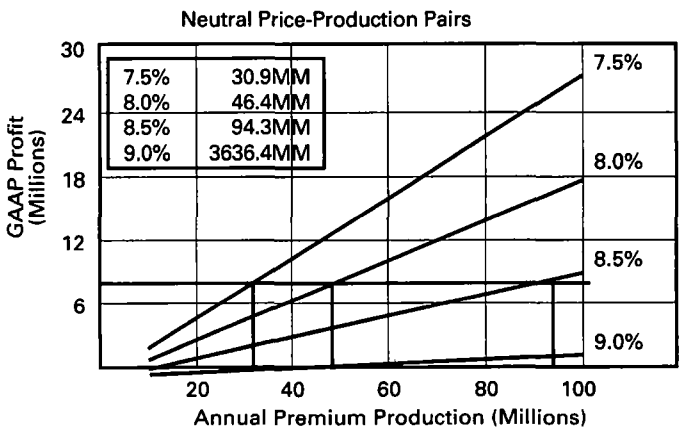
Based on the pricing analysis, the actuary at XYZ Life constructs the price-production graph shown in Figure 12.

Figure 12



With the price-production graph in hand, the pricing actuary meets with representatives of the marketing department of XYZ Life. Because production figures for the existing single-premium product are relatively level over time, sales of the existing product are assumed to continue at the rate of $30.9 MM of premium per year. The actuary notes that the expected value of this business to the company is $8 MM. A horizontal line is drawn across the graph at the $8 MM value level, and each product price is paired with a production level expected to produce a value of $8 MM to the company, as illustrated in Figure 13.

Figure 13



The price/production pairs that result are:

Credited Interest	Annual Premium Production	Value to XYZ Life
7.5%	$30.9 MM	$8 MM
8.0	46.4	8
8.5	94.3	8
9.0	$3,636.4	8

The marketing department of XYZ Life Insurance Company now must choose the most desirable price/production pair. Assume that the marketing officer in charge of this product chooses a credited interest rate of 8.25 percent, accepting a marketing goal of $70 MM per year (the approximate production necessary to produce a value to the company of $8 MM).

The question now arises, did this procedure produce the optimal price, that is, the price expected to produce the maximum profit to the company? Do we have any way of determining whether the chosen price (8.25 percent credited interest rate) is appropriate? Why leave the decision about price to the marketing department? Each of these questions is addressed in turn.

Frankly, there is no way of actually knowing whether the chosen price is indeed optimal. Suppose that in fact the production goal of $70 MM per year is realized. This level of production is expected to result in profits of $8 MM to the company. The realization of this goal does not imply that the correct decision was made; we will never know whether the choice of another price level would have resulted in production with profitability exceeding $8 MM.

As with all business decisions, an action is selected that is expected to produce the best results. All decisions made in the face of uncertainty are subjective. The question becomes, then, *who* shall make the necessarily subjective decision? The price decision should rest with the marketing department for two reasons: incentive and responsibility.

Let us first consider the question of incentive. When making the price decision, the marketing department realizes that there is a necessary tradeoff between price and "required" production. The decision-maker is free to choose a more competitive price, but must "pay" for this more competitive price by promising to deliver more production. As such, marketing will have incentive to choose the price/production combination easiest to meet. In doing so, marketing is making implicit judgments about the sensitivity of product demand to price (the demand curve).[13] Marketing generally chooses the price such that actual production has the greatest chance of exceeding the production goal paired with that price.

Second, let us consider responsibility. Obviously, others within the insurance company have opinions about the shape of the demand curve. For instance, the actuarial department may believe that a credited interest rate of 7.5 percent represents the price at which production has the greatest chance of exceeding the commensurate goal. However, the marketing department's responsibility is to actually meet such a production goal. Because marketing has the most at stake in making a right or wrong decision, marketing's decision bears the most credibility in comparison with others in the company.

B. Entering New Markets

For the introduction of a new product form, a slightly different technique is used for choosing the price structure anticipated to maximize profitability. Here, we do not generally have the benefit of previous experience on production levels.

In the case of modifications to an existing product, we compared each of the alternative price structures to the existing product price. With an assessment of the profitability in continuing the existing product, we could "require" that any variation of the product price produce no less than comparable value to the company.

When the product to be marketed is not currently being sold by the company, there is no standard of value to which we must hold alternative price profiles. With new products, several possible methods can be, and have been, used successfully. All are quite similar in nature and are simply different ways of looking at the same problem. I discuss the two most promising here.

The first method is the most straightforward. The marketing department carefully examines each price profile. For each product price, a production level is selected that seems attainable. As such, the marketing department assembles its own set of price/production pairs, all of which could be expected to be attained with equal effort.

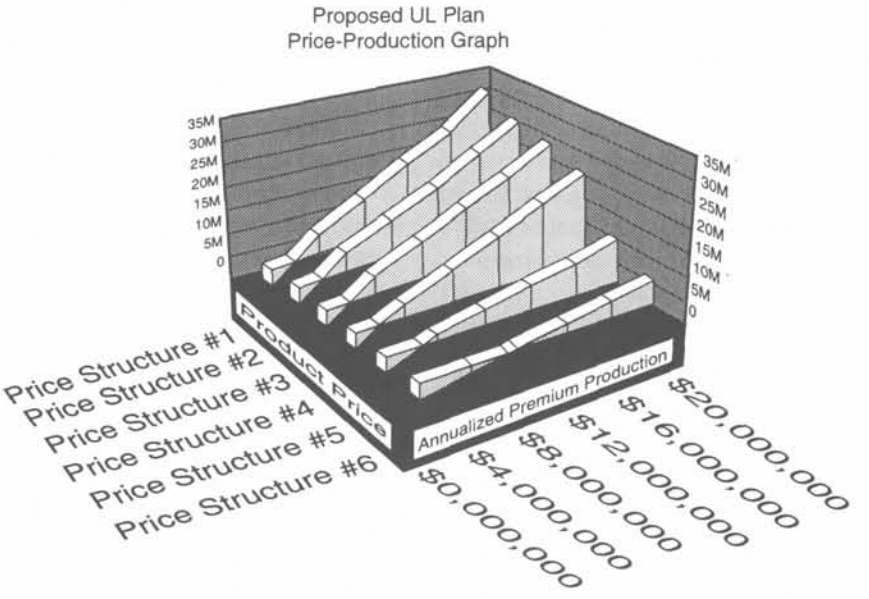
When the price/production pairs are complete, they are plotted on the price-production graph. Plotting the points represented by the price/production pairs identifies the expected total profitability for each product price. The price with the greatest expected profitability is then singled out, and the project evaluated on that basis. If the expected profitability is satisfactory, then the project continues with the chosen price structure. If the expected profitability is unsatisfactory, then consideration is given to expanding the decision set and investigating other potentially more profitable projects.

As an example, consider the development of a completely new Universal Life product, unrelated in form and market to products currently sold by the company. The pricing actuaries analyze six price profiles and develop the price-production graph shown in Figure 14.

Without reference to the graph, the marketing department develops the following production estimates, by product price:

Product Price	Annual Premium Production
1	$ 2.5 MM
2	3.5
3	5.0
4	8.0
5	14.0
6	18.0

Figure 14



Each of these price/production pairs is then evaluated based on the information from the price-production graph, as follows:

Product Price	Annual Premium Production	Value to XYZ Life
1	$ 2.5 MM	$3.0 MM
2	3.5	4.2
3	5.0	5.2
4	8.0	8.0
5	14.0	7.0
6	18.0	5.0

According to the estimates of the marketing department, the greatest expected profit can be attained with product price 4, which has an annual premium production of $8 MM. The $8 MM becomes the annual marketing goal for this product, with an expected value to the company of $8 MM.

As long as the $8 MM of profit is enough to induce the company to proceed with the product, then the project can proceed on this basis.

Alternatively, the marketing department may have said that products at prices 1 through 4 are simply unsalable, while products at prices 5 and 6 could reasonably result in $5MM and $10MM of production, respectively. The results of this assessment appear as follows:

Product Price	Annual Premium Production	Value to XYZ Life
1	$ 0 MM	$0 MM
2	0	0
3	0	0
4	0	0
5	5.0	2.0
6	10.0	1.5

In this case, the optimum profit would seem to arise from product price 5, with a total value of $2 MM. However, a total value of $2 MM may not be enough for the company to proceed with the project. Then the company should expand the decision set and investigate other business ventures, products, or profit opportunities.

This last result is most interesting, because it provides the incentive for the marketing department to be diligent in its estimates. With many projects (if not most), the marketing department is the most enthusiastic about the new product. In fact, often the impetus for a particular project arises from the desires of those responsible for production. However, if marketing is overly conservative in estimating projected production, then the project as a whole may not go forward. This gives marketing an incentive to make the commitments necessary to ensure the success of the project.

The second method of price determination for new products is similar to that discussed above, but avoids the necessity of explicit price/production estimates by the marketing department. In place of this, management determines the minimum total profitability such that the project will be carried through to completion. This profitability figure serves as a minimum standard used to develop price/production pairs as in the method for updating existing products discussed earlier.

For example, consider the project represented by the price-production graph shown in Figure 14. Suppose that management believes that the project as a whole needs to generate a total of $7.5 MM of profit to be worthwhile.

A horizontal line is drawn at the $7.5 MM profit level, as shown in Figure 15.

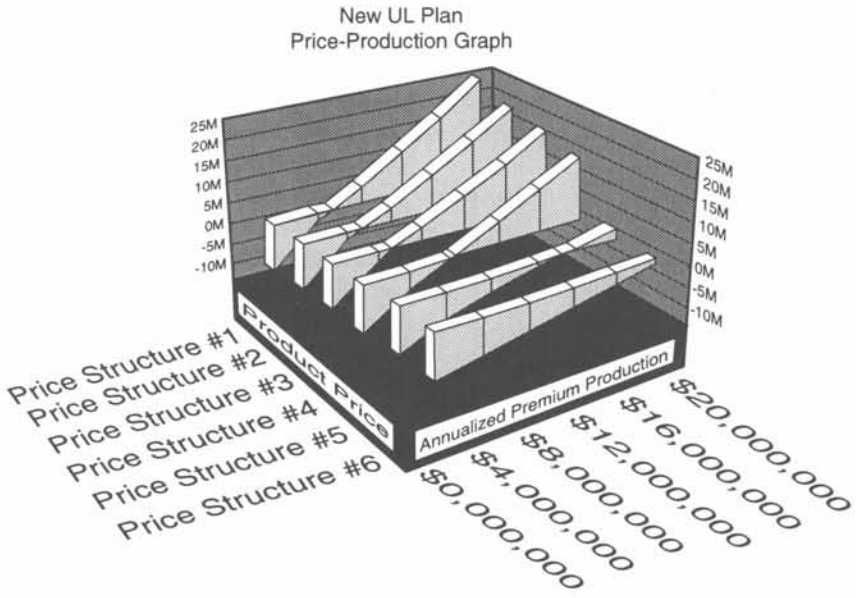
This line now defines a set of price/production pairs, all of which are expected to produce enough profit to induce the company to proceed with the project. The method now proceeds identically to that used for updating existing forms, with the marketing department selecting the price/production pair easiest to attain. Again, the production level commensurate with the chosen price functions as the marketing goal for the product.

VIII. Displacement as a Marginal Cost

When discussing the concepts of marginal and non-marginal costs, we tend to think of tangible expenses such as underwriting and issue costs, mailing costs, advertising, and sales commissions. Other marginal costs are not directly evident, but no less important in their economic impact.

These intangible marginal costs exist in many forms. For example, eliminating the annual convention for the company's top producers might bear the intangible cost of lower field force morale. The immediate impact on production might be satisfactorily estimated, but the long-range effects could be quite difficult to quantify.

Figure 15



Another example of an intangible marginal cost is bearing risk. Although beyond the scope of this paper, the cost of bearing risk should be treated as a marginal expense in pricing analysis.

A particular intangible marginal cost that has a significant impact on the profitability of many insurance ventures is the effect of a new product on the sales of existing products. There are consumers who would have purchased one of the company's products regardless of whether the new product was offered. Sales of the new product to these consumers have displaced sales of existing products. We refer to the total level of this activity as "displacement."

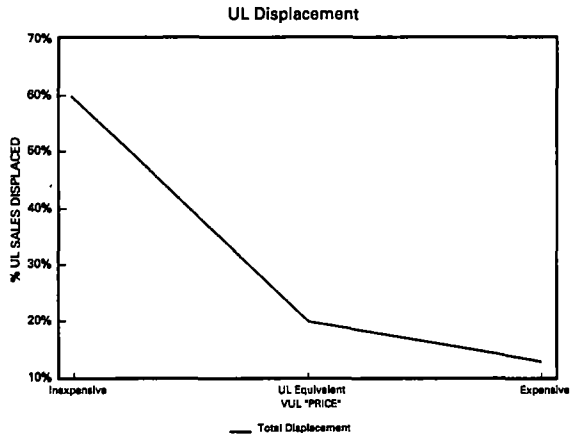
To illustrate, consider the following example. XYZ Life Insurance Company has been marketing a Universal Life product for several years at an annualized rate of $50 MM of new premium per year. The company is planning to offer a Variable Universal Life product as of the beginning of next year. A certain number of consumers who would have purchased the UL plan next year will now purchase the VUL policy.[14] Also, the lower the price of the VUL plan, the more this situation will arise. In other words, the greater the value to the consumer (or the greater the value to the producer), the more displacement will occur. Conversely, the worse the value of the product, either at the wholesale or retail level, the less the effect of displacement.

The expected decline in UL sales as a function of the price of the VUL product (in relation to the price of the UL product) can be represented graphically, as shown in Figure 16.

To what extent, if any, should the effect of displacement be considered in the pricing process? As with other, more tangible forms of expense, consideration of only the marginal portion is conducive to optimal decision-making. Again, the marginal displacement can be determined only within the context of the decision set.

For example, assume that the XYZ Life Insurance Company, in the absence of the VUL product, could reasonably expect to sell $50 MM (annualized premium) of the UL product next year. Further, suppose that if the VUL product is offered, then all production of the UL product ceases. Obviously one cost of offering the VUL product is the lost profit on the UL business that would have been sold had the VUL product not been offered. Considered another way, the expected profitability of the decision to offer the VUL plan is equal to the expected profit from VUL sales less the expected profit from the UL business that could have been sold.

Figure 16

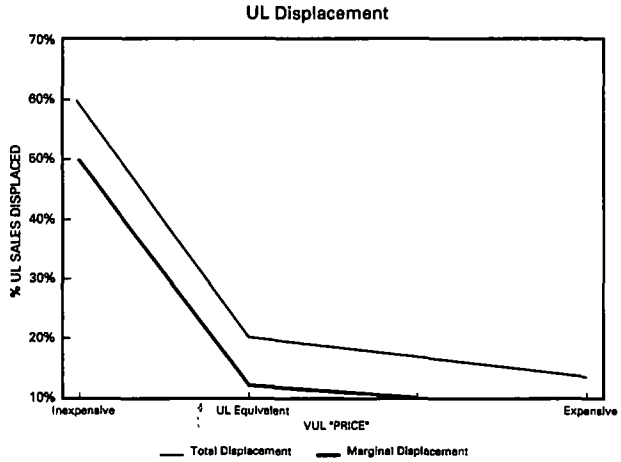


Note, however, that the lost profit on the UL business is a cost of deciding to offer the VUL product only in relation to the option of not marketing VUL. In other words, the lost profit on the UL business is a marginal cost only if the option to withhold the VUL product from the market is in fact a component of the decision set. This is true because the cost—the lost profit on the UL business—can be eliminated by choosing at least one element of the decision set.

Alternatively, consider a decision set composed simply of various prices for the VUL product. This situation might exist if the management of the company is firmly committed to the introduction of the VUL product, and withholding the product from the market is not a possibility. Here, the option to eliminate all displacement costs by declining to offer the product is not available. As such, a certain amount of the displacement cost is not marginal to the decision at hand. How do we determine the marginal versus nonmarginal displacement cost?

Although the number of displaced sales is inversely correlated with the new product price, a certain amount of displacement will occur regardless of the VUL price level. In Figure 16, this amount is represented by the level of the curve on the far right-hand side of the graph, where the price of the VUL product is high relative to the price of the existing UL product. Because our decision set comprises the various possible price structures for the VUL product, all but this "residual" level of displacement can be eliminated through the choice of this high price level. Only the excess of the total expected displacement over the level of displacement not dependent on product price is marginal to our decision. The marginal displacement in this example is shown in Figure 17.

Figure 17



One additional concept warrants discussion before a method for including displacement in the macro pricing analysis is outlined, that is, the distinction between internal and external displacement. In the preceding discussion, expected displacement refers to the difference between the expected sales of an existing product in the absence of a new product and the expected sales of the same existing product with the introduction of a new product. It is important to distinguish this from the effect of declining sales due to competitors' new products or innovations.

For example, in the early 1980s, many insurers found their production of traditional products dwindling due to a general shift in the marketplace to UL products. However, the entire decline in traditional sales cannot be attributed to a decision of a company to introduce its own UL product, even if the decision set includes forgoing the introduction of the UL plan. In the latter case the only displacement marginal to the decision to offer the UL product is the expected decline in traditional sales if the UL product is offered, less the expected decline in traditional sales generally. Displacement that would occur regardless of whether a new product is introduced is not a cost of introducing the new product.

Including displacement in the analysis used to assemble the price-production graph is simple in concept, but entails additional effort. In general, the anticipated level of displacement is an assumption like any other and must be developed prior to pricing analysis. Although there are many ways of including the effect of displacement in the pricing analysis, we have used a technique whereby displacement is estimated in terms of percentage of existing product sales lost to the new plan of insurance. Of course, the amount of estimated displacement is dependent on the price, as well as on the success, of the new product.

The assumption of the percentage of existing product sales displaced varies with each new product price analyzed. Also, because the amount of displacement varies with the overall success of the new product, it follows that the percentage of displacement varies with the tested production scenario. The complete displacement assumption might be illustrated as in Figure 18.

In this example, the percentage of existing product sales displaced was estimated for nine new product prices and for a range of production scenarios. Such a graph represents the displaced sales from one existing product only. A separate graph would be developed for each product that would be expected to suffer displacement. For example, the graph in Figure 18 might represent the displacement of UL sales as a result of the introduction of a new VUL product. A separate assumption might be made about the displacement of traditional whole life sales to the new VUL product.

Once the displacement assumption is developed, the monetary cost of such displacement must be estimated. This is done by creating a model of the existing product sales displaced and calculating the present value of expected profit that would have been generated by the business.

For example, consider once again the company producing $50 MM of UL new premium annually. When analyzing the displacement to the new VUL product, we first develop the displacement graph as in Figure 18. The graph represents the percentage of UL sales displaced dependent upon the price and production of the VUL product. In other words, each combination of VUL price and production carries its own displacement assumption.

Our goal is to calculate a cost of displacement for each combination of VUL price and production. This is most easily done by creating a model office of the full expected UL production over the analyzed VUL product life ($50 MM per year for perhaps 3 or 4 years) and calculating the present value of the expected profit from this business. Suppose that the expected present value of profit for this book of UL business is $25 MM. Multiplying the present value of profit (the $25 MM) by the displacement percentages in the displacement assumption graph results in a marginal displacement cost for each combination of VUL price and production. The results might appear as in Figure 19.

Figure 18

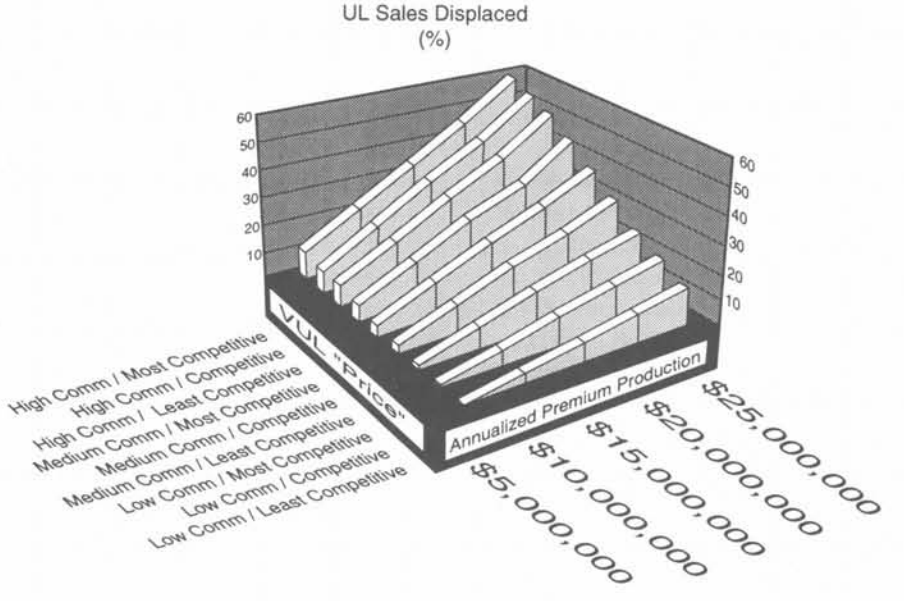
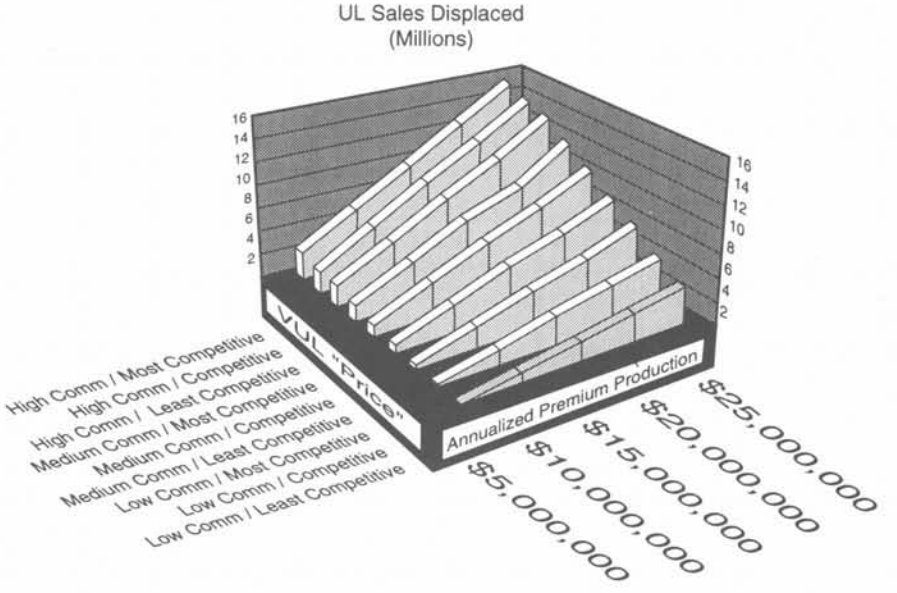


Figure 19



The final step is to include in the analysis of VUL business the cost of displacement appropriate to the combination of VUL price and production under analysis. Such expense is deducted directly from the expected present value of VUL profit.

IX. The Macro Pricing Algorithm

The general macro pricing algorithm has been outlined; here, the algorithm is detailed.

No attempt has been made to present the totality of the product development process. Rather, we list the significant steps involved in arriving at the product's wholesale and retail price structure. The focus of the procedure is the interaction between the actuarial and marketing departments. Any comprehensive product development algorithm would include the interaction of other significant parties in the process (such as the legal, data processing, and underwriting departments).

A few of the steps are common to more widely used algorithms. Several of the steps can be accomplished in differing ways. However, we found the following algorithm is the most useful in practice. The macro pricing algorithm is shown in flow chart form in Figure 20.

1. Determine Competitive Focus

The process begins with a discussion of the major facets of the pricing structure that are used to evaluate the "price" of the product. In general, the approach involves a determination of the characteristics of the product that are most desirable to the marketing department. For example, should the plan compete favorably in terms of early duration cash values, late duration cash values, necessary premium outlay, or some other policy cost factor?

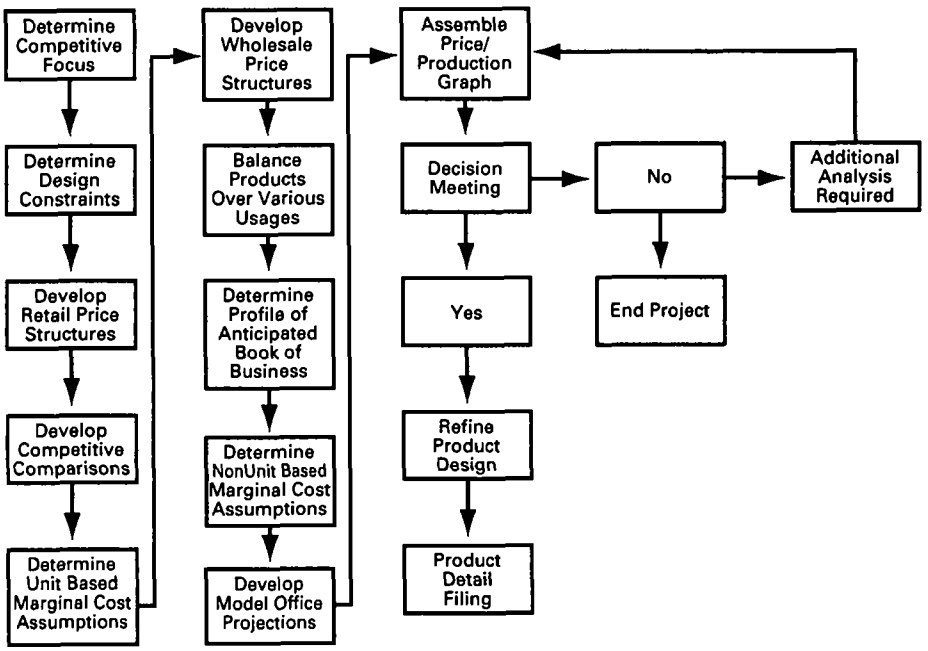
The answers to such questions help determine the methods of contrasting the price structures to be developed with those of competitors' plans. A similar discussion should deal with the wholesale price structure. Questions should be raised about the appropriate form of producer compensation, as well as desired levels.

2. Determine Particular Design Constraints

This stage of the algorithm focuses on the external constraints that limit product design. In general, the departments involved include data processing, marketing, actuarial, and legal, although other management representatives may be valuable to the process.

Figure 20

Macro Pricing Algorithm



The purpose of the discussion (and perhaps follow-up research) is the discovery of constraints that limit possible product designs. For example, it might be determined that the company's administration system will not support a zero cost loan feature,[15] and it has previously been decided that the addition of such a feature would be cost-prohibitive. As a result of this discovery, no time would be spent in the product development process analyzing such a policy provision.

Items to be discussed would include policy loading structures, bonus structures, banding features, commission payment methods, and any other features under consideration for the new product. Although the primary thrust of design limitation usually originates with the administration system, players from actuarial, marketing, legal, or management may deem certain features undesirable for a variety of reasons.

3. Develop Retail Price Structures

Here, the product design actuaries develop the various retail price structures to be considered. We have found it efficient to construct a minimum of four price structures. At least one of the structures should follow the desires of the marketing department. For example, if marketing would like to compete with XYZ Life's "product X," then the product designer would assemble one price structure that performs in similar fashion to product X. The performance might be measured in terms of cash value, necessary outlay, overall rate of return to the policyholder, or death benefit. The measurement (or measurements) used is dependent upon the results of step 1.

Another price structure should perform similarly to one of the company's existing products. The existing product chosen for comparison is usually that being replaced by the product under development. Alternatively, if the new product will not replace an existing product, the price structure is developed to match the product in the company's portfolio most likely to be compared by the field force.

A third price structure should produce a product that performs better than the desires of marketing, and a fourth price structure should perform worse than the

desires of marketing. The goal is the presentation of several price structures that "bracket" the product requested by marketing.

Note that this step involves no profit analysis at all. The price structures are developed by choosing policy cost features (loading structures, cost of insurance rate structures, interest crediting rates, surrender charges, and so on) to produce a certain competitive profile. This is done independently of profitability concerns.

4. Develop Competitive Comparisons

Competitive comparisons are developed that will later be presented to marketing. Because these comparisons are marketing's primary source of information about the various price structures of the new products, they should be comprehensive, comparing a variety of product usages. For example, the various price structures should be compared with competitors' products (as well as the company's existing products) at a variety of face amounts and premium patterns. Both a concise summary and detailed results should be provided.

5. Determine Unit-Based Marginal Cost Assumptions

Expense assumptions related to individual policies are now developed on a marginal basis. Expense assumptions that are independent of any one policy sold are to be determined later.

Expense assumptions that are truly marginal on a unit basis might include underwriting and issue costs, mailing and printing costs, production of the policy form and related documents, production of the policyholder's annual report, billing and collection costs, as well as premium taxes.

Expenses that would not be considered at this stage are the purchase of an administration system, initial advertising and printing costs, product development and implementation costs, and perhaps certain internal costs associated with underwriting, issue, and policy maintenance.

In addition, costs associated with increased production are dealt with later. For example, if production in excess of $10 MM annually would necessitate the purchase of a new computer, such expense, although marginal to that production scenario, is not dealt with in this step.

6. Develop Wholesale Price Structures

The consideration of various retail price structures in step 3 is a critical component of the macro pricing procedure. The development of various wholesale price structures is of equal importance. Once the retail price structure is given, the wholesale price structure is completely determined by the form and level of sales compensation. The task at this stage is the development of a range of sales compensation structures.

As with retail price structures, two compensation structures should be included from the outset: a compensation structure commensurate with the desires of marketing and a compensation structure substantially similar to that currently offered by the company on its existing products.

In addition, two additional compensation structures should be developed: one with generally higher compensation than desired by marketing, and one with generally lower compensation than desired by marketing. As with the development of retail price structure, the goal is to "bracket" the level of compensation requested by marketing.

7. Balance Products over Various Usages

With the development of three or four retail price structures, as well as three or four wholesale price structures, we now have nine to sixteen product "prices" when the retail and wholesale structures are combined. We now wish to further refine each price structure so it is a workable design in its own right.

This is accomplished with a unit-based profit analysis, using the expense assumptions developed in step 5. Such unit-based profit analysis is run for each age and underwriting category under preliminary study. The goal of this step is to balance the unit profitability over various usages of the product. The loading and/or commission structure is slightly altered such that the unit profitability at various sizes and premium patterns is comparable.

The techniques for accomplishing this balance are beyond the scope of this paper. However, the exercise is one of developing comparability of unit profit by age, underwriting category, policy size, and premium pattern. The absolute level of unit profitability is unimportant, so long as the various combinations are comparable with each other.

8. *Determine Profile of the Anticipated Book of Business*

Here, assumptions are developed about the distribution of business to be sold, as well as the pattern of production over time. The process of developing distribution-of-business assumptions is a familiar one and is not dealt with here.

In the macro pricing process assumptions of the pattern of production over time extend over the anticipated product life. For example, if the new product will substantially replace an existing form, then the anticipation of the availability of the new product may cause an explosion of sales upon product introduction. Such initial activity might very well subside within a few months.

On the other hand, a new product concept or the penetration of a new market would yield a different pattern of sales. Perhaps the new product would catch on slowly, with production building as the field's knowledge of the product and market mature. In this case, the pattern of sales would build gradually, perhaps reaching a peak two-thirds of the way into the product's life, and gradually decline.

Regardless of the assumptions, the result of this phase is the development of a pattern of sales over the anticipated product life. The actual level of sales is not developed at this time; the pattern of sales is usually developed in terms of ratios only. For example, a new UL product to be introduced in October 1990 might be assumed to have a product life of three years, with a production pattern as follows:

Anticipated Pattern of Production

	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
1990	0	0	0	2.00
1991	1.00	1.50	1.50	2.00
1992	1.50	2.00	2.25	2.25
1993	1.50	1.50	1.25	1.25

9. *Determine Non-Unit-Based Marginal Cost Assumptions*

Here, marginal cost assumptions are developed that are not uniformly unit-based. Such cost assumptions can include product development costs, legal and filing costs, and administrative system purchase or modification. Not all (or perhaps any) of these costs may be marginal to the decision at hand. Only those expenses that can be eliminated through the choice of at least one element of the decision set should be included.

In addition to developmental or "start-up" expenses, marginal expenses that arise only for certain production scenarios must be considered. For example, exceeding certain production levels might require the hiring of additional underwriters, policy issue clerks, or other administrative personnel. If so, then all analysis of production scenarios that exceed such levels should include the cost of the additional resources. Certain production scenarios might necessitate raising additional capital to counteract surplus strain. For these scenarios, the cost of raising the additional capital (or perhaps the cost of appropriate reinsurance) should be included as a marginal cost.

The above examples show that non-unit-based marginal cost assumptions can vary by production scenario. In addition, non-unit-based marginal cost assumptions can vary by product price structure. For example, one product price structure can entail significant administrative system modification, while the other analyzed price structures do not.

Careful consideration of the likely impact of each product price structure together with each analyzed production scenario is necessary in determining such expense assumptions. This step is critical to the overall success of the macro pricing method.

10. *Develop Model Office Projections*

For each wholesale/retail price structure and for a range of production scenarios, model office projections are developed. In general, each price structure is projected over a range of production levels that represent the realistic possibilities for the company. For example, in an analysis of a new UL product for a company selling $50 million of annualized premium per year, the analyzed production scenarios might encompass $15 million and $100 Million.[16]

Each production scenario (and perhaps each price structure) encompasses its own set of marginal expense assumptions, as discussed above. The number of production scenarios within the range should be sufficient to characterize the expense assumptions accurately. In practice, a total of five production scenarios has worked adequately. For example, if three retail price structures, three wholesale price structures, and five production scenarios are analyzed, then a total of 45 model office projections are necessary (3 x 3 x 5).

For each production scenario, the present value of profit to the company is calculated according to the relevant measure (GAAP, statutory, cash flow, and so on). These present value numbers are then used to assemble the price-production graph.

11. Assemble the Price-Production Graph

From the results of step 10 the price-production graph is assembled. An example of a price-production graph with three retail and three wholesale price structures was shown in Figure 15. It is often useful at this time to assemble the graph of price-production pairs that leave the company neutral as to the realized choice. This involves determining the appropriate level of aggregate profit for which to determine the price-production pairs. This level of aggregate profit represents either the potential profit from the continuation of existing plans, or the minimum level of aggregate profit necessary to induce management to proceed with the project. A typical graph of the company neutral price production pairs was illustrated in Figure 16.

12. Marketing/Management/Actuarial Decision-Meeting

At this time the data necessary for making initial price decisions are complete and available. The analysis is presented to marketing, and a decision on both wholesale and retail price is made. Typically, the foundation of the analysis as well as the plan designs explored are also discussed.

The purpose of the meeting is to decide on the approximate retail and wholesale price structure of the plan under development. The decision rests primarily with the marketing department, because responsibility for meeting the commensurate marketing goal rests therein.

From this meeting, any one of several decisions can result:

(a) A decision on the desired retail and wholesale price structure is reached.
(b) The discussion uncovers additional areas warranting research.
(c) It is determined that the project will not continue.

If a decision is reached as to the approximate product price, steps 13 and 14 are taken.

13. Refine Product Design

At this point the product development actuary focuses on the chosen price structure and more closely analyzes the plan for appropriate balance. The scope of analysis is often broadened to encompass all "standard" underwriting categories. Any refinements in loading structure or other product characteristics are made.

14. Product Detail and Filing

After the final product characteristics and structure have been determined, the final product detail and filing materials are developed. This would include the rates and values for all ages and underwriting categories, and the mechanics of increases, decreases, partial surrenders, and riders. The product is filed with the various state insurance departments, and the bulk of the implementation process begun.

If further analysis is warranted, step 15 is taken.

15. Determine Scope of Additional Analysis

Additional analysis is necessary when ideas surface during step 12 that may have a significant impact on the price-production profile of a certain plan design. For example, assume that the primary focus of the retail price structure is the level of twentieth duration cash surrender value. An idea may surface that allows a higher twentieth duration cash value at the expense of other retail price characteristics. It is possible that this new idea could result in a product design that requires less production for essentially similar retail and wholesale price structures as those previously analyzed. In this case, nothing on the existing price-production graph represents the new idea that has surfaced.

Another instance in which further analysis is warranted occurs when the existing price-production graph is not comprehensive. The marketing department might want to see a retail price structure that is less competitive than the least competitive product analyzed, or perhaps a wholesale price structure outside of the range analyzed.

In these cases, the product development actuary analyzes the necessary plan profiles and adds them to the price-production graph. The process then continues with step 12 above.

The actuary should be cautioned against requests for analysis that serve merely to defer a difficult decision. Continued iterations of product structures that lie within the range of price structures previously analyzed are not often productive and do not add measurably to the knowledge necessary to make the necessary decision. Requests for analysis should be judged on the ability of such analysis to significantly change the nature of the price-production tradeoffs already presented. If further analysis will not change the price-production tradeoffs, then the analysis is likely to slow the development process without improving the chances of success.

If it is determined that the project will not continue, step 16 follows.

16. Expand the Decision Set

The project might logically be discontinued at any time. Here, we discuss discontinuance resulting from the inability to find a feasible price production tradeoff.

However, the project can only be halted if (and only if) that option exists within the decision set. If the decision set does not allow discontinuance of the project, then the most attainable (in the opinion of the marketing department) price-production pair is chosen. Here, however, we assume that the decision set includes the option of withholding the new product from the market.

The project is logically discontinued if, in the judgment of the marketing department, none of the price-production pairs is attainable.[17] If the marketing department does not think that it can meet the minimum production goals for any price structure, then this segment of the market is not sufficiently profitable for the company in question to wage a successful venture. It will not be fruitful to defer the decision by continuing with analysis not pertinent to the overall price production tradeoff. This conclusion is supported fully in the preceding discussions in this paper.

Once the project is terminated, the product development algorithm comes to a close. However, I would like to make one further observation about the procedure after project termination.

Upon termination of the project, management often seeks a substitute project of sufficient profitability through an expansion of the decision set. For example, consider a company exploring the development of a new UL product. Perhaps the original decision set comprised simply the various possible price structures. If the company finds that none of the alternatives is workable, then it would be advisable to determine whether the decision set can be expanded. As mentioned above, this may not be possible. The company could be committed in a number of ways to the introduction of the new product.

Alternatively, the decision set might be expanded to include the investigation of other product forms. The company might, for example, consider the development of a variable life product instead. In fact, a number of other product forms might be included within the expanded decision set. After each product form is analyzed, the company could choose the product form with the greatest expected value to the company.

What if none of the alternative product forms yields an attainable price production decision? Once again, the decision set should be scrutinized for possible expansion. At this level, perhaps the decision set now comprises alternative product lines or other markets. The decision set expansion process continues until one of three results occurs:

(a) A price-production pair is found that is acceptable to the marketing department.
(b) A point is reached at which the decision set cannot be further expanded. This would occur, for instance, if the company were committed to remain in the individual line of business, regardless of profitability. In this case, the decision set cannot be expanded to include the option of discontinuing individual line projects.
(c) The top decision level is reached, at which the decision set can be expanded no further. As discussed previously, the top level decision involves consideration of the veritable continuance of the enterprise. Although this top level decision should rarely be reached, if no profitable uses of capital can be found within the company structure, some form of reorganization should be considered.

X. Ancillary Effects of the Macro Pricing Algorithm

In addition to the obvious role of the macro pricing algorithm in reaching more optimal pricing decisions, there are other positive by-products of the process. Although a number of constructive effects are brought about by the algorithm, here we deal with only the most important.

A. *Converging Versus Nonconverging Processes*

One significant effect of the macro pricing process is the decided decrease in the time expended in the production of new products. This conclusion may be counter-intuitive, because the macro pricing algorithm involves more sophisticated actuarial analysis. The increased complexity of the actuarial role might be expected to slow the process.

However, the depth of the actuarial analysis is not the only determinate of the overall time frame. Consider the traditional product development algorithm. A looping process begins at the second open decision point, that is, where the initial plan proposal is presented to marketing.

Typically, actuaries have done their best in meeting the unit-based, cost-plus "profit requirement." Unfortunately, the profit requirement may be incompatible with the "needs" of the marketing department. So long as the marketing department believes that the plan is insufficiently competitive, the looping process continues. Unfortunately, the cost-plus algorithm does not provide the actuary with the tools necessary to proceed in this situation, and the looping process is not convergent. This is the critical flaw. If an iterative process does not converge, the process itself cannot provide the necessary solutions.

How, then, does the process end? As stated previously, the process comes to a close, not because a satisfactory solution is reached, but because outside time pressures dictate that the process must end. These external pressures can be an implementation deadline, an upcoming agency convention, or simply the embarrassment of failing time schedules. Because the constraints faced by the two players (actuarial and marketing) are, within the context of the traditional algorithm, incompatible, the solution is determined by the balance of political power within the corporation.

The looping process cannot converge to a solution in and of itself. Because the political struggle[18] that follows may be unpleasant, the final result is frequently delayed until time pressures mandate a close of the process. In other words, the maximum available time for the project tends to be utilized.

Contrast the above with the macro pricing algorithm. At each stage of the algorithm, there is a distinct method for proceeding. In addition, actuarial and marketing are not placed in a position where their various requirements are incompatible. The entire range of options is analyzed by actuarial with the commensurate "cost" to marketing of each option shown.

Because the macro pricing algorithm provides a deliberate method of procedure at each step, there are no irreconcilable conflicts to be determined by political power. With the final decision based more on financial information than on posturing, there is less tendency for the process to absorb the limits of available time.

Further, the seeming magnitude of the actuarial analysis necessary with the macro pricing algorithm is deceptive. Granted, a certain depth of analysis is mandatory with the macro algorithm that is not a part of the traditional methods. However, it is important to draw a distinction between depth of analysis and volume of analysis. Although the macro pricing algorithm does require a far greater depth of analysis than traditional methods, the traditional algorithm generally requires a far greater volume of analysis. This greater volume is primarily due to the looping nature of the traditional method. Less actuarial analysis may be required for each iteration, but there are often many iterations. With the macro pricing algorithm, the bulk of the work is done just once.

B. *Shifting of Incentives*

Another strong benefit of the macro pricing algorithm is the alignment of incentives between actuarial and marketing. To illustrate this point, consider first the traditional algorithm. The marketing department is generally held to a performance standard based on prior sales experience. The current marketing goal might be expressed in terms of an increase in prior years' production, premium volume, or applications. Typically, this standard (or marketing goal) is determined independently from the raw material with which marketing has to work. In other words, the marketing department is expected to meet the marketing goal regardless of the price structure.

Given the above situation, it seems logical that the marketing department would seek (or demand) the most competitive product possible. The more competitive (at both the retail and the wholesale level) the new product, the easier it will be for marketing to meet the imposed goal. Marketing officers are often criticized by actuaries for their incessant requests for both lower prices and higher commissions. However, this request is only illogical under a cost-plus paradigm. Given the typical

incentive structure faced by marketing officers, lower prices and higher commissions are exactly what they should be asking for.

The above phenomenon can also be considered in terms of decisions and their associated costs. For the marketing officer operating within the typical life company structure, the decision to request a more competitive product is largely cost-free in terms of future required job performance. In addition, the marketing officer's task becomes easier as the price structure becomes more competitive. In general, whenever a more desirable option bears no increased cost, such option will be selected. As a result, the marketing department will gravitate toward requests that are unreasonable to the actuary looking through the cost-plus microscope.

In contrast, the macro pricing algorithm allows no cost-free decisions. Many price structures are available for selection by the marketing department, but each and every one has a definitive associated cost. This definitive cost is expressed as a marketing goal (or quota) unique to that particular price structure.

Consider now the incentive structure that this creates. Each and every price structure now bears an associated cost. The marketing officer has strong incentive to select the price structure in which it is easiest to exceed the commensurate goal. In other words, the price structure with the cheapest cost (the production goal) in relation to the benefits offered (the price structure) is chosen. As a result, the price structure selected will be that which marketing thinks has the greatest chance of producing sales in excess of the goal. This chosen price structure, in turn, will maximize expected profit to the company. The result is that marketing's goals become aligned with those of the company in general, rather than antagonistic.

Another shift in incentives occurs as a result of the explicit projections made by actuarial and the explicit commitments made by marketing. Because the macro pricing algorithm involves a specific choice of price structure by marketing, together with a specific production goal, the resultant marketing performance tends to fall under greater scrutiny. As a result, marketing gains a heightened sensitivity to the commitment being made. In other words, marketing has a great deal of interest in forming accurate opinions during the pricing process. If marketing is overly optimistic in its judgment about possible production, then marketing bears a cost in terms of credibility, as well as in direct compensation. If marketing is overly pessimistic in assessing future production, then the project may not continue, usually at a great loss to the vitality of the marketing operation.

Consider the incentives when actuaries perform the financial analysis in the pricing process. In contrast to traditional methods, the actuaries now leave a traceable financial projection in the course of the macro pricing analysis. Such a financial projection, done according to marketing goals in real dollar terms, can now be used to assess how closely reality conforms to actuarial opinion. Interestingly, a great deal of time does not have to pass in order to make such an assessment. During the pricing analyses, the actuary has made projections, period by period, of claims, surrender costs, expenses, commissions, and premium flow. The very existence of a traceable record such as this provides strong incentive to perform the analysis as accurately as possible. There is as much incentive to avoid excessive conservatism as there is to avoid optimism. Errors in either direction will subvert actuarial credibility in future product development exercises.

In contrast, the traditional algorithm encourages both marketing and actuarial to approach the process with pessimistic estimates of sales and profitability, respectively. The marketing department requests a plan with a more aggressive price structure than actually necessary, recognizing that much will be bargained away in the iterative process. Actuarial has incentive to begin with conservative assumptions, again recognizing that some room will be needed for negotiation. This "sandbagging" effect largely disappears with the macro pricing algorithm.

C. Transfer of Marketing Responsibilities

The marketing function is many faceted, yet a significant component of marketing is involved with assessments of price sensitivity, the formation of a marketing plan, and projections of the incidence and level of production. With traditional pricing algorithms, much of the marketing function is removed from the realm of the marketing officer. Because in large part the marketing officer works with the raw material provided by the product manufacturer (the product development actuary), assessments of price sensitivity play a minor role, if any, in the analysis. Further, the marketing plan itself is of little relevance to the pricing process, because analysis is performed on a unit basis. As a result, these

functions of the marketing department are rarely a part of the product development process in many life insurance companies.

In contrast, the macro pricing algorithm not only encourages marketing analysis, but also demands that assessments of price sensitivity become an integral part of the decision process. Most importantly, these marketing functions fall squarely in the realm of the marketing officer. With the traditional approach the marketing plan (to the extent that it exists) is buried within the unit asset share calculations. In contrast, with the macro pricing algorithm the marketing department plays an indispensable role in combining marketing planning with the pricing process. More marketing planning tends to be performed, at a higher level of quality, and under greater scrutiny. The marketing department's responsibilities expand to encompass more of the total marketing function.

D. Explicit Versus Implicit Assumptions

One reaction of many actuaries to the macro pricing process is discomfort with the many subjective assumptions that are made throughout the process. Judgments of price/production sensitivity are necessarily subjective. Although past experience can be brought to bear in making a determination, there is no way to know what such sensitivity will be. Further, once a judgment is made, there is little way of knowing whether it was indeed correct.

However, the necessity of subjective decision-making is not a drawback of the macro pricing process. *Every pricing methodology involves making similar subjective judgments.* With many algorithms, these subjective judgments are implicit, and the decision-maker may not be aware of the assumptions being made or even of the fact that assumptions are being made. One important advantage of the macro pricing process is that many of the subjective assumptions are consciously determined and subjected to closer scrutiny.

XI. Conclusion

In summary, the macro pricing algorithm involves both a nontraditional method of analysis, as well as a nontraditional method of price decision-making. The analysis itself relies on three distinct changes in methodology from that commonly used by actuaries:

1. Project-based analysis
2. The use of purely marginal expense assumptions
3. The optimization of price.

The price decision is made primarily by those responsible for delivery of the product (typically the marketing department). This decision is made with complete recognition of the commitment made by marketing to acquire any particular price structure.

The macro pricing algorithm is neither perfect in function nor easy to implement. It does represent a distinct improvement over other methods of price selection. The macro pricing algorithm can generally be expected to accomplish the following:

1. Provide the maximum chance of reaching optimal pricing results and, in turn, provide the maximum chance of continued health of the organization.
2. To the extent possible, remove political considerations from the determination of price, resulting in decisions that are primarily economic.
3. Closely align the incentives of actuarial and marketing, largely removing the natural conflict between the goals of the two functions.

I think that any one of these three effects could warrant use of the algorithm. The three effects combined represent a substantial step forward in actuarial pricing methodology.

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Discussion of Preceding Paper

Linden N. Cole

Breaking away from traditional ways of doing things is difficult, and Mr. Chalke has done just this in his valuable paper on life insurance product development and pricing. A draft of this paper was made available to the Education and Examination Committee, which thought it so valuable that it was immediately placed on the course of reading for Course 210. Thus, hundreds of recent A.S.A.'s have already been exposed to this new way of looking at things.

I briefly state several aspects of the paper that I like and then present a case for the old-timers who did things the old way. I suggest that for the environment in which they worked, the old-timers were able to make the old methods work.

I like this paper because it gives a comprehensive framework for approaching product development and pricing. I particularly like the way in which marketing people are integrated into the process. The introduction of the concepts of the price-production curve, and of "displacement" caused by a new product or a new price, is very helpful. Even if these concepts are not comprehensively used in every pricing situation, we are still better off knowing what we are up against.

Now I would like to defend the old-timers. I broke in with an old-line East Coast mutual life insurance company in 1955. The environment during much of my working lifetime there was characterized by a degree of stability that is beyond belief today. Our product line was homogeneous, namely, permanent individual life insurance. Our pricing was done through the dividend formula, so that we could change the price to owners of in-force policies as circumstances improved. Circumstances did improve, year after year. The bottom line provided a ready-made overall control on our pricing, and we monitored it carefully. Sales rose each year at a sustainable rate, and interest rates rose slowly and steadily each year as well.

In confronting the question of whether to raise dividends in a particular year, we would examine the extent of mortality and interest improvements, look at the competition, and consider what the field was telling us. If a new dividend scale was being considered, we would perform asset share calculations, using the type of unit expenses described in Mr. Chalke's paper. We would also generate a rough model office to make sure that company overhead costs would be covered in the long run. If a new policy series was being considered, the analyses were much more extensive, because premium levels, reserves and cash values were being changed. Our mechanism for overall financial control was the bottom line. If we were close enough to the competition, and contributing almost enough to surplus, our dividend (that is, pricing) assumptions must be all right.

For those of us who were still apprentices, the old-timers (especially the precomputer old-timers) seemed to have exceedingly well-developed instincts. They did not automatically accept whatever our numerical analyses said, whether they were done with cost-plus pricing or marginal pricing. They taught us to be skeptical of asset share results, in fact, warning that translating overhead expenses into unit expenses was both tricky and dangerous. They also warned us that if we priced every product on a "marginal pricing" basis, there would not be anything available to cover overhead. Their pricing method could be best described as "cost-plus viewed very skeptically."

These experienced actuaries had done pricing, valuation, annual statement preparation, and short-term forecasting for decades, on this one line of insurance. They had learned from past mistakes and passed this knowledge on to us. Their judgments and decisions were based on a comprehensive instinctive and analytical knowledge of the company's individual life insurance product line. Within that framework and the stable external environment, the pricing method of "cost-plus viewed very skeptically" worked very well.

Today, of course, it is a whole new ball game. Sharper tools are needed and welcome. Product lines are not even approximately homogeneous, and the

attitudes of agents and customers towards savings and financial security products have changed radically. If we are trying to decide whether to begin marketing a variable life insurance product, and how to price it, the method called macro pricing should work much better than the old methods. This does not mean, however, that the old methods were inappropriate or inadequate for the management questions that the old-timers had to answer in prior decades. They worked with the numbers that we apprentices cranked out on our desk calculators, because that was all they had, but they viewed them with the deep actuarial skepticism that only decades of experience can produce.

Arnold A. Dicke

Mr. Chalke has done a great service to the actuarial profession by calling attention to certain shortfalls of the "traditional" actuarial pricing algorithm that could lead to wrong and, these days, potentially disastrous conclusions.

In particular, his focus on the decision process and his insistence that profit be optimized, not set, are essential to good actuarial practice.

Unfortunately, although Mr. Chalke's logic (which has been in front of the actuarial public for some time) is rarely attacked, his ideas receive more lip service than actual use. This stems from two roots:

1. Certain inputs to the process (notably, the demand or price-sensitivity curve and the product shelf life) are difficult to estimate, and
2. Project-based analyses are hard to fit into current management practices.

Project-based analysis is but one of three changes to the traditional actuarial approach that Mr. Chalke has recommended. The others are:

- Conversion from fully allocated to marginal expenses and
- The treatment of profit as a variable to be optimized rather than as a goal.

These two changes are extremely important; it would be unfortunate to abandon them until revised management practices are adopted. In fact, if the use of demand curves is not insisted upon, these changes could be implemented within a more-or-less unit-based format, allowing their salutary effects to be obtained without an overhaul of the management process.

Project-Based Analysis

Mr. Chalke attributes several advantages to project-based analyses. Most prominent is the ability to incorporate the law of demand into the pricing analysis. No doubt this should be done. However, validated mathematical expressions of the price-sensitivity curve are usually not available, and the utilization of the marketing department for choice and commitment is more complicated in practice than it might appear. The shelf life of a product is also rarely more than a guess. The subsidiary advantages of a project-based approach include the availability of a present-value estimate and the ability to take into account development costs. Experience teaches that present values are often misunderstood even by sophisticated nontechnical managers. The inclusion of development costs is perhaps the strongest argument in favor of the project-based approach. However, development costs may not be truly marginal in that one or another adaptation requiring systems changes will inevitably be made. Even if project-based analysis is seen as desirable, it can be convenient to have a unit-based approach that works in a large number of cases.

Marginal Expenses

On the other hand, the replacement of "full absorption" expenses with marginal expenses is essential in virtually all cases to arrive at correct decisions. Unfortunately, the term "marginal" has a history that raises red flags and often precludes an unemotional discussion. "Marginal pricing" referred to the practice of setting prices by calculating the present value with full absorption unit expenses replaced by the same unit expenses with overhead allocations removed. This process is fraught with problems. To begin with, certain marginal expenses may be left out. For example, displacement costs, often very significant, may be ignored. Moreover, no attempt is made to optimize profit, either for the new product or for the company as a whole. Not only does this approach result in suboptimal profits, but also it can be viewed as creating inequity among policyholders, because the "base" policies cover all the overhead while the "marginal" policies cover none of it.

As opposed to such unskillful application of the concept of marginality, the careful definition of marginal expenses will lead to a better understanding of the business. Effective decision-making requires not only allocations that total to the current budget but also real

insight into the expense structure of the business. For example, in defining the decision set described by Mr. Chalke, the elements can be lined up with expense drivers. An example from Professor Robert Kaplan of Harvard Business School may clarify this:

> A pen company producing a full array of colors finds itself unable to match the prices of a new competitor that sells only blue and red pens. The full absorption unit cost for the former company is 95 cents; the competitor sells its pens for 75 cents. The problem is found to be the cost of changing ink colors in the assembly line.

In this case, the analysis will proceed most effectively if the decision set includes alternatives with various numbers of colors offered.

In particular, as pointed out by Mr. Chalke, expenses that are fixed for one set of alternatives may become marginal as the decision set is expanded. One can even have a continuous decision set with marginal expenses varying continuously over the set.

For example, what is marginal can depend on the level of sales. Furthermore, this result can be path-dependent: expenses that are variable with respect to increases in volume may prove to be fixed if volumes fall below normal levels.

Optimization of Profit

The insistence on seeing profit as a quantity that may be optimized, but not set, is another valuable contribution. The optimization of profit (or minimization of policyholder net cost in the case of mutual companies) is a fundamental goal. However, this goal is usually subject to a number of constraints. The "tight" constraint in recent years has typically been capital. Also, there is usually a diversification constraint—few companies are comfortable investing all their capital in a single line. The mathematical solution to the constrained optimization problem is the maximization of return on invested capital (ROI); that is, the problem is to invest a fixed amount of capital at the highest rate of return.

Merely calculating an ROI does not, however, assure profit optimization in Mr. Chalke's sense. For example, many companies compare ROIs to a specified "hurdle rate," which is merely a profit goal. Unless a more profitable alternative is available, products earning less than the hurdle rate should not be abandoned. (The alternative of holding the capital in statutory surplus is available, but usually has an ROI of less than 5 percent on an after-tax basis.)

However, the most important flaw in the usual application of the ROI approach is the use of unit expense factors that contain an allocation of fixed expense (*overhead* in Mr. Chalke's terminology). All the anomalies demonstrated in the paper occur, but they are often ignored because of management's infatuation with the calculated rates of return. If a given (necessarily arbitrary) overhead allocation shows a product or line to be developing a "substandard rate of return," it is likely to be abandoned no matter what alternatives are available and without thought to the foregone marginal profits. Decisions of this kind have been made in many companies over the last decade.

Decision-Neutral Allocation

An approach that may be helpful in improving decision-making in an ROI environment is the allocation of fixed expense proportionately to invested capital. Such an allocation may be thought of as "decision-neutral," in that the ranking of alternatives, and even their relative attractiveness, should not be affected by the allocation. In effect, rates of return will be expressed on before- and after-overhead bases, with the difference being a constant.

For this approach to work, the capital tied up in in-force business, as well as the investment of capital in new sales, must be recognized. Both (marginal) strain and required surplus should be taken into account. The approach is best suited for decision-making in the context of ongoing businesses, such as the setting of crediting rates and the relative evaluation of product lines. Where significant one-time capital expenditures are required (for example, new software), a project-based analysis should of course be carried out.

A decision-neutral allocation of overhead must be based on a variable that is tightly constrained in the optimization problem, although it may be expressed in terms of any quantity that is roughly proportional to the constrained variable. For example, for annuity products with the usual required surplus formula and a fixed asset mix, assets (or reserves) may be proportional to invested capital, allowing the overhead allocation to be expressed as a spread. For a term product such as major medical, capital may be proportional to expected claims, and the latter may be an appropriate allocation base.

As was the case for Mr. Chalke's project-based analyses, this approach treats overhead as irrelevant to decision-making. The rates of return for alternatives should be compared to one another, with the highest (before- or after-overhead) ROI alternatives supported.

Matthew S. Easley

I compliment the author on his development of these concepts, which should cause many of us to reexamine our pricing models. My comments are intended as an elaboration on the ideas presented rather than as a rebuttal of them.

One aspect of the macro pricing technique that concerns me is the implicit assumption that the company can accept any amount of a product in order to satisfy the profit optimization. This is certainly not true for our company. This limitation needs to be considered, especially when the level of the analysis approaches that of the entire company, such as in annual planning that includes product margins for the coming year. The ability to raise additional surplus may be quite limited or the cost might be prohibitive. In some cases, the cost not only may be financial, but also may include a loss of control over aspects of the business.

Another consideration, closely linked to the first, is that of concentration. A company may properly limit the amount of any one product that it wants to have on its books. Any product has a unique set of risks, and it is just as desirable to diversify this portfolio as it is to diversify the investment portfolio. Expense logic might lead to producing a huge amount of one product and little or none of the other possible products. This may not be a good answer for the company from a risk perspective. To factor this into the equations for macro pricing, the risk charges must be explicit and nonproportional to the amount of business written; that is, the risk formula should be at the macro level like the expense analysis and should penalize the increase in concentration.

The practical aspects of a distribution system also preclude considering the amount of production desired in a vacuum. There are costs of entry in every market. By refusing to write a given level of business in one year, a company can lose the opportunity to write that level in later years. In fact, the departure from the market may make it harder to reenter than if the company had never been a participant in that market.

Another area where practice may not match the macro pricing model is the assumption of nonmarginal expenses not varying (except with inflation) in proportion to the size of the line of business. While this is logical in theory, it is unlikely in practice. A recent study of group insurance showed no improvement in the expense ratio for the larger blocks of business. It is natural for companies to permit additional spending within a successful line of business. In some cases this may be appropriate. For example, there may be risks that justify study once a block is big enough. Similarly, manual administration methods may not be adequate from a control standpoint when a line reaches a certain size.

As in the line areas, there is also a high degree of discretion in the staff areas regarding how much will be spent on a given line of business. These expenses will tend to grow as the line of business grows. There is no apparent limit to the list of good ideas upon which money can be spent. However, that list can be prioritized and a line can be drawn once the question "How much can we afford to spend?" is answered.

One answer to this question is to agree in a contract-like fashion upon how much is acceptable in relation to the margins in the line of business. This agreement can be reached at the time a product is priced and used as a practical target for the given area in reviewing budgets for subsequent years. In this way, the staff can be part of the give-and-take at the time the product is priced. Note that the factor can decrease in the formula as the product line grows, thus creating a decreasing average and marginal rate of expense.

The measurement process may affect the item being measured. As actuaries, we are responsible for producing results, not merely guessing at what they may be. If nonmarginal expenses are assumed to be irrelevant to pricing the product, there is little practical constraint on the growth in these expenses. It is difficult to close the loop from pricing expense levels to actual expense levels even with these types of agreements—it seems less likely to occur without targets to hit.

My final comment relates to the conflict between the sales area and the actuarial area. Unfortunately there are salespeople who care little for the bottom line and actuaries who care little for whether the products they design actually sell. Both are probably unfit to hold responsible jobs at an insurance company. Where there is not a good dose of mutual respect and interest in the success of the entire line of business, I am not sure that any method will close the gap between sales and actuarial. It is possible for sales to refuse all the alternatives offered or for the actuary to use sufficient conservatism

to make all the alternatives impossible to achieve. And it is possible that there is no good solution for a given product/market combination. The determination of the minimum acceptable gain looks like another likely battleground for a marginal product within the macro pricing approach.

Having said this, I agree that macro pricing has promise because it allows the salesperson to have a hand in choosing his/her own target, albeit from a limited slate of options. In my experience, this tends to cause a better feeling about the goal and a stronger sense of commitment to achieving it. However, I would want the corporate environment to have a strong culture of accountability before I would be comfortable with this approach. In other circumstances, it would be too easy to choose the most competitive product and sell a good amount of the product, even if not the amount committed. I would be particularly leery of a situation in which the salesperson has a commission-like incentive arrangement and a history of changing companies. The actuary still has a duty to review the options to determine whether the goals are realistic given the distribution system and the competitive environment. As professionals, it is not sufficient for us to simply accept unrealistic numbers and try to wash our hands of the results.

Charles S. Fuhrer

Mr. Chalke is to be commended for challenging how we think about pricing insurance products. The paper is sure to stimulate heated debate for many years.

Most of the paper assumes that the demand curve is known at a few points and that it is unchanging: in particular, that the insurer's pricing will have no effect on demand. In a competitive market other insurers may react by also changing their prices and thus change the quantity that will be sold by the original insurer. The following is a way of modeling this effect that will shed some light on the appropriateness of macro pricing.

Let the amount sold be a function not only of the insurer's price, p, but also of the market's price, s. Thus, the amount sold $q = f(s,p)$. For simplicity let us assume that there are only two insurers in the market, so that s can be thought of as the other insurer's price. The extension to three or more insurers is straightforward and the conclusions are similar. Then total profit, R, is a function of s and p; that is:

$$R = r(s,p) = (p - e)\, q - e_f = (p - e)\, f(s,p) - e_f$$

where e *is* the marginal expense and e_f is the fixed expense. Then according to macro pricing we obtain the optimum price as the p that maximizes R. This p can be calculated by solving the equation:

$$0 = r'(s,p) = f'(s,p)(p - e) + f(s,p)$$

for p, where the prime notation means the partial derivative with respect to the second argument, for example,

$$f'(s,p) = \partial f(s,p)/\partial p.$$

Let's say that the solution is p_1. Now if the second insurer responds to the first insurer by using macro pricing, the second insurer would change its price to p_2, by solving:

$$0 = f'(p_1,p)(p - e) + f(p_1,p)$$

for p. I have assumed that both insurers have the same demand curve and the same marginal expenses. In practice, they often would be relatively close. Now the first insurer solves

$$0 = f'(p_2,p)(p - e) + f(p_2,p)$$

for p. This process continues until an equilibrium is reached. An equilibrium will exist at price p if

$$0 = f'(p,p)(p - e) + f(p,p);$$

that is,

$$p = e - f(p,p)/f'(p,p).$$

I have not managed to solve the problem of determining what conditions on f will lead to an equilibrium. Assuming that $f(s,p) \geq 0$, $f'(s,p) \leq 0$, and $f''(s,p)$ exists, one set of sufficient conditions is $f''(s,p) \leq 0$ and $f(p,p)$ is constant. That these conditions are not necessary can be seen by letting

$$f(s,p) = p^3 - 3sp^2 + ks^3$$

with $2 < k < 4$. This satisfies neither condition but reaches an equilibrium at $p = 3e/(5-k)$.

I suspect that many insurance markets can be characterized by the value of $u = -f(p,p)/f'(p,p)$. In very competitive markets the value of u is very small. In relatively noncompetitive markets, such as individual life insurance, u will be large. In these u may be large enough so that an equilibrium is reached at $R>0$.

In more competitive markets, such as casualty insurance, the small value of u can lead to cycles as follows. Start at a point in which traditional pricing used by all insurers gives $R>0$. Some new insurers, or the current ones, increase their return by using macro pricing,

which lowers their price because currently $p > e + u$. This lowers the sales (and profits) of the other insurers, who are then convinced to also use macro pricing and lower their prices. Eventually equilibrium is reached at $R<0$. Now most of the insurers are losing money and decide to leave the market or do the equivalent: raise their prices to traditional pricing levels. After this happens, the profits return and we come full cycle.

Many insurers would prefer to break this cycle by always using traditional pricing, but all the insurers would have to do so. Of course, any agreement might be in violation of antitrust laws. This situation resembles a game in which players can realize an advantage at the expense of their neighbors for the short term and hurt everyone in the long run. In such a situation some people would argue that macro pricing is immoral.

James C. Hickman

The title of this interesting paper is slightly redundant. A comprehensive product development process is given the snappy title, "macro pricing." A student of economics will recognize the early sections of the paper as an excellent review of classical pricing theory. This theory is one of the foundation stones of microeconomics. The paper, however, goes far beyond reviewing the application of microeconomics to life insurance pricing. Elements of modern managerial accounting and guidance for the intracompany process for selecting the price-benefit structure are also presented.

Section I is devoted to criticisms, from the viewpoint of classical microeconomics, of the cost-plus algorithm and the arbitrary allocation of nonmarginal costs as used in insurance pricing. The criticisms are valid and have appeared before, but seldom so persuasively. The question that remains is why did these ideas remain part of insurance theory and practice for so long? I believe that there are two answers.

First is the importance of participating life insurance. During most of the past century, dividend determination in life insurance has been a relatively more important activity than the setting of premiums. In addition, policyholders own mutual companies. Ultimately all expenses, both marginal and nonmarginal, must be allocated to some set of policyholders. Despite the absence of a completely satisfactory theory in classical macroeconomics to guide the process, actuaries have felt compelled to create a price-benefit structure in which, through premiums and dividends, nonmarginal expenses are allocated to units of insurance.

The second answer is based on the regulated nature of insurance. It is particularly powerful for coverages that have become business necessities. The necessity is created by lenders or the law for many property and liability coverages and by competitive pressure from employees for life and health coverages. When insurance prices are regulated or business necessity compels an insurance purchase, the demand side of the supply-demand equation is altered. In these situations, the economic actors think in terms of cost-plus pricing. Marketing becomes less important.

The sections of the paper on the macro pricing concept are related to a contemporary revolution in managerial accounting. The name of Robert S. Kaplan, Professor of Accounting, Harvard Business School, is associated with the revolution. In recent years Kaplan and his colleagues have developed the proposition that firms have mispriced their outputs and made capital budgeting blunders because of the increasing irrelevance of traditional cost accounting methods. An approach labelled activity-based costing (ABC) has been developed. The ideas are outlined in a series of *Harvard Business Review* articles [1], [2], [4], [5] and a book [3].

There is a startling similarity between the ideas of Chalke and Kaplan. For example, in Figure 9 Chalke identifies various decision and cost levels in an insurance price-benefit decision. These are called the product, project, line of business, and company levels. Kaplan and Cooper [4, p. 132] display a similar chart for manufacturing decisions in which unit of product, batch level, and product- and facility-sustaining levels of activity are identified, along with the associated costs of each. Chalke states that "Expenses that were overhead with respect to lower-level decisions have become marginal with respect to higher-level decisions." Cooper and Kaplan [4, p. 135] express the same idea as follows: "Costs are not intrinsically fixed or variable." They claim that "ABC analysis permits managers to understand the sources of cost variability and reveal actions they can take to reduce demands on their organizational resources."

I hope that Chalke's article will motivate more actuaries to study current thought in cost accounting. A challenge will be to adapt these ideas to the determination of dividends in participating life insurance.

At several points in his description of the comprehensive product development process, Chalke reminds his readers of the many subjective assumptions that must be made. No one can disagree. Nevertheless, inevitable uncertainty about the future does not reduce the requirement to analyze past data. Chalke comments on the economic volatility of the recent past and the high rate of life insurance product development. The resulting data were not obtained by a controlled experiment, but ingenious analyses can provide at least ancillary information relevant to most product development processes.

In a similar fashion, expense allocation is not an armchair occupation. Within each activity level, regression analysis can help to identify and measure marginal and nonmarginal costs. A decade ago two of my colleagues, Miller and Fortney [6], used Bayesian multiple regression methods to establish industry-wide insurance expense standards. This project exposed some problems with using statistical methods in cost analyses, but the alternative of not using existing data is unattractive.

Chalke describes realistically the conflicts in the product development process that may develop between those with marketing and actuarial responsibilities. By breaking the process into a sequence of steps, he has sought to manage the inevitable conflict between groups that have different corporate responsibilities. When a decision step builds on a view of the future, it sometimes helps to list in general terms the possible future states of the world. Then each party can assign a prior probability distribution to these states. Rather than jump immediately to a single best estimate of the environment that will affect the new project, managers can consider different views of the future, numerically weighted.

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Merlin Jetton

Mr. Chalke's paper was thought-provoking and well-written. His approach to pricing has some very strong points. Most important I believe is its integration with economic theory, in particular the law of demand and price theory.

Although I believe his approach is basically sound, I have a couple of comments. First, I raise a point he did not address. Second, I was confused by some of his statements about expenses and suggest an alternative perspective on expenses.

Profit Goals

In the macro pricing algorithm, the profit objective is to maximize the dollars of profit. Presumably this is a present-value measurement. But at least one other profit goal is often pursued legitimately, especially when the availability of capital is a major constraint: a rate of return on investment (or capital or equity). With such a profit goal, one tries to maximize dollars of profit (taking into account its timing) per dollar invested in a project.

Taking the prices of the products (or two sets of prices and sales volume predictions) as given, let us assume that product 1 offers higher potential dollar profits than product 2. However, product 2 has a much lower capital commitment, so much so that product 2 has a much higher return on investment. The capital-constrained decision-maker will choose product 2, and the capital-rich decision-maker may, too, and then look for another opportunity that will produce the same sort of return on investment as product 2.

From this return on capital perspective, some of the expenses are viewed differently than others. For the most part this would seem to be explained by the timing of the expenses. For example, future policy maintenance expenses would not be viewed as capital, renewal commissions would probably not be viewed as capital, but new business commissions and start-up costs would be.

Expenses

I find confusing Mr. Chalke's labeling of a given expense as marginal at one decision level and overhead at another decision level and how that should affect pricing. Take, for example, his Figure 9 and the three paragraphs immediately following. In the first paragraph, he says that special developmental expenses deemed necessary to embark on project No. 1 are completely irrelevant to pricing the associated products. How can that be, especially if such expenses have not been incurred yet? Even if they had been incurred—quite recently as the result of a decision to proceed with project No. 1—I would deem them relevant to the pricing of the associated products.

It seems to me that the general presumption of overhead expenses being irrelevant to pricing could lead to some bad decisions. The distinction between marginal and overhead expenses is a fuzzy one. For illustrative purposes, let us assume an actuary undertakes pricing a new product that will replace a product now being sold. There is a substantial in-force of the current product, which will no longer be sold once the new product is available. The actuary has an expense study that gives per-unit maintenance expenses, which include overhead. Should such overhead be ignored? I would not ignore it if I recognized that the in-force business will decline with time, but such overhead, or at least some of it, will remain. I would have even greater reason not to ignore it if there were plans to make an exchange offer to the in-force policyholders. However someone might label these future maintenance expenses—"overhead" or "marginal"—would be irrelevant to me. I would deem them expenses associated with the new product.

The author came close to addressing this sort of example in his section entitled "Displacement as a Marginal Cost," but he did not do it directly. Perhaps I misunderstand him and our different views are merely verbal, but there may be a better perspective on the matter.

This example suggests to me that the marginal/overhead distinction might be better replaced by a different distinction. It is made by asking the question: Are the expenses being considered future ones, or do they imply future ones, that should be associated with the new product or project? If the answer is "yes," they are relevant to pricing and if the answer is "no," then they are not. The word "future" here should not be construed too narrowly for at least two reasons:

- Let me use my example to point to the first reason. The overhead maintenance expenses are based on the past, but they could well imply the existence of future overhead maintenance expenses that are properly attributable to the new product or project being considered.
- Recall my comments about the author's first paragraph following his Figure 9 for the second reason. Let us further assume that some of the developmental expenses have already been incurred, quite recently as the result of a decision to go forth with project No. 1. In that case they would be past expenses strictly speaking, yet they would be future expenses relative to the decision to go forth with project No. 1. (The answer should not vary here with when those costs are paid, for example, by installments.) Therefore, they should be relevant to the pricing of any product associated with project No. 1.

Also, the interpretation of the phrase "associated with the new product or project" in the above question should recognize the displacement effect that the author discusses at length.

This alternative distinction with regard to expenses seems fully consistent with the author's future-oriented point of view on pricing.

Thomas P. Kilcoyne

I congratulate Mr. Chalke for his lucid exposition of a very workable pricing algorithm. He presents sound arguments to support the macro pricing concept. The minor shortcoming is the lack of definition of the "competitive environment" in which macro pricing can produce optimal decisions. This causes difficulty in determining the intended scope of the described methodology. Macro pricing appears to be most applicable in addressing the nonguaranteed elements of a nonparticipating product issued by a stock company in an illustration-driven market. In other situations, it may be inconsistent with adequacy or the objectives of the insurance company.

The mutual company philosophy of providing insurance at cost is still viable within certain segments of the market in North America. Mr. Chalke does not explicitly challenge the mutual company philosophy, but this reader senses the implication that it is outdated. I do concede the theoretical possibility of its eventual demise, but I would not exclude it as a possible pricing consideration.

More importantly the issue of adequacy must be addressed. The tradition of placing adequacy as the primary pricing objective is not to be discarded without considerable debate. I believe it has served the industry and the public well as a safeguard to promote, in conjunction with market forces, downward convergence toward an equilibrium price. An unbiased application of the macro pricing technique would seem to permit upward convergence as frequently as downward. Each inadequate price structure guaranteed during the process of convergence restricts a company's future actions and undermines the solidity of the industry. The propriety of reducing the emphasis given to adequacy seems to depend upon the role and responsibility of the pricing actuary. To the extent that adequacy is deemphasized, the pricing actuary becomes less a professional and more a technician.

David Lee

Mr. Chalke has written an outstanding paper, one of the most useful that I have read. I have a few suggestions about the practical applications of macro pricing, but there is not much to add to what Mr. Chalke has presented.

Updating an Existing Product—Choosing the Optimal Price

In this section of the paper, Mr. Chalke first calculates the marginal profit of continuing the existing product, assuming production objectives are met ($8 million in the example). He then determines other points on the price-production curve producing $8 million of profit. Finally, marketing chooses the price-production combination that maximizes the chances of meeting its objectives. If one or more of the elements in the decision set requires significant resources to implement, I think the company should increase the $8-million profit objective for those alternatives to compensate for the resource requirements, even though the cost of the resources is already included as a marginal expense. This assumes that those resources would otherwise be spent on other projects that add value to the company. It avoids spending scarce resources on projects that will not do much more than maintain current profit levels.

The author suggests calculating profit for each alternative being considered over the lifetime of the proposed new product. Theoretically, this is the best approach, and when investigating products requiring a significant learning curve, it is probably the best practical approach as well. The problem is that bonus programs for senior marketing and sales executives often have a one-year time horizon. As a result, sales expectations are solid during the current year but very soft in ensuing years. Therefore, whenever possible, I suggest using one year as the expected sales lifetime of the new product. If the product is introduced midyear, the sales objectives for the year can be adjusted pro rata. The new product will implicitly be included in the following year's objectives to the extent that these objectives are related to current-year sales. This one-year approach could produce a bias towards "maintaining the status quo" because development costs for the new product are amortized over one year of sales, but it is much easier to manage bonus compensation for sales results using a one-year approach.

Application of Macro Pricing to Managing Direct-Response Business

Macro pricing is a very useful tool in managing the direct-response line of business, because the marketers are experts at predicting and managing to response rates for different mailing lists and solicitation packages. That is, the marketers are experts at determining the price-production relationship that maximizes profit, where "production" refers to expected response rates and new business premium and "price" is measured by solicitation cost.

Suppose senior management wants to decide how much money should be allocated to the direct-response line of business for 1992 mailings. Assume that $30 million will be spent on mailings in 1991 and that a roughly flat budget is anticipated for 1992. The budget process might proceed as follows:

(1) Marketing and actuarial prepare a "high-end" marketing plan for $33 million (10 percent increase).
(2) Marketing programs with the poorest expected results are removed, so $31.5 million (5 percent increase), $30 million (flat), $28.5 million (5 percent decrease), and $27 million (10 percent decrease) budget plans are created.
(3) Profit is calculated for each marketing scenario by using macro pricing techniques. The expenses should be marginal, but should include staffing changes required for different production levels. Suppose this calculation yields the following

results. (Increases as the budget amount increases are in parenthesis.)

Solicitation Expense (Millions)	New Business Premium (Millions)	Profit* (Millions)	New Business Premium per Dollar of Solicitation Expense
$27.0	$40.5	$12.0	$1.50
28.5 (1.5)	41.3 (0.8)	12.2 (0.2)	1.45
30.0 (1.5)	41.6 (0.3)	12.25 (0.05)	1.39
31.5 (1.5)	41.7 (0.1)	12.15 (–0.1)	1.32
33.0 (1.5)	41.8 (0.1)	12.1 (–0.05)	1.27

*Present value of contribution to overhead, discounted at 10 percent.

(4) The results are analyzed and the budget is determined (or more information is requested). A flat budget of $30 million might be selected because profit is maximized at that level. A budget in excess of $30 million would be unacceptable, because once the solicitation budget exceeds $30 million, expected response rates deteriorate to the point that the premium generated is not enough to keep profit from decreasing. An argument might be made that the budget should be kept at $28.5 million because there is not enough bang for the buck in going to the $30-million level and the money can be put to better use somewhere else (spend $1.5 million for an additional $300,000 new business premium and an additional $50,000 profit). Alternatively, a financial projection at $29 million might be requested to help make the decision. Suppose a $28.5-million mailing budget is selected. This becomes part of the 1992 objectives, along with $41.3 million new business premium and $12.2 million of profit.

Note that overhead was completely excluded from the calculations. However, senior management might wonder how the line of business will perform in 1992 compared to other lines and whether the direct-response line is covering its overhead, however allocated. The 1992 direct-response business is expected to produce $12.2 million of profit using expenses that are marginal by policy. To address the question of how the line of business is performing, the expenses that are marginal to the line of business that are not marginal by policy must now be included. This would include the salaries and benefits of people working in the direct-response area, as well as expenses from actuarial, policy approval, data-processing, and other functions that would be eliminated if the direct-response line of business were eliminated. If this totalled $3 million, then the expected profit produced by 1992 new business would be $12.2 million – $3 million = $9.2 million. This could be compared to allocated overhead, as well as to the profit generated by other lines of business.

Profit Comparisons for Different Lines of Business

Macro pricing concepts applied on a line of business level can be used by senior management for two purposes:

(1) Comparing the relative profitability of different lines of business on an apples-to-apples basis; and
(2) Making decisions on which lines of business can produce the best return on incremental dollars available for investment.

To compare the relative profitability of different lines of business, the expenses included in the analysis should be marginal by line of business. This avoids allocation of overhead, which can produce misleading results depending on the allocation method chosen. The $9.2 million expected from the direct-response line in the previous example is directly comparable to the profit expected from other lines. Managers of the lines of business can set profit objectives at the beginning of the year, and actual results can be compared to the objectives. Senior management will find this information extremely valuable for making decisions on management of the different lines of business.

When addressing which lines of business can provide the best return on incremental capital available for investment, the expenses in the analysis are marginal by policy. A good example of this process is the direct-response budget process discussed earlier. It was noted that profit was maximized with a mailing budget of $30 million. However, when the budget was increased from $28.5 million to $30 million, profit increased only $50,000. Assuming surplus is a scarce commodity, senior management's decision on a $28.5-million budget versus a $30-million budget depends on whether a bigger return is available if the money were invested in another line of business. In this manner, senior management can use macro pricing techniques to maximize profit for the company.

The macro pricing process presented in Mr. Chalke's paper has widespread application at several levels in an organization and is a valuable decision-making tool for actuaries and senior management.

Frank C. Metz

Mr. Chalke has written a very important paper that in my opinion will become a cornerstone of the actuarial literature for pricing and product actuaries.

In my opinion macro pricing should be considered an evolutionary rather than a revolutionary step in the development of actuarial pricing methodology. It seems natural to me that the realities of today's marketplace are causing actuaries to reexamine some of our "tried and true" methods and to improve them as necessary. Mr. Chalke's paper is an excellent example of this process. Macro pricing introduces several improvements to the traditional pricing model. By focusing on the total economic value of a project and by providing a mechanism for the alignment of actuarial and marketing incentives, macro pricing facilitates rational if not necessarily optimal pricing.

The significance of at least striving toward optimal financial decisions should be uppermost in the minds of insurance company managements in light of recent solvency problems in our industry. In my opinion, macro pricing provides a better mechanism than does the traditional method for arriving at optimal pricing decisions. It would greatly behoove our profession to objectively consider adopting a pricing methodology that enhances the chances of achieving optimal financial results.

This may be a difficult process for some actuaries, particularly those whose education and training have been predicated on the unit-based cost-plus method. It may be a lesser problem for students because an extract from Mr. Chalke's paper is required reading for Course 210 of the Society of Actuaries Examinations. In any event, the importance and relevance of this paper demand that we approach it with open minds free of preconceived notions and personal biases.

Harry Ploss

Mr. Chalke has written a fine paper on the economics of pricing. Most actuarial pricing papers are based on achieving profit objectives on units of insurance. Although these helped us to better understand profit objectives and the cost of capital, they did little to address *when* writing additional business would help build the profitability of the company.

Many entrepreneurial companies priced by using optimistic expense assumptions, yet continued to grow in their niche markets beyond their initial projections! How did they cover all their expenses? How could pricing using less than *actual* expenses be successful? The solution to this *paradox* is herein revealed.

Although there are new and difficult concepts in this paper, in my opinion it is suitable for our Society's educational study materials. The pricing actuary struggles with these issues on a daily basis.

Marketing Decision Frontier

The paper describes how profit varies with both volume and price. Usually the marketing division is expected to achieve some arbitrary level of sales so it demands the lowest price. The actuary needs to defend the official profit margin, with fully allocated costs. A classic confrontation!

The marketer's view can be changed provided marketing is compensated on the price versus volume curves. If sales are limited by saturated demand or geographic area, marketing might choose a higher price to increase its compensation without a sales volume increase. A higher price may require better service and attitudes. On the other hand, a brokerage company may decide that production can increase almost without limit, and the lower price/higher volume will increase profit after capital costs and be less of a sales challenge despite higher production goals.

In an age of increasing cooperation and the success of economics over military power, win-win solutions between actuarial and marketing using price-volume curves are here to stay!

Most people understand concepts better from pictures than formulas! Macro pricing asks where on the price/volume curve they are most comfortable. This information is valuable even if they are still negotiating whether the curve should have a favorable parallel shift.

Investment Decision Frontier

The capital asset pricing model (CAPM) generally only considers unleveraged investors who own their assets unencumbered. Insurance companies are leveraged entities that need to manage risk to capital ratios. A riskier investment policy that will earn a higher expected "total return" but requires more capital may restrain growth and cause expected "returns on required capital" to decrease. Macro pricing can develop efficient frontiers that reflect capital and pricing elasticity in addition to the usual investment risk and total return in CAPM.

Cost of Capital

The company will consider many ventures using macro pricing and fully utilize its capital, either through its own marketing or through reinsurance agreements. Hence capital costs need to be considered a marginal cost in pricing; otherwise the capital-intensive projects will look most attractive.

The alternative is, for each project and decision level, to keep track of the profit, capital requirements, and other resource constraints. Of course the cost of doing nothing, always an alternative, is the cost of unused capital.

Marginal Costs Can Be High

Although marginal costs have a connotation of being low, they can be quite high when production is a small fraction of "critical mass" production levels. Marginal costs are not necessarily lower than fully allocated costs for the company's successful line of business. A classic case is variable life, with the fixed costs of SEC compliance and maintaining the separate investment accounts. Macro pricing automatically reflects this, by pricing the project rather than units. Marketing can then determine the probability of achieving the required hurdle production levels.

Commodity Product Market

An example of noncommodity market pricing has been computer chips, for which the elasticity of the market is great, production costs are low compared with research and tooling costs, and marginal costs are low compared with selling prices.

In a commodity-style market, the universal marginal costs are high relative to the selling price; there is great homogeneity of product; a good market exists to substitute the product of one company for another, such as insurance brokerage; and service is provided by the supplier and not by the manufacturer.

Macro pricing is most needed in pricing new ventures in noncommodity markets. In existing commodity-type markets, conventional pricing works quite well.

Service—The True Product

Service is a most important and intangible part of financial services, but it is not mentioned in the policy form. The cost of good service may be less than its impact on volume, persistency and product profitability. The ultimate administrative system is frequently built after product salability is demonstrated. Macro pricing can price several administrative/marketing scenarios for the same policy form.

Macro Pricing

The manner in which macro pricing is implemented will evolve. The advantage of showing the decision frontiers is that it shows pictorially the direction of the maximum good for the organization, with the resultant win-win solutions. Macro pricing provides a mathematical way of saying "God, give me the strength to accept what I cannot change, the courage to change what I can, and the wisdom to know the difference."

Using many assumptions in a complicated model can foster distrust if not communicated in a win-win way. It is not clear whether the pricing solutions are stable under sensitivity testing. Nor is it clear that the solutions can be derived by a single bottom-up path. Higher-level decisions change the lower marginal costs, which may in turn change the projects proposed, resulting in further changes in higher decisions. Iterative solutions may be required. In a slowly changing organization this iterative process may not be apparent.

Macro pricing provides a mechanism to model how the entire organization and the outside market affect the optimal pricing solution. It lends itself to a dynamically changing market and organization. Traditional cost-plus pricing methods worked in stable, slow moving markets, but they are not accurate enough to find market opportunities and they do not facilitate win-win solutions.

Colin M. Ramsay

While reading this paper, I was reminded of Lord Justice Oliver's statement that, "as a method of providing a reliable guide to individual behaviour patterns or to future economic and political events, the predictions of an actuary could be only a little more likely to be accurate (and would almost certainly be less entertaining) than those of an astrologer" [1].

I congratulate Mr. Chalke for pointing out the political/psychological nature of the pricing process. I commend his attempt to change it to a more logical and rigorous process, and I hope his article will serve to stimulate discussions among actuaries about the efficacy of this process.

After carefully reviewing Mr. Chalke's paper, I have four main criticisms:

1. The author repeatedly misuses the word "marginal." In addition, he uses the words "expected" and "profit" in an ambiguous manner.
2. The paper contains numerous unsubstantiated claims. For example, in the Abstract the author claims that his method "...can produce optimal decisions in competitive environments." In fact, the author's macro pricing algorithm is generally suboptimal—it will be optimal only by coincidence—because it does not actually use the demand function.
3. His macro pricing algorithm is not built on a rigorous application of economic theory.
4. The bibliography was provided with neither guidance nor references to assist us in its use.

Terminology

In Section 1, Mr. Chalke exposes the inherent weakness of the traditional pricing methodology: there is a lack of microeconomic reasoning behind the way prices are chosen. With the aid of an example, he shows that "unit-based analysis" and the "cost-plus" approaches do not maximize profits. True. In constructing his example, he appeals to microeconomic theory by using a demand function, marginal costs (expenses), and a new term, "nonmarginal expenses." In this example and throughout the rest of his paper, he uses the word "marginal" to mean "variable." In microeconomic theory, the term "marginal" *always* means "the addition to the total due to the addition of the *last* unit." For example, "marginal cost (expense)" is the addition to total cost (expense) resulting from the addition of the last unit of output; see Mansfield [2, p. 175). This definition is sacrosanct and should not be trifled with. In view of the meaning of the word marginal, the term "nonmarginal" is meaningless! However, I think the author uses nonmarginal to mean "fixed."

I strongly urge Mr. Chalke to reconsider his definition of "marginal cost" in Section V; it should be called "marginal *decision* cost" instead.

Mr. Chalke uses the word "expected" in terms such as expected profit expected consequences, expected value, and the like throughout his paper. It is not clear to me whether "expected" is to be taken in a statistical sense (based on the decision-makers' subjective probabilities) or whether it simply means "anticipated."

Another source of confusion is the word "profit." In view of the author's appeal to microeconomic theory, I was unsure whether the term "profit" was being used in an economic sense or in the usual accounting sense. Note that a decision results in an economic profit if, and only if, the decision-makers will make more money with their resources than they could have made with any other decision. So an economic profit of one dollar ($1) cannot be dismissed as unworthy!

The treatment of "displacement" in Section VIII could have benefited from an analysis of the cross-price elasticities between the different competing products; see, for example, Mansfield [2, Chapter 5.7].

Unsubstantiated Claims

In Section I.F, the author cites the two failures of the traditional product development algorithm: (i) the existence of "open decision points," which result in looping, and (ii) a lack of a rigorous basis for pricing. He then claims that his macro pricing algorithm (MPA) will eliminate these problems; see the beginning of Section II. Unfortunately his MPA does not live up to its billing.

The author's solution to the open decision problem is as obvious as it is simple: let the marketing department make the final price decision! He gives two reasons for this: incentive and responsibility (see the last three paragraphs of Section VII.A). In a competitive environment, this decision is obvious for the reasons he gives. The theory and methods described in Sections II to VI had absolutely no bearing on his decision to give marketing the final price decision.

Sections X and XI are replete with unsubstantiated assertions, for example:

- Section X, first sentence: Mr. Chalke never proves that the MPA reaches a more optimal (whatever that means) decision.
- Section X, second sentence in subsection A: "...the macro pricing algorithm involves more sophisticated actuarial analysis." The actuarial analysis in his MPA is very subjective and lacking in conceptual complexity.
- Section X, the entire final paragraph of subsection A.
- Section XI: The author *never proves* that the MPA provided the maximum chance of reaching optimal pricing results.

Lack of Rigorous Basis

The author fails to provide a *rigorous* basis for his pricing methodology as described in the MPA. Placing his comments in Section VIII.D prominently in the early stages of Section 11 would have alerted the reader to the numerous assumptions ahead and thus relieved him or her of any anxieties. As I read this paper, I failed to see any improvement in rigor over the traditional method. For example, the author shows the traditional approaches do not lead to optimum prices and acknowledges that this can only be attained with the aid of actual demand functions (surfaces). However, he fails to use demand functions in his MPA and as such renders his pricing suboptimal as well. He concedes this fact by stating, "Frankly, there is no way of actually knowing whether the chosen price is indeed optimal" (see the fourth paragraph from the end of Section VII.A). This uncertainty occurs because of the highly subjective nature of the "price-production" graphs he relies on. Instead, he should have used field data to estimate the demand surface for a few key variables, then optimize profits and price.

End Notes

1. This statement originally appeared in a judgment of the U.K. Court of Appeal in *Auty and Others v National Coal Board (1984)* and was quoted in R. Owen and P. S. Shier, "The Actuary in Damages Cases—Expert Witness or Court Astrologer?" *Journal of the Institute of Actuaries Students' Society* 29 (March 1986): 53.
2. Mansfield, E. *Microeconomics Theory and Applications,* shorter 4th edition. New York: Norton and Company, 1982.

(Author's Review of Discussion)

Shane A. Chalke

I thank each of those who took the time to discuss this paper. Due to the number of discussions and the variety of excellent points raised, I respond to each discussion individually, in alphabetical order.

Linden Cole

Mr. Cole develops a case that the traditional methods functioned well in past years, when both external and internal environments were more stable. With this case I am only partly in agreement. The time period Mr. Cole refers to (I believe 1955 through perhaps the mid-1970s) was marked by stability only as a result of two external influences:

1. The regulatory structure dictated significant limitations to financial services competition. It was illegal for banks to pay interest on demand accounts, and the maximum interest rate payable on savings accounts was uniformly determined by regulation. In addition, the mutual fund industry was in its infancy, itself hamstrung by a byzantine regulatory structure. These effective statutory price floors created effective barriers to entry, stifling competition.
2. A money partially linked to a commodity (gold) provided limited (but somewhat effective) constraints on active federal reserve management of the money supply. As such, interest rates were relatively stable.

In this environment, companies generally had the luxury of cost-plus product pricing. Actuaries, I would presume, rarely found themselves in the quandary that the application of cost-plus algorithms produces today. This is a natural result of a slowly changing environment and government restrictions on competition.

Can we say that the cost-plus methods "worked" in this environment? Certainly we can conclude that the insurance industry enjoyed relatively stable earnings, with few outright failures. However, rather than concluding that the traditional method was optimal, I would say that the environmental conditions *allowed* the use of the older approach.

As an example, consider the case of a government-granted public utility monopoly, the ultimate regulatory restriction on competition. Public utilities have, and still do, practice cost-plus pricing. This is comfortable behavior in a monopoly environment and produces predictable profit streams.

The point, however, is not that cost-plus algorithms are optimal, but that they are allowed by noncompetitive environments.

I submit that the macro pricing approach consistently produces better results under all conditions, but exhibits its greatest relative advantage in competitive environments.

Mr. Cole also stresses the intuitive (or instinctive) approach to the pricing process brought to bear in the past. On this point I am in full agreement. The backbone of business is subjective decision-making, and it is dangerous for pure quantitative analysis to supplant inarticulate knowledge. I am a firm believer that the instinctual approach to business is learned slowly over time and is invaluable to any organization aspiring to success.

In fact, the macro pricing approach relies heavily upon inarticulate, or intuitive, knowledge of product demand elasticity and of financial forecasting. Its success lies in the allocation of decisions to those with the most credible intuition in each area.

Arnold Dicke

I find myself in agreement with the majority of Mr. Dicke's fine discussion. I appreciate his recognition that the use of marginal expenses is essential to good decision-making and that marginal expenses may vary continuously over the decision set. However, I do have a few minor points of contention, as follows.

Mr. Dicke observes that the macro pricing approach functions best with a revision in structure and management. He then makes the point that it is unfortunate to forestall the implementation of the approach pending these changes. I believe that this point must continually be stressed. Partial implementation of the macro pricing approach seems to work surprisingly well in practice. For example, the common stumbling block seems to be the existence of static compensation schemes for marketing personnel. Even in this case, however, implementation of macro pricing without dynamic marketing goals proves enlightening.

In mentioning some of the practical difficulties of the macro pricing approach, Mr. Dicke states that "Certain inputs to the process (notably the demand or price-sensitivity curve and product shelf life) are difficult to estimate." I am left puzzled by this reference to demand curve estimation. In fact, the macro pricing approach is deliberately designed such that this estimation process for the demand curve is not necessary within the quantitative analysis.

Further, Mr. Dicke states that "the utilization of the marketing department for choice and commitment is more complicated in practice than it might appear." Here I must disagree. In my experience, utilization of the marketing department in this role has been far easier than I would have guessed. Experiences gained from many implementations of the macro pricing process have shown ready acceptance of the approach by marketing professionals. In contrast (and in support of Mr. Dicke's opening statements), I have found that the roadblocks can generally be traced to the actuarial department.

I find Mr. Dicke's approach to allocating overhead by invested capital interesting. In an ROI measurement arena, this approach produces a one-to-one mapping of marginal ROI to "after-overhead ROI" However, I feel compelled to caution readers that there are a number of dangers in this approach. Specifically, there is the risk that management will consider the "after-overhead ROI" in an absolute sense and reject projects that would have made the enterprise healthier.

In addition, unless all projects exhibit the same resultant "after-overhead ROI," there is no direct correlation between the stated profit number and the goal of "covering overhead." Therefore, this one-to-one mapping adds little to the basket of information supporting the pricing decision. Because this approach costs time and effort, I cannot advocate its practice.

Finally, I would like to make an observation regarding Mr. Dicke's statements about the "tight" constraint of capital. Most constraints to growth (including time and capital) are rarely absolute and can be bought for a certain price. Therefore, rather than consider these constraints absolute, I find it more instructive to price the incremental resource within the quantitative analysis. For example, even in the case of a mutual insurance company, the pool of capital need not be static. Capital can be "bought" in a number of ways, including policyholder subordinated debentures, mergers, or by raising capital from the customer/owner population through the steepening of dividend scales.

Matthew Easley

Although Mr. Easley agrees with the macro pricing concept in general, he is rationally skeptical in several areas. In fact, his comments are typical of a thinking person's first reaction to the methodology. As with Mr. Dicke's discussion, his also raises the problem of limited capital, stating a concern over the "implicit assumption that the company can accept any amount of a product in order to satisfy the profit optimization." This apparent dilemma is also cited, in differing forms, in Mr. Easley's discussion of diversification/risk and the limits of the distribution system.

Each of these comments is properly answered through a closer examination of marginal cost. For example, if a particular production scenario requires greater capital than another, then that marginal capital requirement bears a certain cost. If the capital is not internally available, then the marginal cost of procurement may be quite high. If the cost is high enough (for example, if regulatory obstacles must be overcome), then the marginal profit for this production scenario turns negative, and the choice is removed from the decision matrix. The same is true for the procurement of additional distribution capacity and for nondiversification risk. The macro pricing algorithm, therefore, explicitly recognizes the true economic costs of these obstacles.

In the latter case, it must be recognized that the bearing of risk is a marginal cost like any other. Although this topic is beyond the scope of the paper, I have been applying the macro pricing algorithm with "risk-adjusted profit" for some time. I calculate risk-adjusted profit through the use of a utility model. Through this approach, we can reflect the costs of "putting all your eggs in one basket." In other words, the marginal expense (in terms of risk premium) of writing exclusively one type of product may be prohibitive. If this is the case, then once again these options are removed from the decision matrix.

Mr. Easley also mentions that nonmarginal expenses do not vary in proportion to the size of the line of business. Some clarification is necessary here. By definition, if "nonmarginal" expenses vary with business volume, then they are, in fact, marginal.

However, Mr. Easley may be referring to the fact that *marginal* expenses may vary with volume. This is not only true but also commonplace. Once again, however, rather than concluding that the macro pricing algorithm is at odds with reality, we can explicitly recognize this fact by appropriately assuming marginal expenses differing by production scenario. This procedure is referenced in step 9 of the algorithm, "Determine Non-Unit-Based Marginal Expense Assumption."

I support Mr. Easley's approach to operational expenses. The idea of bargaining a fee structure with the various functional areas at the time of product pricing is quite workable and necessary for ultimate success. In recognizing this, Mr. Easley begs the entire question of company organization. I believe that organization around an internal contract structure produces profoundly positive financial performance. In contrast, the vast majority of corporate entities are organized on a "command economy" (or socialist) model. Macro pricing is simply one small step toward internal organization on a market model.

As a final point, Mr. Easley notes that if nonmarginal expenses are "assumed to be irrelevant to the pricing of the product, there is little practical constraint on the growth in these expenses." Here I must disagree. First, even if these expenses were considered relevant to the pricing process, I find little reason to believe that a practical constraint on their growth would follow. Second, control over these expenses is effectively gained only at the decision level at which they become marginal. This is discussed at length in Section VI, "Levels of Decision-Making within an Insurance Company."

Charles Fuhrer

Mr. Fuhrer raises an interesting question about the market's response to an individual entity's change in price. Mr. Fuhrer is quite right in assuming that firms do respond (in some way) to competitor's price adjustments. However, I believe that his conclusions are not supportable for several reasons.

Mr. Fuhrer creates a mathematical demonstration whereby an insurer chooses a price without regard to possible competitor response. When the competitor does respond and the original insurer counters, both fail to generate profit.

This scenario fails to be convincing at the outset. At such time that the first insurer is choosing price, it is unrealistic to think that the decision-maker will not consider the market response to the price under consideration.

In practice, this phenomenon is actively discussed during the macro pricing algorithm, and any price decision is made with full expectation of future market prices. As a result, the macro pricing algorithm displays no tendency towards systematic losses. On the contrary, macro pricing, with its holistic outlook on the market, is the best defense against destructive "price wars." It is precisely the blind political pressures that are allowed to surface through the traditional approach that cause price spirals chasing market share.

On a broader scale, can Mr. Fuhrer be implying that competitive pricing leads generally to business profit cycles? Rothbard [2, Chapter 12, Section 11] provides a more insightful explanation of the business cycle.

Further, Mr. Fuhrer states:

> Many insurers would prefer to break this cycle by always using traditional pricing but all the insurers would have to do so. Of course, any agreement might be in violation of antitrust laws. This situation resembles a game in which players can realize an advantage at the expense of their neighbors for the short term and hurt everyone in the long run. In such a situation some people would argue that macro pricing is immoral.

Several economic sophisms are displayed in this paragraph. First is the idea that cartels can actually be sustained through private enterprise. On the contrary, each member of a cartel stands to gain more by breaking the cartel than by supporting it. Cartels are only durable when supported by force (that is, price controls, regulation, barriers to entry). The fact that government is the only real source of monopoly is the fundamental irony of the antitrust law framework.

The last two sentences are not so much an indictment of macro pricing but of the free market in general. Although the western system of private property can be said to be profoundly moral, the market itself is quite *amoral*. The rich texture, beauty, and powerfully positive effects of an unfettered market have only begun to be understood in this century. Hazlitt [2] provides an introduction to the intricate workings of the market.

James Hickman

Dr. Hickman makes a number of important observations. I agree with his explanation of why traditional methods have lingered for so long in the insurance industry. Certainly the concept of the "mutual insurance company" suggests cost-based algorithms at the outset.

I am grateful to both Dr. Hickman and Mr. Dicke for introducing me to the work of Professor Robert S. Kaplan. I have since collected and read many of his articles and have enjoyed them. Although my approach differs from Professor Kaplan's in many ways, we reach several of the same conclusions.

Dr. Hickman notes that historical expense information is useful and important. As with all historical information, however, it is only useful in its ability to assist in better anticipation of the future.

I also value the notion of players in the process revealing their assumptions about future states of nature and their view of the likelihood of each state coming to fruition. Discussions of this type greatly improve the quality of forecasting and business decision-making generally.

Merlin Jetton

Mr. Jetton also raises the question of the appropriate profit goal to use in a capital-limited situation. First, I would observe that many companies can, and do, use the macro pricing algorithm with the profit measure expressed in ROI terms. However, if capital is priced within the model at marginal cost to the organization, then the goal of total profit will result in maximization of total profit for the firm. The question, then, is one of proper marginal costing of resources, rather than inappropriate profit goal.

Mr. Jetton also raises a question about the definition of marginal expenses, referring to Figure 9 and the following text. For the example in question, start-up costs for the proposed product are indeed irrelevant to the determination of price, but not irrelevant to the go-no-go decision. If, in fact, it has been decided to proceed with the project, then such start-up expenses are a constant to the decision at hand and thus irrelevant.

Mr. Jetton proposes that all expenses be taken into account in the pricing process that are "associated with the new product or project." I find this definition of marginal expenses troublesome. Expenses may be associated with a new product but not marginal to the decision at hand. Clearly this definition fails when considering sunk development costs, and faced with the decision to proceed with the project. Sunk costs cannot be recovered even by pulling the plug on the project, yet they are clearly "associated with the new product or project."

Thomas Kilcoyne

Mr. Kilcoyne raises a question about the intended scope of the macro pricing algorithm. In answer, I point to the above response to Mr. Cole. I think that the macro pricing algorithm provides superior results in both elastic and inelastic markets, but displays its greatest relative advantage in the more elastic markets. Firms may practice cost-plus pricing in less-than-competitive environments without going out of business, but enjoy no such luxury in highly competitive markets.

With respect to the application of macro pricing to mutual insurance companies, I am skeptical that the traditional approach is workable even in a mutual company

environment. For example, consider a mutual company practicing cost-plus pricing. If the resulting price differs from that anticipated to provide the greatest profitability (the macro pricing-derived price), then the application of the cost-based algorithm shorts return to existing policyholders. Because mutual companies derive most of their capital from policyholders, mutual companies will find themselves uncompetitively vying for capital. This brings into question the long-run viability of the traditional approach, even in a mutual environment. To be clear, I am not challenging the mutual form of corporate organization, but seriously doubt that the traditional approach can be practiced effectively.

Finally, Mr. Kilcoyne stresses the importance of adequacy and asks whether macro pricing is at odds with this goal. Consider that the macro pricing algorithm seeks, in all cases, to maximize profitability. The resulting price is the one expected to produce the greatest profit, with all other prices (higher or lower) creating a smaller expectation of profit. This seems quite congruous with the principle of adequacy. In fact, I would submit that the macro pricing algorithm is more likely to produce an "adequate" price than the more traditional approaches.

David Lee

Mr. Lee begins by building a case for considering the opportunity cost of marginal resources, rather than the cash cost. I agree with Mr. Lee's suggestion, but would like to propose an alternative, and perhaps more attainable, approach.

Mr. Lee is quite right in identifying opportunity cost as the economically relevant measure. However, if the opportunity cost for a resource differs from its cash cost, then the enterprise is well served to buy more of that resource. In fact, the enterprise should continue to buy more of the resource until the marginal benefit of the resource matches the marginal cost.

Rather than dealing with the current state of divergence between opportunity cost and cash cost, sound decisions can be made by pricing resources within the model at their marginal cost of procurement. This technique, although not perfect, seems more approachable than that of pricing opportunity costs for each factor of production.

Potential problems in the marketing compensation mechanism are described quite well by Mr. Lee. As he observes, it is important that the marketing goal negotiated during the macro pricing process become an integral part of future years' hurdles. A three-year goal forgotten after year one leads most definitely to suboptimal behavior. Faced with this circumstance, the astute actuary can assume patterns of production that decline after the first year.

Mr. Lee provides a good example of the application of the macro pricing algorithm to direct-response business. Further, I appreciate his observation that the concept is valuable at all levels of decision-making and need not be confined to the product-pricing process.

Frank Metz

I appreciate Mr. Metz's recognition that the macro pricing approach, with its bias towards improved financial performance, should improve the probability of an insurer remaining solvent. Many actuaries focus on the prescription for marginal expense assumptions, intuitively drawing this one aspect into the cost- plus paradigm, and assume that macro pricing results in more aggressive (that is, lower) prices. However, my experience in practice seems to contradict this supposition. I have found that those companies practicing the macro pricing approach have generally increased prices and enjoyed improved financial performance.

Harry Ploss

Mr. Ploss raises several notable points. Early in his discussion he recognizes that the cost of capital is a marginal expense in the macro pricing algorithm. This point must be clearly understood for successful application of the method.

Further, Mr. Ploss astutely states that "marginal costs can be high." The majority of actuaries, when first exposed to the concepts, assume that "marginal" means "small." On the contrary, a true marginal cost analysis, including displacement, may produce a marginal expense assumption that exceeds the traditional "full allocation." As a brief aside, many actuaries also assume that the macro pricing algorithm produces lower prices. In environments in which noncommodity products are sold with thin margins, the macro pricing algorithm will, as often as not, result in a price increase.

After appropriately defining the characteristics of commodity markets, Mr. Ploss states that "In existing commodity-type markets, conventional pricing works quite well." I find this statement particularly revealing.

It is quite true that a producer finds little latitude in price in overly elastic markets. Therefore, whether practicing macro pricing or the traditional approach, the resultant price is likely to be within the narrow range of market prices. However, the two algorithms would arrive at this answer in quite different ways.

The macro pricing algorithm would arrive at the market price scientifically and deliberately, while the traditional approach would arrive at this price only because the marketing department would veto the product until this result is achieved. As an additional observation, elastic markets warrant, not so much a determination of price, but a determination of whether a producer wishes to produce in this market. Here, the macro pricing algorithm is clearly superior, while the traditional approach is unarmed with respect to this important question.

A final observation by Mr. Ploss deals with the aspect of customer service. Mr. Ploss recognizes that various levels of service can be explored through macro pricing. This is an excellent point and should be explored as part of the macro pricing process. Service is simply another component of product "price."

Colin Ramsay

Dr. Ramsay raises four basic objections to the paper. Dr. Ramsay's first criticism deals with my definition of marginal cost. Dr. Ramsay states that the term "marginal" always means "the addition to the total due to the addition of the last unit." In contrast, I have defined the term marginal in relation to the decision set. This generalized definition provides useful guidance in the realm of financial analysis and in no way contradicts the use of the term in classical economics. Note that in a decision set composed of precisely these two elements (sell an additional unit; do not sell an additional unit), the generalized definition produces the same result. Further, I direct Dr. Ramsay to the rich field of "Austrian Economics" (typified by Rothbard). Sometimes referred to as "Market Process Economics," the Austrian School delves into the broader question of human interaction, in which a more general approach is warranted.

Dr. Ramsay then criticizes the macro pricing algorithm for producing suboptimal decisions "because it does not actually use the demand function." In actuality, the possibility that demand elasticity can actually be known does not exist. Therefore, *actual use of the demand function is not an element of the pricing actuary's decision set.* Rather, we must rely on the judgment of those who:

1. Are likely to possess the greatest level of tacit knowledge with respect to product demand elasticity, and
2. Can best be held accountable for the accuracy of their judgment.

In the macro pricing algorithm we utilize the judgment of the professional marketing personnel as best meeting the above criteria. In this way, the macro pricing algorithm produces decisions that are optimal over the range of options available to us in the real world.

Dr. Ramsay also states that "The actuarial analysis in the macro pricing algorithm is very subjective and lacking in conceptual complexity." It is true that the macro pricing algorithm is very subjective. However, it is unclear that this is a criticism. The paper is intended to provide a sound business application based upon economic reality. Business decision-making (as well as all decision-making) is profoundly subjective. Recall the second phase of decision-making: that of evaluating the expected consequences of choosing each element within the decision set (Section V). Such activity involves a necessarily subjective assessment of the possible future states of nature, and a further subjective evaluation of the effect on the decision-maker of each. The subjective nature of life is completely unavoidable and no more real to anyone than the entrepreneur making business decisions.

With respect to the bibliography, the references by Friedman, Rothbard, and Kirzner provide the reader with a firm grounding in Austrian economic theory, while the balance provide a partial survey of the actuarial literature with respect to product-pricing methods.

References

1. Hazlitt, H. *Economics in One Lesson.* New York, Norwalk, Conn.: Arlington House Publishers, 1946.
2. Rothbard, M.N. "Binary Intervention: Inflation and Business Cycles." Chap. 12 in *Man, Economy, and State: A Treatise on Economic Principles.* Los Angeles, Calif.: Nash Publishing, 1970.

End Notes

1. Throughout this paper, the term "price" is used to denote the bundle of characteristics that collectively determine both the cost structure to the consumer and the value to the retailer (generally an insurance agent). For insurance products, such items include commissions, cash values, policy loads and charges, interest rate credits and performance, death benefit structure, and so on.
2. Over the years, various economists have attempted to find exceptions to this rule. The possible existence of goods that violate this fundamental law of demand has been attributed to Sir Robert Giffen. Such "Giffen Goods" have never been conclusively identified.
3. Expenses can also be allocated per dollar of premium or per policy. However, the effect is still to allocate nonmarginal expenses in an arbitrary manner.
4. Microchips have been chosen arbitrarily for this example; however, the choice of goods is immaterial to the analysis.
5. The shape of the demand curve was chosen for illustration only.
6. Intangible costs may exist in many forms and be difficult to analyze financially. For example, an insurance company that reduces agent commission rates may face the intangible cost of worsening field force morale.
7. Naturally, a firm does have the ability to choose an aggregate profit level lower than that allowed by market forces. However, such a choice could not be maintained indefinitely, because the firm would find it difficult to attract and maintain capital.
8. The possibility of taking no action is an implicit element of many decision sets. However, this is not always the case. Note that the inclusion or exclusion of this element within the decision set is critical to the determination of marginal expense.
9. In reality, the marginal cost of accepting an additional passenger could include such items as the cost of an additional meal, the cost of processing the transaction, a slight amount of extra fuel, and so on. In addition, the airline may face less tangible marginal costs, such as passenger dissatisfaction with the possible departure delay.
10. Here, profit is used in the economic sense, ignoring the effect of various accounting biases.
11. In fact, not all expenses can be avoided even with the decision to dissolve the corporation. Many longer range commitments would survive the closing of the company.
12. This range of prices is wider than that normally analyzed in practice. However, the dramatic distinction in price shown here better illustrates the techniques involved.
13. Because in this example we have removed the variable of wholesale price, the sensitivity of demand with respect to price is a curve rather than a surface.
14. Or equally relevant, it might be the producers who promote the new product in place of the old.
15. Zero cost loan features allow the policyholder to borrow certain sums at a loan rate equal to the rate credited to the policy account value. Such features were popular at the time of this writing.
16. The range of production analyzed will be bounded by any existing structural limitations of the company. Production levels that are thought to be unattainable under any circumstances would not be taken into consideration.
17. There are conditions under which a directly non-economic project would logically continue. An example of this situation would include a "loss leader" product intended to penetrate a new market.
18. The political process referenced may not always be overt. The author has found many situations in practice in which the balance of power (and the wielding of such) is quite subtle.