THE PRICE-VOLUME-COST CYCLE: USING BASIC TOOLS OF ANALYSIS TO UNDERSTAND CURRENT MARKET PRACTICE

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ABSTRACT

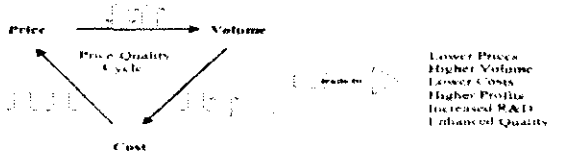
This paper extends the use of basic tools of analysis such as break-even and stay-even analysis in exploring current business practices. An example demonstrates how these tools are utilized to assist companies in revamping their cost structure, investing in R&D and managing the experience effect to better compete in a global environment that is biased toward lower cost and lower prices.

OVERVIEW OF ISSUES

A revolution has been under way over the last two decades in the way consumers shop, companies manufacturer, and marketers sell. The key is price. Consumers won't pay higher prices, retailers can't charge higher prices, and manufacturers have to cut costs to keep prices low. Manufacturers no longer automatically raise prices every year but slash operating costs by investing in research and development and technology to make their firms more efficient Dodds (2003).

The new way of doing business relies on basic tools of analysis that need to be reinvented in ways that they are applied. Break-even and stay-even analysis is moved beyond their customary role to track the price-quantity-cost-quality cycle shown in figure 1. This cycle, so prevalent in our global marketplace, places an emphasis on lower prices, better quality and increased profits. Companies cut price to pursue additional volume leading to lower costs to attain stronger and more profitable positions in the marketplace. These companies wisely invest their additional profits in R&D to further enhance quality and reduce costs, thus enhancing value for the consumer and strengthening prospects for long-term profitability.

FIGURE 1
The Price – Volume – Cost Cycle



QUALITY AND PRODUCTIVITY

Savvy marketers like Rubbermaid have anticipated the fundamental change in the marketplace by spending more on product development and on capital expenditures designed to improve quality and productivity. Rubbermaid slashed prices three times over three years and offset all three price cuts with improvements in productivity (Dodds 2003). Across a wide spectrum, companies that have managed to keep a tight rein on their prices have offset the resulting drag on profits by finding ways to improve productivity. Sara Lee's Hanes underwear division was able to cut costs and prices by bringing yarn production in-house, training workers to sew and package in teams, and switching to higher-tech sewing equipment (USA Today 1993).

COST AND PRODUCTIVITY

Break-even analysis is useful for evaluating alternative prices - especially when prices being considered are fairly realistic from a demand point of view. A realistic appraisal of the likelihood of achieving the break-even point associated with each alternative price might show that some prices are clearly unacceptable. Rather than pricing at an unacceptable level, companies look toward productivity gains to reduce costs.

Value engineering concentrates on improving the relationship between value to the customer. Managers at Ford use the equation value = function over cost) trying to provide a better quality car for less cost. The idea is to either enhance the function of the car part for the same cost or reduce the cost for that same function and achieve a higher value. The function of the part and the cost could also be lowered proportionately and achieve the same value for the customer, yet result in a lower priced product (Dodds 2003).

EXPERIENCE EFFECTS AND PRODUCTIVITY

The experience effect[1] is defined as a decline in costs by a certain percentage every time cumulative

[1] BCG consultant Bruce Henderson first described the Experience Curve Effects in 1960. Henderson found that there is a consistent relationship between the cost of production and the cumulative production quantity. Simply put it states that the more often a task is performed, the lower will be the cost of performing it. The

volume doubles. These cost reductions are not automatic, so management must seek ways to force down costs as volume expands. Production costs are most likely to go down, but all cost elements should be subject to management pressure. The sources of this cost reduction are found in three areas:

Learning.

- Assembling the product better over time
- Becoming more proficient in carrying out marketing strategy
- Improving design features and performance while at the same time reducing costs.

Technological improvement.

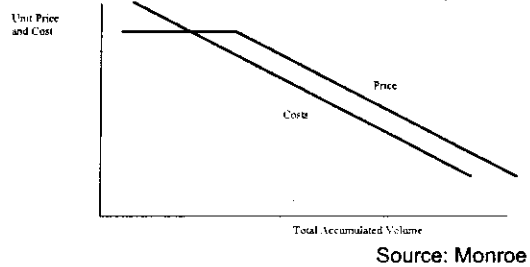
- Improving the manufacturing process
- Changing the resource mix of labor and capital
- Utilizing less costly material

Economies of scale

- Decreasing cost per unit decreases as production volume increases.

In the formative years of the computer chip industry, Texas Instruments (TI) was able to build a significant share of market by reducing prices to build volume. Indeed, they may have entered the market with a price that was below their costs. This strategy was justified by the forecast of a cost reduction in the experience curve as shown in figure 2. The outcome for TI was a significant market share consequently placing them in a position to gain substantial cost reductions. After a period of time, TI's price was above cost and they were then able to decrease price over time in accordance to the gain in cost reductions.

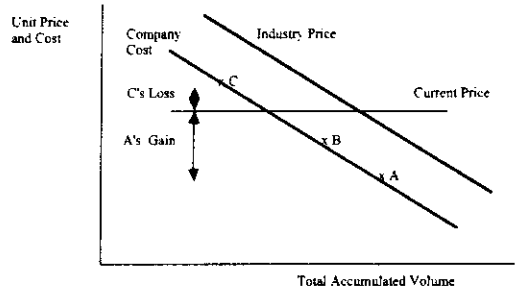
FIGURE 2 –
A Stable Price-Cost Relationship



Source: Monroe 1990

Competition will produce survivors who attain this cost reduction potential. Figure 3 illustrates the profitability advantages of the experience curve. If cost per unit decreases predictably with cumulative output, then the largest competitor (Company A) in the market place has the potential for the lowest unit cost and highest profits. Smaller companies (Company B) must continue to grow at least as fast as the leading competitor and pursue cost reductions effectively. Otherwise, profits will dwindle and eventually vanish. The dominant position is best seized early when the experience effect doubles quickly. Gains in experience curves are most easily achieved in fast growing markets by capturing a disproportionate share of sales. Company C has lost out in the competition and will probably leave the industry.

FIGURE 3
Profitability Advantages of the Experience Effect



Source: Monroe 1990

In recent times, research and development has spawned huge advances in productivity so as to dramatically reduce the price for computers and other technology products while providing tremendous increases in quality. Table 1 illustrates these advances. Over the past 20 years, price has decreased by 71.2% while quality in terms of processing speed and hard drive capacity has increased by 27,153% and 124,999% respectively. These are pretty astounding numbers! Put in another context, the price per MHz of processing speed has gone from $691 to $0.73 while the price per KB on hard drive space has decreased from $20.65 to $0.00005.

TABLE 1
Technology's Effect on the Price – Quality Relationship

Year	Brand	Processor	Hard Drive	Price
1981	IBM PC	4.77 MHz	160 KB	$3,300
1991	Compaq 486	33 MHz	120 MB	$2,300
2001	Dell Dimension	1.3 GHz	20 GB	$950

Data: Business Week

While the computer industry may be a leader in redefining the price-quality relationship, any industry must believe that there is potential to reduce price while simultaneously increasing quality. When a firm can do what the computer industry has done to reduce costs without decreasing product/service quality or enhance quality without significantly increasing costs, then the firm has pursued strategies that enhance value for the consumer. Active management of costs and productivity produces a potential for better quality and lower prices for the consumer while solidifying a strong base for long-term profitability.

subject is treated as common knowledge in most business texts today.

A TEACHING PROBLEM

The Animas Manufacturing Company (AMC) introduced the Itsy Bitsy Stereo Receiver with its incredibly small size but tremendous sound quality into the market one year ago. AMC sells directly to large electronics retail outlets such as Best Buy and Circuit City. The current retail price is $289. Retailers take a 25% markup based on retail. Cost information follows:

Variable costs		Fixed costs	
Material	$98.40	Overhead	$5,260,000
Labor	24.10	Administrative	1,430,000
Supplies	2.17	Advertising	1,250,000
Misc. mfg costs	7.84	Sales	300,000
Commissions (10%)	21.68		$8,240,000
	$154.19		

Unit sales: 158,500

AMC is ready to launch the "second generation" model that is the same size but a tremendous sound quality made even better. Executives of AMC searched for ways to increase quality and reduce production costs in order to remain competitive in world markets. Increasingly they substituted robots, automation, and computer-controlled manufacturing systems for workers. Quality improvements were found through acquisition of new equipment that is reflected in a $200,000 increase in factory overhead and $150,000 invested in research and development. The following variable costs savings were gained in manufacturing experience:

Material	$24.40
Labor	9.30
Supplies	.98
Misc. mfg costs	3.58
	$38.26

AMC plans to drop the retail price by $30 while still offering their sales people the same dollar commission of $21.68 per unit sold. They will also support the retailers with a $10.00 allowance for cooperative advertising on each unit. National advertising was increased by $250,000 and an additional salesperson was added at a salary of $30,000.

As a starting point, the lead manager for this project wants to compare the break-even points for the first and second-generation receivers as well as the stay-even point for the second-generation receiver?

The Typical Analysis

Break-Even Analysis. Operating leverage is a financial concept closely akin to breakeven analysis. Operating leverage refers to the extent to which fixed costs and variable costs are used in the production and marketing of products and services. Firms that have high total fixed costs relative to total variable costs are defined as having high operating leverage. The higher a firm's operating leverage, the faster its total profits will increase once sales exceed break-even volume (Kerin and Peterson 2004).

To understand the implications of AMC's investment to move towards a higher operating leverage, consider the situation:

	Low Leveraged Situation 1st Generation	High Leveraged Situation 2nd Generation
Price (P)	$216.75[2]/unit	$194.25[3]/ unit
Variable Cost (VC)	$154.19	$125.93
Fixed Costs (FC)	$8,240,000	$8,870,000
BEQ[4]	131,714[5] units	129,830[6] units

While the high leveraged situation has more fixed costs, its lower break-even quantity provides a cushion if annual sales fall within the range of 129,830 to 131,714 units. For example, if demand is 129,950 units, the high leveraged situation will provide a profit while the low leveraged situation will not. But what about profit potential if sales exceed 131,714 units? 150,000 units? 200,000 units? Profits in the high leverage situation will increase at a faster rate than the low leveraged situation.

Stay-Even Analysis. When price changes are being considered, there is an expectation that demand will also change. If a price decrease is considered, the logical question becomes "how much must volume increase before a more profitable situation is attained?" When considering price and cost changes simultaneously, the problem becomes even more interesting.

Using the profit function [Profit = (Price - Variable costs) * Quantity - Fixed Costs] the "stay-even" profit position can be described as:

$$\underline{\text{Current Situation}} = \underline{\text{Proposed Situation}}$$
$$(P_1\text{-}VC_1)*Q_1\text{-}FC_1 = (P_2\text{-}VC_2)*Q_2\text{-}FC_2$$

Consequently, the stay even quantity would be Q_2, derived by solving for Q_2 in the equation above.

$$(SE)Q_2 = \frac{(P_1\text{-}VC_1)*Q_1\text{-}FC_1+FC_2}{P_2\text{-}VC_2}$$

[2] A $289 price at retail where the retailer takes a 25% markup would necessitate a manufacturer's price of $216.75. ($289)*(1-.25) = $216.75

[3] ($289-$30)*(1-.25) = $194.25

[4] Break Even Quantity = FC/(P-VC)

[5] $8,240,000/ ($216.75 -$154.19)

[6] $8,870,000 / ($194.25 -$125.93)

AMC is considering a price decrease of $22.50 coupled with increased leverage where decreased variable costs is traded-off against an increase in fixed costs. The crucial question for AMC is whether they will be able to maintain or increase profit. At what point does increased profitability occur? In the 1st year, the firm enjoyed a profit of $1,675,760. SEQ indicates how many units will have to sold at $194.25 (10.38% price decrease) to maintain this profit?

$$SEQ = \frac{(216.75-154.19)*158,500-8,240,000+8,870,000}{(194.25-125.93)}$$
$$= 154,358 \text{ units}$$

The "new" costs in year 2 leads to a situation where volume could actually decrease to 154,358 units and still reach year 1 profit of $1,675,760. If AMC had not restructured their costs, then the 10.38% decrease in price would necessitate an increase in demand to 247,523 units, an increase of 56.2% to reach year 1 profits. This determination will help immensely in understanding whether or not to change price and the ability of the competitor to match that change.

An Enhanced Analysis

A firm's ability to understand the price-quality-value relationship is key to reaching long-term organizational objectives such as profitability through strong customer loyalty. This loyalty is a result of strong value in the company's offering.

When AMC introduced its first generation receiver at $216.75, it might only be perceived as a fair value at that price. The financial structure looked like this:

Volume	158,500 units
Price per unit	$216.75
Cost per unit	154.19
Contribution margin per unit	62.56
Contribution margin %	28.9%
BEQ = 131,714 units	
Total contribution margin:	$9,915,760
Less fixed costs	8,240,000
Profit contribution	$1,675,760

However, if AMC pursues the strategies of cost, productivity and value management, they might find a better position in the eyes of the customer and in their bottom line. AMC's strategy plays out, as shown in figure 1, like this:

- Cutting price increases volume.
- Increasing volume hastens the reduction of cost through the experience effect.
- Reducing costs spur further lowering of price that will increase demand.

This process adds to profits that makes more money available for research and development which leads to higher levels of quality and/or lower costs. AMC is managing the price, volume, cost cycle so as to compete successfully in the "super deal" market with high volume and high quality at a low price. If demand in year 2 was 186,690 units, then the financial structure looks like this:

Volume	186,690 units
Price per unit	$194.25
Cost per unit	125.93[7]
Contribution margin per unit	$68.32
Contribution margin %	28.9%
BEQ = 129,830 units	
SEQ = 154,358 units	
Total contribution margin:	$12,754,660
Less fixed costs	8,870,000
Profit contribution	$3,884,660

AMC's strategy lowered their BEQ from 131,714 units to 129,830 units, while having a SEQ of 154,358 units which is below the 1st generation's demand of 158,500 units. AMC developed an advantageous scenario for price-cutting. As the price, volume and cost cycle continues, AMC might use a portion of their increased profits in R&D to spur further quality gains while investing in equipment to shift cost structure in gaining leverage in producing the third generation receiver. A future scenario for this receiver might be where the financial structure is:

Volume	204,000 units
Price per unit	$176.50
Cost per unit	103.75
Contribution margin per unit	$72.75
Contribution margin %	41.2%
BEQ = 126,460 units	
SEQ = 179,858 units	
Total contribution margin:	$14,841,000
Less fixed costs	9,200,000
Profit contribution	$5,641,000

Again, as the price, volume and cost cycle revolves, AMC is finding lower breakeven points and profit goals to meet the previous generation's profit. To complete the scenario, the additional profit would be used to continue the cycle of lowering the price further, investing in R&D and further modernization of the manufacturing process.

REFERENCES

-Available upon request

[7] The new variable cost of $125.93 is computed as $154.19 - $38.26 + $10.