Estimating Brand Level Price Elasticities for the Margarine Industry: A Two-Stage Budget Approach

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ESTIMATING BRAND LEVEL PRICE ELASTICITIES FOR THE MARGARINE INDUSTRY: A TWO-STAGE BUDGET APPROACH

A Thesis Presented

by

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Submitted to the Graduate School of the

University of Massachusetts Amherst in partial fulfillment

of the requirements for the degree of

MASTER OF SCIENCE

September 1997

Resource Economics

ACKNOWLEDGEMENTS

While this thesis took longer than most to finish it would have never been completed with out the help and support of Professor Richard Rogers. Rich allowed me to explore on my own and knew when to pull me in when ever I began to get in over my head. I also thank my committee members Dr. Julie Caswell and Dr. Bernard J. Morzuch for their much needed expertise. Dr. Ron Cotterill provided me with a thorough background in Industrial Organization and was of immeasurable help to me in understanding how to estimate brand level elasticities. Thanks must also go to Dr. Kellie Raper for reviewing the later drafts of the thesis.

I thank the outstanding graduate faculty at Draper, who gave me a solid grounding in economic theory and econometrics, and my classmates, especially Michelle, Tracy, and Tiho who offered support and suggestions.

Finally I must thank Heather Greene for being patient with me while I complained about and dragged out the writing of this thesis.

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CHAPTER I

INTRODUCTION

The congressional elections of 1994 rocked Washington and the country with the ousting of the Democratic party's long-standing control of the Congress. Less than two years later radical welfare reductions were signed into law by the democratic president. The reemergence of conservative ideology has brought calls for the slashing of government programs and a renewed zeal for the free market. This enthusiasm for the market mechanism rests on the *belief* that unfettered economic exchange will yield the most efficient allocation of resources to society. This belief is based on the implicit assumption that markets tend to be competitive in the absence of governmental intervention. Given the growing demand to limit the government's direct intervention in matters of the economy, it is imperative to know if and when markets are competitive.

The solution to this question has been at the root of industrial organization since the 1950's with the early empirical work of economist Joe Bain. It is now over forty years later and there is still a lack of a definitive answer to this fundamental query. It is not from lack of effort - hundreds of theoretical and empirical papers have been published on this topic. Why the answer should be so elusive stems largely from two basic limitations to economic inquiry:

1) Explicit and implicit political values influencing research.

2) The difficulty in applying the experimental design to economic questions.

The two are related of course, but each plays its own role in preventing economists - and society - from reaching definitive conclusions to economic problems.

This paper is not a discourse on the subjective (political) nature of economic analysis, but it is important to briefly touch upon the political ramifications inherent in conclusions about market performance. Conservative economists tend to produce theory and research that show that the US economy is largely comprised of competitive industries. These results provide the bases for arguments that government intervention in the form of regulations and anti-trust litigation is unnecessary and even damaging to the economy.

Far from being destructive, liberal economists tend to view government intervention as an important component in ensuring the efficient operation of the economy. Liberal economists often reach the conclusion that concentrated industries are uncompetitive - supporting regulation policies and anti-trust action. Of course, in economics there are more than these two general views but much of industrial organization can be viewed as a struggle between the Conservative-Liberal dichotomy. Harold Demsetz clearly saw the role of ideology when he cautioned "believing is seeing." (Scherer and Ross 1990, p.447)

While the root of conflict within industrial organization tends to be political, the explicit focus of scholarly writings tends to be on methodological issues. The variety of arguments over the correct approach to test market competitiveness - the absence of market power - is a reflection of the difficulty in applying the scientific paradigm to economics. The sheer number of potential economic relationships and the possibility that all economic objects are overdermined - both the causes and effects of every other object

- renders a true controlled experiment a virtual impossibility for the economist (Wolf and Resnick, 1987 p. 20).

That said, it should also be pointed out that the degree to which empirical economics strays from the ideal is diminishing. With progress in computational ability and improvements in data collection, economic analysis is becoming increasingly focused. Assertions of overdeterminism aside, as technology improves our ability to capture and analyze information, results from empirical economic research will become much more robust.

An example of resent advances in data collection is the use of computer scanners at supermarket checkout lines. Information about each product is stored on a bar code printed on a product's package. The bar card is read by the checkout scanner at the point of purchase. This information is then captured and saved in a computer database. The result is a database that has a wealth of information about the sale of branded products - including price, size, and some marketing information - over time and across markets.

This type of data -unheard of only a few years ago- provides the opportunity to apply theoretically defined empirical demand models to the study of competition. In the past such models were difficult to apply due to severe data limitations. It is now possible to estimate the demand conditions for branded products within specific industries where this data is collected.

Demand conditions are the changes in consumer purchases due to price and marketing changes made by firms. Consumers' reactions to market changes are often measured as elasticities – a percent change in demand due to a percent change in price or

marketing variables. For example, a percent change in price will correspond to a certain percentage change in quantity demanded. The demand elasticity for a given firm's product depends in part on the market structure of the industry.

The market structure of an industry can take several forms. The major market types are listed below in Table 1. Market structure in this schema is determined by both the number of competitors and the existence of product differentiation.

Table 1

Principal Seller's Market Structure Types

	Number of Sellers		
	One	A Few	Many
Products			
Homogeneous	Pure monopoly	Homogeneous oligopoly	Pure competition
Differentiated	Pure multiproduct monopoly	Differentiated oligopoly	Monopolistic competition

Source: Scherer and Ross, 1990

In general economists agree to theory pertaining to monopoly and pure competition. It is difficult, however, to find the exact demarcation between oligopolistic and competitive markets.

> "The key to the distinction is subjective - whether or not the sellers consider themselves conscious rivals ... . If the sellers are sufficiently few in number to have each believe (a) that its economic fortunes are perceptibly influenced by the market actions of other individual firms, and

(b) that those firms are in turn affected significantly by its own actions, then the market can be said to be oligopolistic". (Scherer and Ross, 1990. p.17)

The propensity for this awareness increases as the number of firms in the market decreases.

According to Scherer and Ross: "Pure monopolists, oligopolists, and monopolistic competitors share a common characteristic: each recognizes that its output decisions have a perceptible influence on price . . . . All three types possess . . . *market power* [1]." (Scherer and Ross, 1990 p.17) Firms that leverage market power extract profits by pricing above marginal costs. Market power can be neutralized, however, if entry in and out of the market by new firms is free and frictionless.

Pricing strategies that raise price above marginal cost can only be maintained if entry of new firms is restricted. Barriers to entry prevent the self-correcting mechanism of increased competition from forcing prices back to cost levels. A monopoly that does not enjoy this form of protection will not realize profit because any positive difference between price and cost will be immediately eliminated due to instantaneous entry by competitors. However, such instantanious entry is limited in real markets but the extent of barriers to entry has become a central element of market structure.

The complexity of market models incorporating strategic behavior has stymied economists seeking a simple and clear theory for markets with few firms. There are two primary approaches to carrying out market power analysis. The first is to study several

[1] italicized in original

industries at once to see if general results hold across industries. These studies tend to be structural profit studies, where profit is regressed on some combination of concentration and market share. The second is the case study approach which analyzes a single industry for market power. Although a more detailed discussion of the different approaches is found in chapter two, this thesis uses the case study approach to estimate brand-level price elasticities in the margarine industry.

The primary objectives of this paper are:

1) to apply newly available retail data to estimate brand level elasticities

2) to test for market power in the form of differentiation for the margarine industry.

Until recently elasticities have been estimated only at the industry level. This has provided economists with aggregate measures of demand useful in comparing different industries but not very useful at comparing brands within an industry. If the brand level price elasticities are small in absolute value (less than 100) than the products are differentiated from one another. Product differentiation creates market power.

The estimated price elasticities for individual brands of margarine will be used to determine if margarine is differentiated and therefore not perfectly competitive. The margarine industry was chosen because of the availability of scanner data needed for the detailed estimations and unlike its complement product, butter, margarine has achieved a degree of product differentiation despite a minimal degree of physical differentiation among brands.

Even before estimating elasticities the possible market structures (in Table 1) for margarine can be reduced. In 1992 there were no less than 103 margarine brands produced by 47 different manufactures, thus Monopoly, both pure and multi-product, is ruled out. A four firm concentration ratio of 80%,and an advertising sales ratio of 4.3 % suggests a differentiated oligopoly.

To complicate matters many manufactures sold more than one brand. In 1992

> "the average number of brands sold by a manufacturer was 2.14 brands, it varied from 24 brands by Unilever to just one brand per firm. Philip Morris marketed the next highest number of brands with nine; followed by Borden Inc. with six; Nabisco with four; and Dean Foods, Sunnyland, PVO INTL., Miami Margarine, CPC International and Osceola Foods each with three. Ten manufacturers marketed two brands and the rest had one brand each. Although the majority of the manufacturers marketed more than a single brand only the top five market more than three brands." (Andonov 1995, pp 17-18)

It was noted that margarine tends to be similar across brands. It might be expected that each brand is an almost perfect substitute - consumers view brands as equivalent- for any other brand. If this were true we would expect to see one price for all brands -equal goods should sell at equal prices. A look at margarine prices for 1992 in Table 2 suggests that - product similarities aside - margarine brands are not perfect substitutes, although here we do not control for the location of the retail market.

Table 2

Frequency Distribution of the Price per Pound of Branded Margarine

for the 6205 Observations, 1992[2]

Margarine Prices in Dollars	Frequency
less than 0.30	6
0.30 - 0.44	237
0.45 - 0.59	755
0.60 - 0.74	1007
0.75 - 0.89	917
0.90 - 1.04	715
1.05 - 1.19	605
1.20 - 1.34	694
1.35 - 1.49	656
1.50 - 1.64	385
1.65 - 1.79	168
1.80 - 1.94	44
greater than 1.94	16

Source: (Andonov, 1995)

Table 2 is made up of margarine prices taken from 65 regional markets over the four quarters of 1992. Prices for the most expensive margarine in Table 2 are over six times that of the lowest priced brands. The large price differences and the existence of multi-brand firms strongly suggest that the margarine industry is differentiated.

[2]All brands in the 65 markets and all four quarters of 1992 are included here.

This thesis will test if the margarine industry is differentiated by directly estimating the own and cross-price elasticities of demand of the major national brands. It is expected, given the range of prices, that different margarine brands are not perfect substitutes - resulting in relatively low own price elasticities. Relationships between the brands will be reflected in the cross-price elasticities. The size of the cross-price elasticities indicate the degree of substitutability between brands - the larger the cross-price elasticity the greater the substitutability.

A first order differential demand model is used as the functional form for the elasticity estimation. The differential model has the benefit of being less complex than empirical demand models more consistent with utility theory, such as the Almost Ideal Demand System (AIDS). In addition, the differential demand model is consistent with utility theory if consumers' utility functions are of the Gorman form. This will be discussed in detail in chapter three.

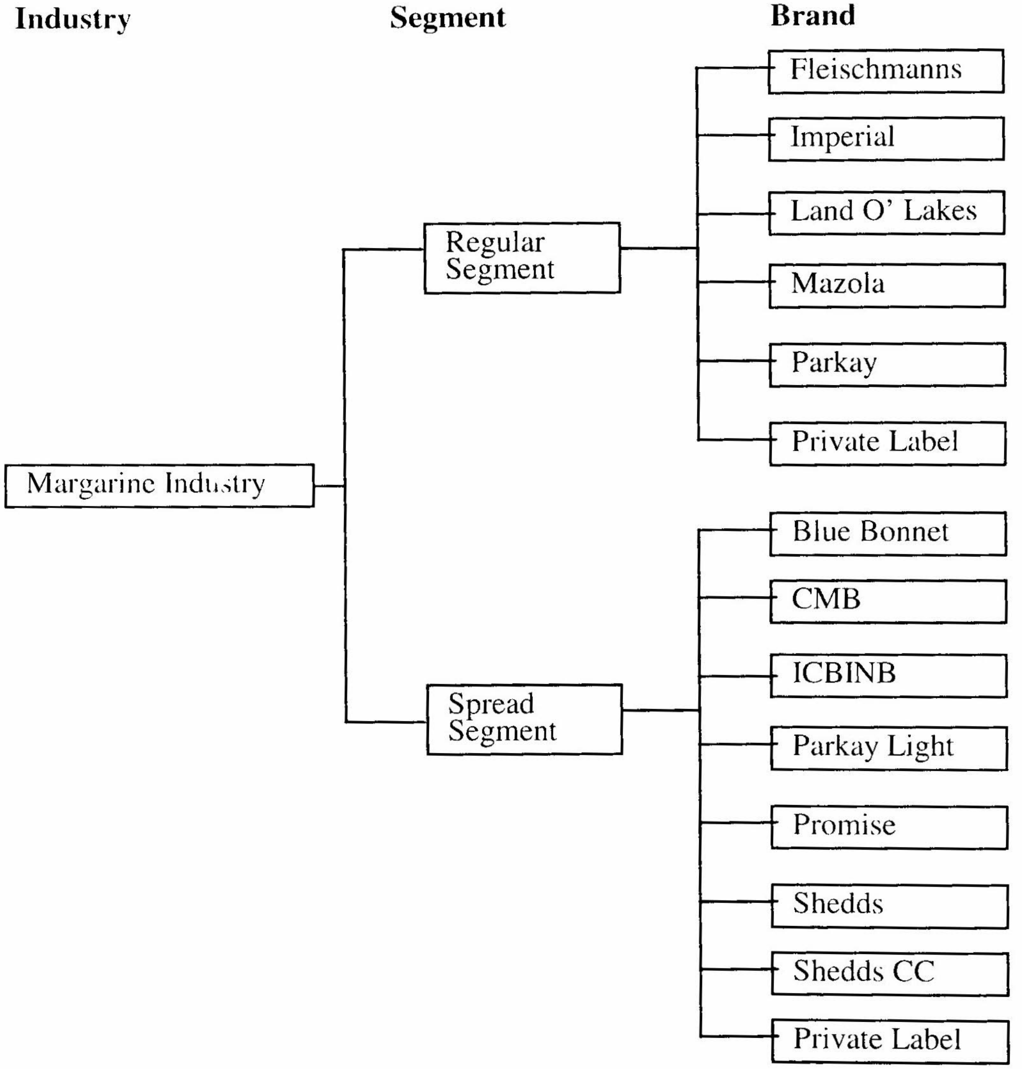
The empirical work in this thesis uses a two stage-budgeting model for the theoretical framework. Consumers are assumed to initially allocate expenditures to broad product categories. Products are then chosen based on the prices of only the products within each broad product group.

Margarine is divided into two product groups, regular margarine and spread. There are six brands in the regular category and eight in the spread category. The elasticities of each brand are estimated as a system for each category, i.e., the regular and spread brands are estimated as two separate systems. The next stage estimates the elasticities for the regular and spread product groups. Using two regression equations,

representing the aggregate demand for regular and spread margarine. The final stage is a demand equation for all margarine. Figure 1 helps visualize the nested allocation process of the two-stage budget system. These stages are represented in the margarine utility tree starting with the industry level at the left and moving to the brand level at the right of the figure.

Figure 1

Utility Tree For the Margarine Industry



The next chapter is a review of the industrial organization literature. Chapter Three focuses on the theory used to specify the empirical model used in this thesis. Chapter Four reviews the objectives of the study, discusses the data sources and presents some descriptive statistics. Chapter Five reports the empirical results of the analysis. Finally, Chapter Six presents the conclusions.

CHAPTER II

LITERATURE REVIEW

The industrial organization literature is extensive, particularly for the past forty years. The early work comprised mostly structure-conduct-performance studies. These studies examined and tested the relationship between market structure and profit rate. Economists believed that higher industry concentration (few suppliers) facilitated market collusion, which in turn lead to higheer industry profits.

To test this hypothesis, a measure of concentration is regressed on industry profit, along with several other variables. A positive, and statistically significant, coefficient for the concentration measure is interpreted as evidence that profit increased with industry concentration. For over twenty years tests of this sort predominantly found a positive concentration-profit relationship existed, although counter-arguments were made that either the studies were flawed or the interpretation was wrong.

More recently, economists have been concerned with the structure-performance studies lack of theoretical grounding. Alternative tests of market power have been derived that are anchored to economic theory by directly estimating market power through rigorously specified empirical models. This direct approach is known as the new empirical industrial organization (NEIO).

While the NEIO has made significant inroads, it has yet to be enthusiastically embraced by practitioners of the traditional methods. Direct estimation of market power

often requires unrealistic assumptions of market conditions[3], as well the imposition of arbitrary functional forms. While economists disagree about methodology, the question they seek to answer is the same - are markets operating efficiently?

Economists look to perfect competition for the benchmark for efficiency. The measure of efficiency used by economists is Pareto efficiency. An allocation is Pareto efficient if there is no possible change to an allocation such that an individual or set of individuals is made better off without injuring others. The results of the first welfare theorem indicate that perfectly competitive markets will be Pareto efficient. It follows then, that the benchmark for market efficiency is perfect competition.

Competitive Performance

The neoclassical model of a perfectly competitive market consists of many individual buyers purchasing a homogeneous good or service from many suppliers. The buyers, each competing with his or her fellow buyer, will tend to bid up the price of the good. Simultaneously, the suppliers compete with one another to sell and will tend to bid the price down. With many equal sized suppliers, the competition to sell is so fierce that price is driven down to the cost of producing the good. It is not without some irony that each group's objective, low price for buyers and high price for suppliers, is sabotaged by each individual pursuing his or her self interest.

This interaction between buyers and sellers is the standard supply and demand taught in introductory economics courses. Market price is determined when market

[3] For example many studies have used a Gormon polar form of the cost function, which leads to equal marginal costs across firms.

supply equals market demand where market supply and demand are the sums of individual supply and demand curves respectively. The individual suppliers, or firms, are motivated by profit defined as total revenue minus total cost. Total revenue (TR) is market price multiplied by the quantity sold. Total cost (TC) is determined by multiplying the quantity sold by the average total cost (ATC) and then adding the fixed cost of production. Firms seeking maximum profit, will produce up to the point that the marginal cost of production equals the marginal revenue. More formally, the objective function of a profit maximizing firm is :

$$(1) \qquad \max \; P \bullet q_i - C(q_i) \quad i = 1,\ldots,n$$

$P \bullet q_i$ is the total revenue (TR) firm i receives for selling amount q_i. C (TC) is the cost function firms face when producing. In this simplified model all cost functions are the same for each firm. Additionally, price is also the same across firms so that P is a market price.

The first order condition is :

$$(2) \qquad P = c'.$$

At the optimal profit level marginal revenue equals market price (P) and therefore price equals marginal cost (c').

Interdependence

Industrial organization tests the assumption that markets are characterized by perfect competition. Often industries are dominated by a few large firms (oligopolies)

with several fringe firms. The traditional structure-conduct-performance empirical models use the basic industrial organization paradigm as a guide for research.

This paradigm asserts that in actual markets firms can capitalize by realizing their interdependence. If the number of firms is low, the potential exists for individual firms to stem supply without rivals stepping in to offset the restriction. The oligopoly restricts supply to raise market price, which leads to profit. This is a shift from the static first order condition of equation (2) to dynamic behavior of strategic decision making.

Inter-industry interdependence is modeled in the profit maximizing conditions by writing price as a function of market quantity. If there are N homogeneous firms then the i^{th} firm's optimization problem is:

(3) $$\max\ P(Q)\bullet q_i - C_i\bullet(q_i)$$

Where the first order condition is:

(4) $$P + (\partial P/\partial Q)\bullet(\partial Q/\partial q_i)\bullet q_i = C_i^{'}$$

which can be rewritten as

(5) $$P + P(\partial P/\partial Q)(Q/P)(1 + \lambda)S_i = C_i^{'}$$

reorganizing to get the equality

(6) $$\frac{(P - C_i)}{P} = \frac{S_i\bullet(1+\lambda)}{\varepsilon}$$

where

S_i = firm i's share of the market

ε = price elasticity of demand

P = market price

C_i' = marginal cost for the i^{th} firm

Q = total industry quantity

q_i = firm i's output.

λ = conjectural variation

The left-hand side of equation (6) is known as both the price-cost margin and the Lerner index. The index is a unit free measure of a firm's profits bounded between zero and one; the former indicating normal profit. As price exceeds marginal cost, profits are higher. The conjectural variation (λ) is how firm i believes firm j will respond to a change in i's production[4]. Often λ is assumed to be zero, mostly for simplicity, because there is no easy way to predict firms' reactions to rivals' output decisions.

The relationship suggested by (6) is the crux of structure-conduct-performance studies. In (6) we see that profitability is a function of both demand conditions (ε) and market structure (S_i and λ). In the case of monopoly, S_i is equal to one. In perfect competition S_i is equal to zero because a firm's market share approaches zero as the number of firms increases. When S_i is zero the Lerner index is also zero - price equals marginal cost.

Equation (6) shows that an industry's structure, or concentration, will affect the market price. Although causation is not clear in equilibrium conditions, it is traditionally

[4]This is assumes a Cournot case. In a Bertrand example the conjecture is in prices.

hypothesized that an increase in industry concentration will lead to market power and cause price to exceed marginal cost. Models that test the concentration-market power relationship need to have appropriate measures for industry concentration.

Concentration Measures

There are several statistical measures of industry concentration. The best measure depends on the availability of data and the specific use. Good measures reflect major structural changes over time, reveal differences in structural power within distinct markets and firms, and accurately predict market performance (Greer, 1992).

In an industry with many firms, a single firm may be supplying most of the market, and hence have a high market share. A firm with high market share may exercise market power even in an industry with many firms. A useful concentration measure, therefore, needs to account for size differences of the firms.

For example, the concentration ratio (CR-N, where N is the number of firms used in the numerator) attempts to account for both the absolute number of firms and their size distribution. The CR-N is calculated by finding "the percentage of total market sales accounted for by a given number of leading firms (Greer, 1992)." A four-firm concentration ratio (CR4) would be the percent of an industry's market share held by the top four firms. Besides providing a meaningful reflection of the size distribution, the concentration ratio is also easy to understand (Greer, 1992).

The concentration ratio is useful but limited as a measure of industry structure. The concentration ratio does not capture the entire size distribution for all firms. This adds to the difficulty in comparing the level of concentration between industries. While

one industry may have a higher CR4, it is possible that another industry has a higher CR2 or CR8.

The concentration ratio also lacks information about the relative size of individual firms in the top category. Even if a particular CR4 measure were superior to other concentration ratios, it would still lack information about size distributions of those four firms. Other indexes have been developed to allow for both size and number of firms.

One frequently used is the Herfindahl-Hirschman (H) index. It is derived by summing the squares of firm size, where firm size is represented as the percentage of industry sales. More formally:

(7) $$H = \Sigma(s_i)^2 \quad (i = 1,2,3,\ldots,n)$$

Where s_i is firm *i* 's percent of market share and *n* is the total number of firms in the industry. In a monopoly s_i equals 100 percent, the H index is one hundred squared, or 10,000. If the industry is perfectly competitive, s_i and H approaches zero as no individual firm has any discernible market share. (Greer, 1992) If all firms are of equal size then H=1/N.

The H index is widely used because it reflects the effects of both firm size and the number of firms in the market. By squaring the market share, the impact of larger firms is given greater weight than smaller firms. However, the H index is not necessarily better than the concentration ratio. The choice of the concentration measure is debatable and dependent upon the given problem. Fortunately, few empirical studies seem sensitive to the choice of either H or the CR4.

Price-cost Margin

Early research tended to avoid using market price as a dependent variable for various reasons. The early work was cross-sectional, which would require the comparison of prices between diverse industries. To avoid the problems of comparing apple prices to those of jet engines, researchers have typically used profitability instead of price as the dependent variable.

The industry price-cost margin is a frequent measure of an industry's profitability; it can be derived from equation (6). Rewriting (6) into an industry's price cost margin form:

$$(P - \overline{MC})/P = \frac{H}{\varepsilon}. \tag{8}$$

Here MC is the industry's weighted average of firms' marginal costs. The variable H is the Herfindahl-Hirschman concentration index from equation (7) (Scherer and Ross, 1990 p.200). The left-hand side of equation (8) is the industry's price-cost margin (PCM). The more concentrated the industry, the higher H and in turn the higher the PCM. The PCM, therefore, is a positive function of the industry's concentration (H).

A market power explanation for this positive relationship is that firms in industries with high concentration can collude, or follow a dominant firm, ensuring higher profits (Clarke, Davies, and Waterson, 1984). This argument is presented by Schmalensee as the Differential Collusion Hypothesis (DCH):

> "Industries differ in the effectiveness with which sellers are able to limit competition by tacit or explicit collusion. Collusion is more likely to be effective, and profitability is more likely to be above competitive levels, the higher the seller concentration (Schmalensee, 1987)."

Through collusion (explicit or tacit) oligopolistic firms exercise market power by raising price. By increasing price, the collusive firms can extract economic profits as market price rises above ATC. This has led researchers to examine the effect of industry concentration on profits.

Profit and Concentration

The early empirical work testing the concentration-performance hypotheses was mainly the work of Bain and his followers. Bain found that the average profit rate was significantly larger in manufacturing industries with eight-firm concentration ratios (CR8) of 70 or greater compared to industries with a CR8 below that level. Bain also found that the concentration ratio is positively related to industry profitability. Since then there have been hundreds of studies that have yielded similar conclusions (Scherer and Ross, 1990 p. 411). Pelzman was so impressed by the accumulated evidence that he concluded in 1977 that "[w]ith few exceptions, market concentration and industry profitability are positively correlated (Clarke, Davis, and Waterson, 1984)."

Recent studies have shown that these previous results may have been spurious. This was caused by aggregating "a positive relationship between sellers' market shares and profitability to the industry level." (Scherer and Ross, 1990 p.411) Instead of concentration leading to higher profits, it is the larger market share that affects profits. To account for this, studies started to look at firms' market shares as a cause of positive economic profits. This refinement was not possible earlier due the lack of detailed firm data.

Profit and Market Share

The availability of detailed business line data has enabled researchers to confirm the importance of market share. The Federal Trade Commission's Line of Business program is one example of a data set that provided disaggregated data at the business level. Using this data set, studies have found that when holding market share constant, concentration (CR4) , in general, does not have a positive effect on profits. Concentration has even been found to have a negative effect on profitability when market share was also included in the model (Ravenscraft, 1983).

Further evidence is found in Montgomery's study of product-market diversification. Montgomery (1985) included several explanatory variables in her model, including market share, concentration, and a returns-on-invested-capital variable (a measure of a firm's profitability). In criticizing the theory that diversified firms attain higher profits, she provides results that support the market share argument of market power. Specifically, market share had a significant and positive estimated coefficient, whereas the estimated coefficient of CR4 was not significant. (Montgomery, 1985)

Because of the varied results found in studies of market share's effects on profit, Szymanski, Bharadwaj, and Varadarajan (1993) performed a meta-analysis on over seventy such studies. They found that, on average, market share is positively correlated with business profitability. However they caution that the relationship is moderated by specification errors, sample characteristics, and measurement characteristics.

Although market share appears positively correlated with profits, the magnitude of the effect may be less than originally thought. It had been assumed that a one-percent

change in market share led to a half-percent change in profits. However, changes in profit may be closer to a one-tenth percent change for a one-percent change in market share (Aaker and Jacobson, 1985). Further work is needed to reach general conclusions, if any exist, regarding the actual magnitude of the relationship.

Profit, Concentration, and Market Share

It is possible that both concentration and market share can have a positive effect on profits. While concentration increases the industry's price level, i.e., all firms receive higher profits, high firm market share allows firms to receive higher individual profits. Concentrated industries would have higher profit levels than non-concentrated industries, and high market share firms would have higher profits than low market share firms. This has been supported by several studies including Ravenscraft (1983). In the Ravenscraft study, both market share (which should capture the greater efficiency or "luck" of leading firms) and industry concentration (a proxy for the potential to collude) had a positive and significant effect on profits (Connor, et al., 1985). Many researchers (for a review see Connor, et al.) combine measures of CR4 and market share to create a relative firm market share variable. This variable captures both the contributions of CR4 and market share without the multi-collinearity problems of using the two correlated measures.

Rents

Much of this work has been used to provide clues as to the existence and degree of market power within an industry. Profit can increase, however, without price increases caused by market power. The left-hand side of equation (5), (P-MC)/P, is made up of

both price and marginal cost. It is possible that prices increase, which would support the claims of market power, or that MC has decreased, suggesting an efficiency-based argument. Efficiency arguments are based on the assumption that certain firms have lower costs (due to size or a unique factor) than their rivals.

Positive profits are not necessarily due to market power. They can be caused by economies of scale in the industry or by a unique input. These profits are sometimes called rents. Rents are either Ricardian or monopolistic and are generated either by efficiency or by supply restriction, respectively.

Economic profits that result from lower average total cost (ATC), which are not the result of monopsony power, are known as Ricardian rents. The positive profit is a reflection of the higher value of the low ATC firm's inputs. The unique input leads to greater relative efficiency for the firm possessing it.

For example, a particular farm may have exceptionally fertile land. This farm can produce at a lower cost than other farms. Because the market price of an homogenous industry is equal the cost of the marginal supplier (highest cost) the price of the agricultural commodity will be above the fertile farm's cost. This gives the fertile farm positive profits on the sale of its produce. The discounted flow of extra profit received will equal the current stock value of the difference between the fertile plot of land and the lower quality land; if not, the fertile land will be sold to invest the price premium elsewhere. The Ricardian rent will therefore equal the opportunity cost of holding on to the scarce input.

If the unique input is such that it prevents others from entering the market, then the market is a natural monopoly. For example, assume that there is a single mine for a particular ore. The mine would be able to completely control market supply because entry of new suppliers is impossible. The flow of profit received from the mine over time, while still equal to its stock value, is based on supply restriction, not to efficiency.

Imperfect competition can also result from economies of scale. Economy of scale (EOS) simply means that as all elements of production are increased by some factor, output will increase by some larger factor. A good example is the auto industry. Because there are such high fixed costs to produce, auto firms are more efficient with greater size. The industry becomes concentrated as the larger firms, with low ATC, price the smaller competitors out of the market.

There is much debate in the literature if industries characterized by economies of scale receive Ricardian rents or monopoly rents. Of course, monopoly rents associated with industries with EOS would not be an issue if firms could enter freely as assumed by the basic neoclassical model.

This assumption of the neoclassical model of free entry is questionable considering the above discussion of the auto industry. Without entry, or the threat of hit-and-run entry of a contestable market, the corrective effect of entering firms on price is prevented. If entry barriers are coupled with concentrated industries (few firms), the potential for market failure is high.

Concentration of an industry could come about through competition if there is a cost advantage due to scale economies or through shifts in positively sloped marginal cost curves (Demsetz, 1972). The Differential Efficiency Hypotheses (DEH) states that:

> "Effective Collusion is rare or nonexistent. In some industries, long-lived efficiency differences are unimportant, and both concentration and accounting profitability are generally low. Where efficiency differences are important, efficient firms obtain large market shares and earn rents, and both concentration and industry-level profitability are thus high (Schmalensee, 1987)."

Demsetz believes that some industries are concentrated because large firms are more efficient. From this argument, concentration and profitability are correlated, but it is from efficiency, and not from collusion. However, "evidence . . . is more sympathetic to the traditional market power explanation of profitability-concentration correlation at the industry level than it is to DEH" (Clarke, Davies, and Waterson, 1984).

Demsetz does, however, put into question the nature of profit studies. Not all oligopoly theory points to increased profit with higher industry concentration. Both Bertrand and Chamberlin's theories do not predict higher profits. While Bertrand does not predict higher prices, Chamberlin's large numbers case predicts that in oligopoly profits will disappear while high prices remain. There is also the possibility of X-inefficiencies eating away at excess profits in oligopolistic markets (Weiss, 1989). This ambiguity in theory makes it difficult to formulate empirical tests of market structure-profit relationships.

Another problem with profit studies is difficulty in measurement. Frequently, well-defined economic concepts are very difficult to measure empirically. The literature

is filled with various studies testing profit determinants without a common measure. Weiss (1989) outlines a host of measurement biases that occur within these studies. An approach that circumvents some of these problems is the price-market structure model. This literature is reviewed in the next section.

Price and Market Structure

Price-market structure models provide a more direct means to study the market power question (Connor, et al., 1985). By using a price model, the criticisms of Demsetz can be circumvented; the effect of concentration and market share on price can be associated with market power instead of greater efficiency. Note that high prices may be a goal, but that they should not remain after "the adjustment is *complete in competition*." (Weiss, 1989) In the long run, entry by new firms will drive price back toward minimum ATC.

In practice, it is very difficult to ascertain marginal costs. This is due in part to firms' reluctance in reporting sensitive cost data. To avoid the problem of missing cost data, a proxy for MC is often used instead. For many products sold in large supermarkets, there are both branded products and the retail store's version of the product called a private label. Private labels' prices are assumed to approximate the competitive price and therefore marginal cost for all firms (Connor and Peterson, 1992). Where private labels exist they are used as the proxy for MC.

There are three basic types of price-market structure studies. The first is the Price-Concentration model that models price as a function of industry concentration. The second is the Price-Market Share model where increased market share is postulated to

raise price. The third type is a combination of the first two, with price as a function of both industry concentration and market share.

Price and Concentration

Many models have been designed to test the effects of industry concentration on price. These models are similar to the profit-concentration studies but instead use price as the dependent variable instead of profit. Price models also differ in that they tend to look at single industries with virtually homogeneous products, to avoid incomparable market prices (Weiss, 1989).

In a study of local cement markets, Koller and Weiss tested the basic hypothesis that seller concentration is positively correlated with price levels. They found that concentration was statistically significant for each of the seven years of data. In all but two of the years there was a positive relationship between concentration and price (Weiss, 1989).

In another study by Parker and Connor, national-brand and private-label retail price differences were regressed against CR4, $CR4^2$, two advertising variables, and five control variables. Their results yielded statistically significant results for all structural variables, with a positive regression coefficient for the concentration variable (Connor, et al., 1985).

To avoid the problems of price comparisons over distinct markets, Kelton and Weiss developed a simultaneous equations model to test the relationship between change in concentration and change in price. By examining changes in price and concentration they could present more general results. They concluded that "rising concentration does

lead to long term price changes." They note that the relationship is stronger for consumer goods than capital goods (Weiss, 1989).

Differentiation and Branding

Firms are able to charge different prices for goods if the products are in some way different from other products in the industry. When an industry is made up of functionally similar but slightly different products it is said to be differentiated. These distinctions are based on either real or perceived quality differences and image of the brands.

Firms try to differentiate themselves from their competitors through branding. A branded product is endowed with physical and implied attributes, often created and maintained by advertising. These attributes are both functional evaluations and emotional connections.

Marketing is used to bond the consumers with a particular brand. Marketers attempt to convince the consumer that the brand is functionally superior and/or socially superior to other brands in the industry. Brand loyalty develops as the consumer begins identifying with the brand. Firms attempt to identify their brand with certain characteristics that appeal to the consumer. Those skeptical of price effects due to brand image need only look at the prices of bottled water to be convinced. It is not uncommon for some branded water to sell at twice the price of the lowest priced competitor.

Conspicuous consumers are not the only ones influenced by branding. For example, Jell-O brand gelatin is chemically identical to other gelatins yet sells at a substantially higher price over its nearest rival, Royal gelatin. Jell-O sells its gelatin with

all of the implied attributes of the Jell-O brand: wholesomeness, family fun, and the actor/comedian Bill Cosby as their spokesperson.

It is essential that the brand name be distinguished from the product. The product is the physical good (gelatin, water, margarine) and the brand is a conceptual set of attributes. Successful brands (Jell-O or Parkay) rarely have any product reference in their names, which allows for expansion or movement of the brand into other industries.

Regardless of how the product is differentiated the effects are higher prices. Higher prices are maintained because product differentiation serves as a type of "micro" barrier to entry. For example, the more consumers who view Coke and Pepsi as different products (low substitutes), the higher these firms can raise their own cola prices.

Price and Market Share

The price-market share model attempts to account for the effects of product differentiation on prices by allowing multiple prices to exist within an industry. In most concentration models a single price is used for the entire market and necessitate many local markets to create a cross-sectional dataset - rarely are goods sold at one price in multi-firm markets. Models that incorporate the effects of market share in differentiated industries avoid averaging out the effects of market share on price.

Most of the price studies by Weiss, unfortunately, have not included market share as an independent variable. However, a paper by Wills did study the effects of market share on price. In his study of food markets, Wills looked at "the prices of individual brands, private labels, and generic labels for 145 very specific categories . . . " This approach removed many of the price differences due to unequal quality levels. The results

of the study showed that national market share was positively related to brand retail price (Connor et al., 1985). Many price-market share studies, such as Wills, have come under fire for not having an explicit theoretical base for the empirical models. This has lead to criticism that the work has been "data mined" for results or that results represent correlations rather than causation.

To counter the opponents of this work, Haller (1994) laid out in detail a theoretically derived model of differentiated products. The derivation starts with the profit maximization problem of firm i where

$$(9) \qquad \pi_i = (p_i - AVC_i) \bullet q_i - FC_i$$

is the firm's profit function where:

π_i = firm i's profit

p_i = firm i's price

AVC_i = average variable cost for firm i

q_i = firm i's quantity

FC_i = fixed cost for firm i.

Through manipulation of the first order conditions, Haller arrives at a functional form of firm i's price determined by cost, elasticity of demand, and market share. In the simple Bertrand (zero-conjectures) case the above relationship reduces to

$$(10) \qquad p_i = MC_i \left[\frac{1}{1 - s_i / \eta^m} \right]$$

where:

p_i = firm i's price

MC_i = firm i's marginal cost

s_i = firm i's market share

η^m= market price elasticity of demand.

Haller points out that even if all firms have identical marginal costs, prices can still vary due to differences in market share. This is in direct opposition to the Demsetz differential efficiency view. Demsetz argues that all price differences are due to cost differentials between firms. Haller's work shows that this explanation of differing prices overlooks the effects of market share on price.

Haller tested his theory of market power with empirical models using cottage cheese and catsup sales data from sixty-five retail markets in the U.S.. Average price per pound was regressed against several independent variables, including volume market share. There was clear evidence of a positive relationship between market share and price. This relationship, however, "is an inter-brand rather than an intra-brand relationship." The brands with higher market shares had higher prices but to increase share firms needed to lower price.

The above relationship was tested with investor owned firms (IOF) and agricultural cooperatives. Haller compared the results of the catsup industry where no significant cooperatives operate with the cottage cheese industry, with many significant cooperatives to test for differences between cooperatives and IOFs. He found that cooperatives differ from their IOF counterparts.

In the cottage cheese industry, brands marketed by cooperatives do have the positive market share-price relationship Haller noted above. They do not, however, have as strong a relationship as the IOFs. The relationship was one third to one half that of brands not marketed by cooperatives. Even more significantly is that cooperatives seem to affect prices of all brands. "Brands sold in markets where co-ops compete sell for three to eight cents less than they would were the co-ops not there." From this Haller concludes that "cooperatives should be encouraged to enter or expand their presence in branded products markets."

In another study of cooperatives, Andonov (1996) estimated a price model, similar to Haller's, for the margarine industry. This industry was selected due to its high degree of physical product homogeneity, which served to reduce the degree of quality differences among brands. The data set consisted of quarterly, retail margarine price data from 1992. There were over six thousand observations gathered from about sixty retail markets across the United States.

Private-label price was included in the model to control for varying costs by geographical retail markets (Andonov, 1996). Connor and Peterson (1992) have argued that if private-label firms operate in a market then their prices should be a good proxy for the competitive price (and hence MC) in the industry since the private-label segment has minimal barriers to entry. Therefore, private-label price is used to control for price differences related to different costs in these geographic markets. For each of the approximately sixty retail markets used there is only an average price for all private-labels in each regional market - this variable is meant to capture general cost differences among

the retail markets. For example, many large cities have high labor costs that put upward pressure on all the products sold in the market, including margarine.

Andonov's results were strikingly different from Haller's. Andonov did not find a significant effect of cooperatives on the market price levels, and he failed to find the positive price share relationship found in Haller's work. Market share had an estimated regression coefficient of -.11, and was highly significant. Andonov's result seems to support the differential efficiency hypothesis that larger-share firms are lower-cost producers with lower prices, however, once advertising expenditures were accounted for leading brands with the highest advertising had the highest prices and increased as either their market share or advertising increased.

Advertising

As stated earlier, firms will try to differentiate their product from rivals. This non-price competition is achieved by slight alterations of the product and/or heavy advertising. It is difficult to distinguish between the price effects of superior quality and the perceived quality differences caused by advertising. Advertising serves both to educate the consumer about actual product attributes and to influence consumers' perceptions.

Wills' (1983 a) study of fifty processed foods attempted the difficult task of separating these two effects. Wills used Consumer Reports for quality evaluations to compare quality differences among the products. By holding quality constant, he concluded that brand prices were a positive function of advertising. His results would

suggest that advertising does affect consumers' beliefs regarding product quality (Connor et al., 1985).

Advertising expenditures should be included in most models of market performance for branded products. However, an econometric problem may arise when advertising is included in models along with market share, at least in consumer markets. The results of many studies show that advertising is significantly related with profit in consumer markets. Jacobson and Aaker (1985) also show that market share is related to advertising. This suggests the possibility of collinearity in models where both market share and advertising serve as explanatory variables for profit, and by similar reasoning, for price.

Price, Market Share, and Concentration

As with the profit models, both concentration and market share may have a positive effect on prices. Concentrated industries are expected to have higher price levels than non-concentrated industries. Accordingly, high market-share firms are hypothesized to have higher prices than low market share firms.

In one such study, Marion et al. examined price levels by retail grocery stores for a market basket of 94 comparable products across varying retail market structures. Measures for retail concentration and market share or relative market share (RMS) was used. RMS was derived by dividing CR4 by a firm's market share. The market basket price was regressed on these variables along with several other explanatory variables. The authors found that the estimated coefficients for concentration and for both market share measures were positive and statistically significant (Weiss, 1989).

In a similar study, Cotterill performed a price analysis of the same 94 products in the Marion report and added frozen, dairy and health products (Weiss, 1989). While the basic structure of the study was the same, most of the explanatory variables were different. Included was a measure for concentration and a measure for either market share or RMS. Cotterill ran two regressions with both concentration and RMS, with concentration measured by CR2 or CR1. These concentration ratios based on either the leading firm or top two firms were used because the markets being studied were much smaller than the markets in the Marion study. The first regression used CR2 as the measure for concentration, and yielded statistically significant positive estimates for the two coefficients. The second estimate equation used CR1, and only concentration was significant - not surprising given that CR1 is the leader's market share.

The above studies provide evidence, albeit tenuous, to support that price is a positive function of market concentration, market share, and advertising levels. The notion warrants further research beyond that done on the more conventional structure-conduct-performance relationships.

Market Share and Price

Most of the studies that look at market-share price relationships make an implicit assumption about the causal flow. Specifically, they assume that price is a positive function of market share. However, market share can be written as a function of price, by reversing the causality relationship.

The study by Aaker and Jacobson is one of the few traditional IO studies that looked at market share as the dependent variable. The study separated the data into four

categories: All Business, Consumer Goods, Capital Goods, and Supply Goods. Market share was written as a function of several variables, including two lagged measures of market share and a measure of relative price. Relative price was statistically significant for all categories except Capital Goods. In all of the significant cases, relative price was negatively correlated with market share. This would suggest that higher relative prices lead to lower market share (Aaker and Jacobson, 1985). New empirical industrial organization (NEIO) studies also use share as the dependent variable. The NEIO argues that the key to understanding market power is in the demand structure that each firm faces when selling its products.

New Empirical Industrial Organization

In 1982 Appelbaum laid the foundation for the NEIO by outlining a procedure that used a system of equations to estimate market structure. Specifically, Appelbaum provided a structure to estimate directly the conjectural variation (λ) so that price-cost margins could be estimated. Unfortunately this approach assumes constant marginal cost across industries and hence is unable to answer the efficiency argument.

Baker and Bresnahan (1985), while following Appelbaum's demand analysis approach to market power, introduced competitive analysis based on the residual demand curves associated with a given firm. Cotterill (1993 p.11) states:

> "The residual demand and the market structure-price approach avoid the cost efficiency critique when testing for market power. Residual demand analysts estimate the residual demand curves for an individual product

(business unit) and discover whether the residual demand cure has nonzero (negative) slope."

A negative slope of the residual demand curve indicates market power.

The analysis applied the residual demand method to the beer industry where residual demand elasticities for beer products sold by Anheuser-bush, Coors, and Miller were estimated. By simulating mergers, Baker and Baresnahan tested the assumption that there would be an increase of market power. This was done by estimating both own price and cross price elasticities of demand from the residual demand curves. By making limiting assumptions about supply they could estimate residual demand elasticities and show the increase of market power based on simulated mergers between the above firms. The measure of market power used was the observed price elasticity of demand - a function of demand elasticity (own and cross) and price reaction elasticities, the percent change in price by a firm given a price change of a rival. The general form of the observed elasticity is given as:

(11) $$\eta'_{l} = \eta_{ll} + \sum_{2=i}^{N} \eta_{li}\varepsilon_{i1}$$

where:

η^{o}_{1} = the residual price elasticity of demand

η_{11} = the non-followship or unilateral price elasticity of demand

η_{1i} = the cross-price elasticity of demand

ε_{i1} = the price response elasticity of rival i.

The residual demand elasticity is estimated directly from the residual demand curve. This estimate is inverted and is equated to the price markup; this holds exactly when the firms are in a constant conjecture equilibrium. (Baker and Baresnahan, 1985)

Hausman et al. present a less limiting approach to demand estimation in their 1994 paper by estimating the own and cross price elasticities. The beer industry is again analyzed, this time using a multistage budgeting model to estimate the demand elasticities. The elasticities are then used in a competitive analysis of the beer industry to simulate the market power effects of mergers between brands.

To generate the elasticities Hausman first set up a three-tier demand system. The top tier corresponds to the total demand for the product (beer). The middle level estimates the demand for beer in each segment of the industry; the industry is broken into light, popular, and premium beers. At the bottom level are the demand equations for brands within each segment.

Once these elasticities are estimated it is possible to forecast the change in price of a given brand after a merger. The form derived is

$$(12) \qquad \alpha_j = \frac{1}{(\varepsilon_{jj} / (1 + \varepsilon_{jj}))(1 - \theta_j^{m'})} - 1$$

where:

α_j = the percentage price increase of each merging product

ε_{jj} = the own-price elasticity of demand for brand j

$\theta_j^{m'}$ = the post-merger markup

The authors "calculate a hypothetical merger between two brands in the premium segment, Coors and Labatts . . . " from the above equation. They find that the increase in price following a merger between the two brands depends on the constraining effects of other brands in the industry. The simulation yielded a wide range of price increases ranging from 4.4% to 108.3% for Coors and 3.3% to 104.8% for Labatts (costs were held constant).

Adding to Hausman et al., Cotterill (1994) attempts to unveil the price change of a particular brand given the change in a rival's price. A system of demand equations is estimated with price reaction functions to uncover both the elasticities of demand and price reaction elasticities.

To derive the price reaction function, Cotterill substitutes an empirical demand equation into the firm's profit equation for q_i; the reaction function can be uncovered by differentiating the profit equation with respect to the firm's price and then solving for price. Cotterill has shown that this approach will yield estimates for price reaction functions that can be used in estimating the observed demand elasticities in Baker and Baresnahan.

While Cotterill's approach to estimating the price reaction elasticities leads to unrestricted estimates, the functional form of the price reaction function is difficult to derive. The revenue portion of the profit equation used to generate the reaction functions is easily defined but the cost portion is not. This makes it difficult to solve for price in terms of only the parameters of the model and rivals' prices.

Another elasticity paper by Haung and Hahn estimates meat elasticities for several agricultural segments. An interesting feature of this paper is the functional forms used to estimate the elasticities - a first order differential demand function. This same functional form is used in this thesis to estimate margarine elasticities. The next chapter outlines the Haung and Hahn model and the two-stage budgeting frame work used in this paper.

CHAPTER III

DEMAND THEORY

In a study of price elasticities of demand, Huang and Hahn (1994) use a first order differential approximation of the general Marshallian demand curves for meat. The derivation of the differential demand model is completely general and imposes no restrictions on the demand structure. In the following section we will see that certain restrictions should be imposed to aggregate across commodities and consumers. The model is then re-derived considering these restrictions.

The following comes almost exclusively from Huang and Hahn (1994). The Marshallian demand curve is derived from the constrained maximization problem facing the individual consumer. The consumer's utility function is maximized subject to a linear budget constraint[5].

More formally:

(13) $$\max_{q,\lambda} L = U(q) - \lambda(p \bullet q - M)$$

where:

U(q) = the utility function

λ = the Lagrangian multiplier (marginal utility of income)

p = an n-coordinate row vector of prices

q = an n-coordinate column vector of quantities

M = consumer expenditure (inner product of p and q)

[5]The budget constraint need not be linear. See Deaton and Muellbauer 1980.

Differentiating the above yields

(14) $$U_i(q) = \lambda \bullet p_i\ , \ \forall i = 1, 2, .., n$$

and

(15) $$p \bullet q = M\ .$$

Solving these equations simultaneously gives

(16) $$q_i = g_i(p, M), \quad \forall i = 1, 2, ..., n$$

which is the ordinary demand system in its most general form.

The first order differential approximation imposes no explicit structure on the conceptual demand equation. Taking the total derivative of the general demand function yields

(17) $$dq_i = \Sigma_j(\partial q_i / \partial p_j)dp_j + (\partial q_i / \partial M)dM\ .$$

"This demand system is quite general in relating . . . small changes from any given point on the n-commodity surface." (Huang and Hahn, 1994)

It is a simple matter to rewrite (17) in terms of elasticities. Multiplying the first and second terms of the right-hand side of (17) by p_j/p_j and M/M respectively, yields

(18) $$dq_i = \Sigma_j \frac{\partial q_i}{\partial p_j}\frac{p_j}{p_j}dp_j + \frac{\partial q_i}{\partial M}\frac{M}{M}dM$$

which is then divided by q_i to obtain

(19) $$\frac{dq_i}{q_i} = \Sigma_j\left[\left(\frac{\partial q_i}{\partial p_j}\frac{p_j}{q_i}\right)\frac{dp_j}{p_j}\right] + \left(\frac{\partial q_i}{\partial M}\frac{M}{q_i}\right)\frac{dM}{M}$$

where the terms in parenthesis are the price and income elasticities, respectively. This can be rewritten as

$$(20) \qquad \frac{dq_i}{q_i} = \Sigma_j \, \varepsilon_{ij} \frac{dp_j}{p_j} + \eta_i \frac{dM}{M} \qquad i, j = 1, 2, .., n$$

where ε_{ij} equals the price elasticity of demand (own and cross price) and η_i equals the income elasticity of demand for good i.

There are several constraints that Huang and Hahn impose on (20) to insure consistency with classical demand theory of the consumer. These are as follows:

Engel Aggregation: $\Sigma_i \, w_i \, \eta_i = 1$

Homogeneity :$\Sigma_i \, \varepsilon_{ij} + \eta_i = 0$

Symmetry: $\varepsilon_{ij}/w_j + \eta_i = \varepsilon_{ji}/w_i + \eta_j$

Negativity: $\varepsilon_{ii} + w_i \, \eta_i < 0$

where w_i is the budget share of the *ith* good. The budget share is the proportion of total expenditure for good i, $(p_i \bullet q_i)/M$. The next section explores when it is appropriate to model market demand in this fashion. Based on this discussion the correct structure of the price elasticity for the differential model will be derived.

Separability and Two-Stage Budgeting

As discussed at the close of the previous chapter, Huang and Hahn (1994) present a very useful model, although it is not appropriate in all situations. This section outlines the utility structure that allows for the correct application of the differential demand

model. The following section will derive the general form of the price and income elasticities for the appropriate utility structure.

The advantage of the two-stage budgeting approach is that it significantly reduces the number of parameters that need to be estimated. Instead of modeling demand as a function of prices from all products in the economy, the researcher can eliminate all but the most relevant brands or markets from estimation. Demand at each level is conditional on the allocated expenditure for that level. This eliminates unlikely brand level consumer comparisons, e.g., deciding between a Magnavox television and a Snapple iced tea.

The general demand function specifies the demand of any single good as a function of the prices of all goods available (now and in the future). Accounting for the prices of all goods, however, both present and inter-temporally, is impossible. Fortunately, it is possible to model demand as a series of partial maximization problems. For example, the demand for "food" can be found without knowing the distribution of individual food products. (Varian, 1992 p.147)

Consider the case where there are two "subbundles"[6] so that the consumption bundle is (x, z) and the price vector is (p, q). The consumer's maximization problem can be rewritten as

$$\max_{X,z} U(X,z) \text{ such that } PX + qz = m \tag{21}$$

[6]term from Varian, 1992.

where P and X are indexes that are functions of individual prices and quantities, such that:

P = f (p) and X = f (x).

These indexes are some average price and quantity for the aggregate commodity bundle. Aggregation of this type is possible only if there is either Hicksian or functional separability[7].

Functional separability indicates that there is separability of preferences such that "commodities can be partitioned into groups so that preferences within groups can be described independently of the quantities of other groups." (Deaton and Muellbauer, 1980) This is equivalent to saying that there is a subutility function for each commodity group and that total utility is a combination of the subutilities. "[T]he utility function can be written as

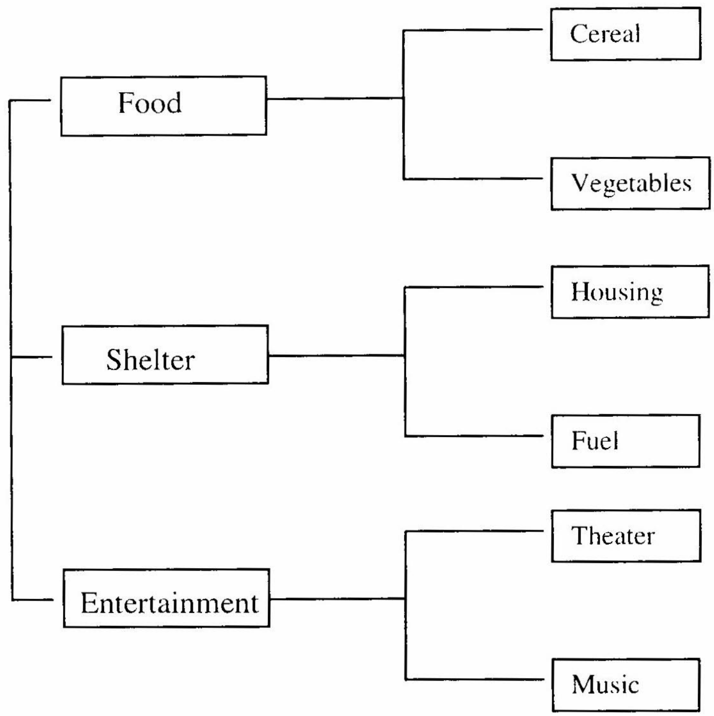
$$(22) \qquad U = v(q_1,q_2,q_3,q_4,q_5,q_6) = f[v_f(q_1,q_2),v_s(q_3,q_4)v_e(q_5,q_6)]$$

where f (•) is some increasing function and v_f , v_s , and v_e are the subutility functions associated with food, shelter, and entertainment, respectively." (Deaton and Muellbauer, 1980) It is possible that each subutility function is itself comprised of further subutility functions. The utility tree in Figure 2 shows the hierarchical nature of nested subutility functions.

[7]Only functional separability will be addressed.

Figure 2

Utility Tree: Commodity Groups and Separability



Two-stage budgeting can be seen as a natural extension of the utility tree. Total expenditure is first allocated across the aggregate groups (food, shelter, and entertainment). Then the consumer maximizes the subutility function for each specific good conditioned on group expenditure. "In order to have a budget constraint that is linear in quantity index, we need to assume . . . the subutility function is homothetic." (Varian, 1992 p.151)

The intuition behind a multi-stage budget demand system is that consumers make purchasing decisions hierarchically. Purchasing decisions are first made at the industry

level. Once the industry is selected, the consumer then selects the appropriate market segment from which to purchase. Finally the consumer chooses the brand from the remaining brands. Consider an example of an automobile purchase. The consumer first decides to buy a car (industry), then decides the type (market segment) and then chooses which car to buy from that segment (brand). "Note that two-stage budgeting involves both aggregation (to construct the broad groups) and separable decision making (for each of the group sub-problems)." (Deaton and Muellbauer, 1980)

While related, separability does not imply two-stage budgeting. The first stage needs stronger conditions than weak separability for an exact solution[8]. Separability is, however, necessary and sufficient for the second stage of two-stage budgeting. (Deaton and Muellbauer, 1980)

Aggregation Across Consumers

When modeling market demand, it is tempting to treat aggregate behavior as an individual utility maximization problem. Unfortunately, this is appropriate only in very specific situations. Aggregate demand will hold "no interesting properties other than homogeneity and continuity." Hence "the theory of the consumer places no restrictions on aggregate behavior... ." (Varian,1992 p.153)

It is possible, however, to model aggregate behavior as if it were generated by a representative consumer. Market demand will appear to be generated by utility maximization if all individuals are assumed to have an indirect utility function with the

[8]See Deaton and Muellbauer, 1980.

Gormon form:

(23) $$v_i(p,m_i) = a_i(p) + b(p)m_i \ .$$

Notice that the b (p) term is independent of i and is therefore identical for all consumers. When income enters the utility function linearly as above, the marginal propensity to spend is identical for all consumers. The demand function derived from the Gormon utility function clearly shows this result.

Using Roy's identity we find that the demand function for good j for individual i is

(24) $$q_i^j(p,m_i) = \alpha_i^j(p) + \beta^j(p)m_i$$

where:

$$\alpha_i^j(p) = -\frac{\dfrac{\partial a_i(p)}{\partial p_j}}{b(p)}$$

and

$$\beta^j(p) = -\frac{\dfrac{\partial b(p)}{\partial p_j}}{b(p)} \ .$$

Differentiating q_i^j with respect to m_i yields b^j, which is independent of i. From this we can conclude that the marginal propensity to spend is "independent of the level of income of any consumer and also constant across consumers since b (p) is constant across consumers." (Varian, 1992 p.153)

The aggregate demand function can be found by summing the above demand function across all consumers so that

$$(25) \qquad Q^j(p, m^1, \ldots, m^n) = -\left[\frac{\sum_{i=1}^{n} \frac{\partial a(p)}{\partial p_j}}{b(p)} + \frac{\frac{\partial b(p)}{\partial p_j}}{b(p)} \sum_{i=1}^{n} m_i \right].$$

The associated indirect utility function of Q^j can be shown to be

$$(26) \qquad V(p, M) = \sum_{i=1}^{n} a_i(p) + b(p)M = A(p) + B(p)M,$$

where $\Sigma m_i = M$ (Varian, 1992 p.153).

The Gormon form can be shown to be both sufficient and necessary for the representative consumer model to be valid. Considering this, we must revisit the Haung and Hahn model to determine when it is consistent with the Gormon form.

Huang and Hahn report that their first order differential approximation of demand is derived from a demand curve with an unknown utility structure. However, Huang and Hahn are modeling market demand with theoretical restrictions, implying that the demand function is derivable from a utility function. Following from the above discussion, the use of restrictions in an aggregate demand model requires the use of the Gormon form. By substituting the Gormon indirect utility function for the general function used by Huang and Hahn we can determine what the structure of the differential model must be to impose restrictions on market demand.

Rewriting the representative consumer model

$$(27) \qquad q_i^j(p, m_i) = -\frac{\frac{\partial a_i(p)}{\partial p_j}}{b(p)} + -\frac{\frac{\partial b(p)}{\partial p_j}}{b(p)} m_i.$$

Then taking the total derivative as indicated by Huang and Hahn

$$d q_i^j = \Sigma_k \left[- \left[\frac{\frac{\partial^2 a_i(p)}{\partial p_i \partial p_k} + \frac{\partial^2 b(p)}{\partial p_i \partial p_k} m_i}{b(p)} \right] + 2 \left[\frac{\frac{\partial a_i(p)}{\partial p_i} + \frac{\partial b(p)}{\partial p_i} m_i}{b(p)^2} \right] \frac{\partial b(p)}{\partial p_k} \right] dp_k + \left[\frac{\frac{\partial b(p)}{\partial p_i}}{b(p)} \right] dM$$

and rewriting to get

$$d q_i^j = \Sigma_k \left[- \left[\frac{\frac{\partial^2 a_i(p)}{\partial p_i \partial p_k} + \frac{\partial^2 b(p)}{\partial p_i \partial p_k} m_i}{b(p)} \right] + (2 q_i^j) \frac{\frac{\partial b(p)}{\partial p_k}}{b(p)} \right] dp_k + \left[\frac{\frac{\partial b(p)}{\partial p_i}}{b(p)} \right] dM$$

we see that

$$\frac{\partial q_i^j}{\partial p_k} = \left[- \left[\frac{\frac{\partial^2 a_i(p)}{\partial p_i \partial p_k} + \frac{\partial^2 b(p)}{\partial p_i \partial p_k} m_i}{b(p)} \right] + 2(q_i^j) \left(\frac{\frac{\partial b(p)}{\partial p_k}}{b(p)} \right) \right]$$

and

$$\frac{\partial q_i}{\partial m_i} = \left[- \frac{\frac{\partial b(p)}{\partial p_i}}{b(p)} \right].$$

The marginal propensity to spend is clearly independent of i in the above partial derivative. These derivatives show that the differential demand structure is consistent with utility theory if all individuals are assumed to have a utility structure of the Gorman form.

Much of the empirical work in this paper blends the procedures outlined by Hausman et al. (1994) and Huang and Hahn, (1994). A two-stage budget model is used to estimate elasticities at each level within the model. The functional forms for the demand equations at each level are first order differentials of general demand functions. The coefficients of the demand functions at each level are conditional elasticities - conditioned on the expenditure allocated to that level. While not calculated here, it is possible to combine the elasticities at each level to construct unconditional elasticities[9].

[9]Hausman et. al (1994) calculate the unconditional elasticities from the conditional elasticities estimated with an AIDS model.

CHAPTER IV

EMPIRICAL MODEL

In the last chapter a theoretical model for a demand model in elasticity form was laid out. This chapter will present the empirical form of these equations used in the estimation procedure. The demand system for each stage will be presented, followed by a description of the variables and their data sources.

Each stage of the model, except for the industry, is conditional on consumer expenditures on the next highest level. In this study the brand level demand system is conditional on segment level expenditures. In turn, the demand at the segment level is conditional on total expenditures for the industry. Therefore, both brand and segment demand elasticities are conditional; the demand is conditioned on a fixed level of expenditure. It is only after industry demand is estimated that the lower level elasticities can be transformed into unconditional elasticities.

The empirical functional forms for the demand equations for all three levels are based on the first order linear approximations of Huang and Hang. While all of the demand equations are based on the same theoretical model, they do differ between the levels. The differences will be explicitly noted after each has been presented.

The brand level equations are the first stage. Here demand is seperated into regular margarines and spreads. This separation was based on a study by Consumer Reports that divided the margarine industry into distinct market segments based on the ingredients.

Demand for a brand is written in terms of prices and expenditures for that segment only. No cross-segment price or other decision variable effects are included at the brand level.

The demand equations can be written in the general form:

$$
\begin{aligned}
Y_{imt} = {} & \beta_{i0} + \beta_{i1}\mathrm{Exp}_{amt} + \varepsilon_{ii} P_{imt} + \varepsilon_{ij} P_{jmt} + \rho_{i1} Time + \\
& \beta_{i2} Ma_{imt} + \beta_{i3} Mb_{imt} + \beta_{i4} Advert_{it} + \beta_{i5} Adriv_{it} + \\
& \beta_{i6} Unt_{imt} + \gamma_{i1} D_1 + \gamma_{i2} D_2 + \ldots + \gamma_{i38} D_{38}
\end{aligned}
\tag{28}
$$

where

Exp_{amt} = change in total expenditure for the segment (either regular or spread)for segment a, in market m, at time t

Pr_{imt} = change in own price in market m, at time t

Pr_{jmt} = change in rivals' price in market m, at time t

Time = quarterly time trend

Ma_{imt} = change in the percent of volume sold under featured ads for brand i in market m, at time t

Mb_{imt} = change in the percent of volume sold while on display for brand i in market m, at time t

Advert_{it} = change in advertising expenditures for brand i, at time t

Adriv_{it} = change in the sum of brand i's rivals' advertising at time t

Unt_{imt} = change in the units per pound for brand i in market m, at time t

$D_1, \ldots, D_{38}$ = dummy variables for 38 different regional markets.

The next set of equations represent the empirical equations for the market segments. The form of the demand equations at the segment level is almost identical with the brand level. There are some differences that should be noted. The marketing variables, advertising intensity variable, and the units per pound variable (Unt_{imt}) have been removed since at this level of aggregation these variables would be inappropriate. The subscript 'a' distinguishes the two segments:

$$Y_{amt} = \psi_{a0} + \psi_{a1} ExpI + \Phi_{a1} P_{amt} + \Phi_{b2} P_{bmt} + \psi_{a3} Adreg_{mt} + \psi_{a4} Adspd_{mt} + \Psi_{a5} Time + \omega_{a1} D_1 + \omega_{a2} D_2 + \ldots + \omega_{a38} D_{38} \tag{29}$$

where

Y_{amt} = change in the quantity sold in segment a, in market m, at time t

Exp_I = change in industry level margarine expenditure in market m, at time t

P_{amt} = change in the weighted average price for segment a, in market m, at time t

P_{bmt} = change in the weighted average price for segment b, in market m, at time t

Adreg = change in the sum of advertising expenditures in the regular margarine segment at time t

Adspd = change in the sum of advertising expenditures for the spread margarine segment at time t

Time = a time trend

$D1 \ldots D_{38}$ = dummy variables for 38 different regional markets used in estimation

The final stage is the Industry level. This equation will be used to estimate the industry level demand for margarine. It is

$$(30) \qquad Y_{IND} = \Upsilon_0 + \Upsilon_1 P_{ind} + \Upsilon_2 P_{but} + \Upsilon_3 Pop + \Upsilon_4 Inc$$

where

Y_{ind} = change in total quantity of margarine sold

P_{ind} = change in aggregate price for margarine

P_{but} = change in aggregate price for butter

Pop = change in domestic population

Inc = change in per-capita income

At the industry level demand is not conditioned on a fixed level of expenditure. Instead demand is written as a function of income.

Estimation Method

The two brand level demand systems and the segment demand system were estimated using restricted iterative seemingly unrelated regression (SUR). The SUR method was used to take into account any possible cross-equation correlation of the error terms. SUR improves efficiency over ordinary least squares (OLS) if the independent variables differ across equations and there is contemporaneous correlation of errors across equations.

Improvement in efficiency using SUR is a large sample property. In order to realize efficiency gains there must be a “reasonable amount of data... .” (SAS/ETS

User's Guide, p. 555). The 524 observations of margarine data should be enough to reduce the sampling variability of the estimator - allowing for efficient SUR estimation.

The SUR estimates were constrained by three demand restrictions: symmetry, Engle aggregation, and homogeneity. Both Engle aggregation and symmetry are system constraints that impose restrictions across equations. The homogeneity restriction constrains the relationship of estimates within each equation. The actual restrictions used can be found in the appendix.

Variables and Data

The scanner data are from the InfoScan data base purchased from Information Resources, Inc. (IRI). IRI acquires supermarket scanner data from several retail markets across the country. These data are assembled to calculate quantity, price, demographic, and marketing variables for every brand sold. Additional data were taken from the Leading National Advertisers (LNA) reports. LNA collects brand level advertising expenditure data on the advertisers in each industry.

Most of the data for the brand and segment stages comes from the IRI data set; the segment data are an aggregation of the brand level data. Not all of the margarine data from the IRI data set is used in the final database. The following are the reasons for taking only part of the available data.

To maintain a balanced panel data set every brand analyzed had to be in every market in every period. Frequently, a brand was in many markets but not in all time periods (the brand entered or exited the market). Conversely a brand might be in all (or most) periods but be absent in some markets. The number of markets in the available

data set ranged from 38 in 1988 to 65 in 1992 and included a maximum of 150 brands. A tradeoff between markets versus periods had to be made. The final data set consists of 39 regional retail markets spanning all four quarters in the years 1989 to 1992, all brands from each segment present in every market and in every quarter. Five brands were in the regular segment and seven brands were in the spread segment. This final data set comprised over 60 percent of total margarine sales. While some regional economic effects may be lost, it is hoped that the results will provide excellent estimates for these national brands.

An additional 6th brand in the regular segment and 8th brand in the spread segment were private-label composites. These composites were created by splitting total private-label retail volume into the two segments in a two to one ratio of regular margarine to spreads. This division was based on past research and trade information. A drawback of this approach is that "brand" level prices for private-label composites are the same for both segments, but given that IRI averages private-label data by market, price differences across segments are impossible to discern.

Data for the industry demand equation were taken from two sources. The data on income and population were found in the Statistical Abstract of the United States. The butter and margarine prices and margarine quantity data are from Bureau of Labor Statistics publications. The industry level data are not disaggregated over regional markets as are the brand and segment data sets.

In following Huang and Hahn's specification it was necessary to transform many variables before they could be used in an estimation procedure. Much of the data is

transformed into the relative changes over time. For example Y_{itm} at time t is defined to be $(Y_{itm} - Y_{it-1m})/Y_{it-1m}$. This procedure makes our data consistent with the first-order differential functional form. One quarter of data is lost due to the first differencing of the variables. This brings the number of quarters in the data set down to 15 from 16. It will be explicitly noted which variables have not been so transformed and why they were not.

Quantity

The dependent variable used for demand is the relative change in volume (pounds) sold. The quantity of the product sold at a given price equals the amount consumers are willing and able to buy at that price. The brand level data were taken from the IRI data set, except for the media advertising data taken from LNA. For the segment level, brand level volumes in each segment were added together by market to yield an aggregate value for quantity, $\Sigma_i (Y_{itm})$. To differentiate segment quantity for each segment the subscript a is used where a = 1 for the regular segment and 2 for the spread segment. The quantity at the industry level was derived by summing both over segments and markets, $\Sigma_a \Sigma_m \Sigma_i (Y_{itm})_a$.

Expenditure

Demand theory clearly dictates that there be some expenditure or income variable included in demand estimation. From theory it is expected that expenditure (income) will have a positive effect on demand; this positive relationship will not hold, however, if the product is an inferior good.

At the brand level the expenditure variable is created by summing brand prices multiplied by brand volume. More formally $\Sigma_i (P_{itm} \times Y_{itm}) = Exp_{atm}$, where i, a, t, and m are index variables for brand, segment, time, and location, respectively. To account for inflation the expenditure variables are divided by a regional consumer price index (CPI_{tm}) all price and expenditure data must first be divided by the appropriate CPI to control for inflation. Once the segment expenditures have been calculated it is possible to find the industry expenditure. Industry expenditure is calculated as $\Sigma_a Exp_{atm} = Exp_{tm}$, where Exp_{tm} is the industry expenditure in each regional market at time t. Note that we do not have to divide the industry measure by the CPI because the data have been converted into real expenditures at the segment level.

The industry stage is not conditional on a set expenditure, instead per-capita income is used in place of an expenditure measure. These data were already in real terms when they were collected. The source for the income data is the Statistical Abstract Of the United States.

Prices

As with expenditure, demand is explicitly derived as a function of price. Theory also predicts that own-price will be negatively related to quantity demanded while rivals' prices may have either a negative or positive effect; it will be positive if it is a substitute, negative if a complement. For margarine, the cross-price elasticities (coefficients on rivals prices) are expected to be positive; i.e., they are substitute goods.

The price data used at the brand level are the average price for the branded product in each of the 39 markets. This price is the average price facing the consumer "net of all discounts except manufactures' coupons... ." (Haller, 1994) The average price for each segment was calculated by dividing expenditures by total volume. Specifically $Exp_{at\ m} / \Sigma_i (Y_{i\ t\ m}) = P_{amt}$, where P_{amt} is the weighted average price for the segment. This approach to calculating price takes into account the differences in brand sales. Before being used in the analysis, the price data were divided by the relevant CPI .

The producer price index (PPI) is used as the price data for the industry regressions. The monthly data are converted to quarterly data through simple averaging. Because the data are an index there is no need to divide by the CPI.

Marketing Variables

Marketing variables are included with the presupposition that marketing efforts will increase demand. The two marketing variables used are the percent of retail volume in featured ads (Ma) and the percent of retail volume on display (Mb). Ma "measures the percentage of the volume of a given brand sold during the quarter while featured in ... newspaper advertising" (Haller, 1994). Mb "measures the percentage of the volume of a given brand sold during the quarter in conjunction with some sort of in-store display..." (Haller, 1994). These variables are available only at the brand level.

Advertising

Like the marketing variables, advertising is often postulated to have a positive impact on demand -both in total and for individual brands. Variables for own and rivals'

advertising are included at the brand and segment stages. The industry regression has no advertising variables due to a lack of available data. All of the advertising data come from LNA and are not broken down by retail markets, hence each brand is assigned the national value in each market. At the brand level there are the Avert and Adriv advertising variables. Avert is own advertising expenditures and Adriv is the sum of rivals' advertising. Rivals are competing brands in each segment and include only those brands included in the data set.

Retail Dummy Variables

Included in the brand and segment level regression are several dummy variables. These variables are included to account for regional differences in the structure of the data. While there are 39 separate markets only 38 dummy variables are included to avoid invertability of the design matrix. The intercept term should be interpreted as the fixed effect of the 39th regional market. A table of all of the regional markets can be found in the appendix.

Units per Pound

Units per pound (U_{int}) is defined as the number of pounds sold divided by the number of units sold. This measure is included to control for differences in package size (e.g., a 10 oz. box vs. a 16 oz. economy size). This variable should account for differing purchase decisions due to changes in packaging size. U_{int} is included only in the brand level regression.

Population

Industry level demand includes a variable for population. Data for population were taken from the Statistical Abstract of the United States. It is expected that with an increase in consumers there would be an increase in quantity sold. A population variable is included only in the industry regression.

That completes the description of the model, the variables, and their data sources. We now turn to the actual empirical results of estimating the demand system.

CHAPTER V

EMPIRICAL RESULTS

This chapter is comprised of the empirical results for the four main segments: brand-level regular margarine, brand-level spread margarine, segment level, and industry level. Due to the sheer number of estimates for market effects they will not be reported on in this section.

Budget Shares

The budget shares of the brands indicate the relative size of each of the brands within a segment. This information is useful when interpreting the cross-price elasticities. The change in demand for a relatively large brand is unlikely to increase by a large percentage when a small brand raises its price. This is because the shift in demand from the small to large brand is a smaller percentage of the large brands total demand. Conversely, a price increase of a large brand will tend to have a larger impact on demand for a smaller brand.

The budget shares for the regular segment are in table 3. Fleischmanns' has the largest budget share, accounting for 38% of the segment. Parkay is the next largest with 27% of the segment. These two players dominate the segment with a combined share of 65%. The smaller three players represent only 22% of the segment: Land O' Lakes with 10%, Mazola with 8%, and Imperial with only 4%. The Private-Label composite is 13% of the segment.

Table 3

Budget Shares for the Regular Margarine Segment

Brands	Budget Shares
Fleischmanns'	38%
Parkay	27%
Land O' Lakes	10%
Imperial	8%
Mazola	4%
Private Label	13%

The budget shares for the spread segment are found in table 4. The two largest brands, I Can't Believe Its Not Butter and Shedds Country Crock, represent 56% of the expenditures in the spread segment with budget shares of 23% each. Blue Bonnet and Promise are the next two largest brands with budget shares of 17% and 15 % respectively. The smallest brands are: Country Morning Blend (7%), Shedds (4%), and Parkay Light (3%). The Private-Label composite is in the same size range as the smallest brands with a budget share of 7% .

Table 4

Budget Shares for the Spread Margarine Segment

Brands	Budget Shares
I Can't Believe Its Not Butter	23%
Shedds Country Crock	23%
Blue Bonnet	17%
Promise	15%
Country Morning Blend	7%
Shedds	4%
Parkay Light	3%
Private Label	7%

The Regular Margarine Segment

The regular segment brand level results are presented in this section. The system R^2 will be reported first, then the own and cross-price elasticities and finally the non-price elasticities and control variables. The overall model had a system weighted R^2 of 0.7909. This R^2 indicates that 79% of the variability in the dependent variables are explained by the model. Considering the complexity of the model, this is an excellent fit.

All of the own- and cross-price elasticities for regular margarine are in table 5 (the italicized values are t-statistics). Own-price elasticities are displayed along the main diagonal and are in bold type. The cross-price elasticities are on the off-diagonal. The columns of table 3 represent the percent change in quantity of the brand due to a one

percent change in price of the brand in each row. For example, Fleischmanns' (column one) quantity demand increases by .125% with a 1% increase in Imperial's (row two) price. Conversely, the effect of a brand's pricing on other brands is read along the rows.

Table 5

Regular Margarine Own and Cross-Price Elasticities

Brands	Fleischmanns	Imperial	Land O' Lakes	Mazola	Parkay	Private-Label
Fleischmanns	**-1.293**	0.459	-0.064	0.460	0.188	0.106
	-23.127	*4.171*	*-0.653*	*2.026*	*4.863*	*4.863*
Imperial	0.126	**-2.896**	-0.011	0.174	0.272	0.236
	6.830	*-21.067*	*-0.113*	*2.379*	*8.975*	*6.237*
Land O' Lakes	-0.013	-0.041	**-1.103**	-0.036	0.055	0.038
	-0.665	*-0.338*	*-0.113*	*-0.488*	*1.626*	*0.955*
Mazola	0.040	0.061	-0.017	**-1.988**	0.017	0.0917
	1.946	*1.860*	*-0.628*	*-10.024*	*1.374*	*2.222*
Parkay	0.150	0.814	0.157	0.169	**-1.695**	0.3055
	6.844	*8.156*	*1.626*	*1.952*	*-35.884*	*2.222*
Private-Label	0.056	0.351	0.064	0.365	0.160	**-1.861**
	1.868	*5.396*	*1.136*	*2.442*	*6.832*	*-22.939*

The top number in each cell is the estimated coefficient.
The bottom number is the t-statistic.

The own-price elasticity of Land O' Lakes is the only statistically insignificant own-price elasticity in the study. Land O' Lakes' price effect is significant in the system only in the two cross-price elasticities between Land O' Lakes and Parkay. At first glance these results appear to suggest that Land O' Lakes' margarine is insulated from pricing effects of rivals. Unfortunately, this does not explain why Land O' Lakes pricing has no real effect on its own and rivals' demand. Future research will be needed to explain Land

O' Lakes' weak results. Perhaps as the only agricultural cooperative in the industry, Land O' Lakes behaves differently than investor-owned firms.

Fleischmanns' has the most inelastic demand with an estimated elasticity of -1.293. Not surprisingly, as a large brand, Fleischmanns' pricing has a large effect on rivals, especially on Imperial and Mazola. A one percent increase in Fleischmanns' price increases Imperial's quantity by .459% and Mazola's quantity by .406%. Parkay, the other large brand, has a smaller increase in quantity, only .188% with a one percent increase in Fleischmanns' price .

Parkay has the largest effect on Fleischmanns' quantity, increasing quantity by .150 % with a one percent change in price. A price increase by Imperial increases Fleischmanns' quantity almost as much as Parkay, with a cross-price elasticity of .126. This is interesting given that Parkay is almost three and a half times larger than Imperial. Mazola, the smallest brand, and the Private-Label composite increases quantity for Fleischmanns by only .040 % and .056% when they increase price by one percent.

Imperial is the most elastic brand with an estimated elasticity of -2.896. Imperial has the strongest effects on Parkay and Private-Label with cross-price elasticities of .272 and .236 respectively. Imperial also has a significant effect on Mazola with a cross-price elasticity of .174.

A one percent increase in Parkay's price results in a .814% jump in Imperial's quantity, a huge change. As noted above Fleischmanns' has a cross-price elasticity of .459. Even Private-Label has a large effect on Imperial with a cross-price elasticity of .351. These high cross-price elasticities are consistent with Imperial's high own-price

elasticity. Only Mazola has a small effect on Imperial's quantity with a cross-price elasticity of .061.

Mazola has an own price elasticity of -1.988. The smallest brand in the regular segment, Mazola has only small price effects on other brands' quantity. The cross-price elasticity between Mazola and Private-Label is .092, which is the largest Mazola price effect.

Parkay has an own-price elasticity of -1.695, the second most inelastic brand in the segment. Imperial has the largest price effect on Parkay's quantity. An increase in Imperial's price increases Parkay's quantity by .272%. The high cross-price elasticities between these two brands suggests that they are seen as substitutes, at least for a subset of their customers. Other than the previously noted effects of Fleischmanns, Private-Label has the next largest impact on Parkay. As Private-Label's price increase by one percent Parkay's quantity increases by .160%.

The Private-Label composite has a own-price elasticity of -1.861. Parkay has the largest price effect on Private-Label with a cross-price elasticity of .306. Imperial also has a large price effect, increasing Private-Label sales by .234% with a one percent price increase. Fleischmanns has a relatively small impact on Private-Label quantity with a cross-price elasticity of .106.

Overall the results for the regular segment are significant for 20 of the 30 cross-price elasticities at the 90% significance level (two-tailed test). Only one of the insignificant estimates -the cross-price elasticity of Fleischmanns' on Private Label - does not involve Land O' Lakes.

The results in the next section are taken from table 6. Included are all of the non-price variables in the regular segment model. Each variable's impact will be discussed separately.

Table 6

Regular Margarine: Results for the Non-Price Regression Variables

Variable	Fleischmanns	Imperial	Land O' Lakes	Mazola	Parkay	Private Label
Intercept	-0.014	0.258	0.016	-0.179	0.100	0.002
	-0.913	*2.073*	*0.059*	*-2.93*	*3.247*	*0.052*
Expenditure	0.935	1.253	0.974	0.856	1.002	1.085
	42.436	*8.188*	*6.462*	*11.421*	*27.741*	*31.592*
Percent Featured	0.004	0.037	0.088	0.014	0.031	-
	1.402	*1.835*	*2.382*	*3.271*	*3.031*	-
Percent on Display	0.001	0.035	0.020	0.002	0.023	-
	0.56	*3.001*	*0.951*	*0.839*	*2.613*	-
Own Ad Expenditure	-0.003	0.029	0.138	0.001	0.011	-
	-0.63	*1.559*	*5.083*	*0.067*	*1.381*	-
Rivals Ad Expenditure	0.028	-0.156	-0.040	-0.049	-0.017	-
	3.338	*-2.484*	*-0.436*	*-2.627*	*-1.303*	-
Units per lb.	1.572	-0.526	-76.238	-2.205	0.944	-
	2.971	*-0.881*	*-0.323*	*-7.379*	*0.378*	-
Trend	-0.002	0.011	0.003	0.007	0.001	0.002
	-3.302	*2.392*	*0.284*	*2.622*	*0.961*	*1.534*

The top number in each cell is the estimated coefficient.
The bottom number is the t-statistic.

Expenditure

The expenditure elasticity is significant for all regular margarine brands. Imperial margarine has the largest estimated expenditure elasticity at 1.25; Mazola has the lowest with a .856 estimated expenditure elasticity. This indicates that there is an unequal distribution of additional expenditures in the regular segment across brands. A one percent increase in segment expenditure increases Imperial's quantity buy 1.25 percent but Mazola enjoys only a .856 percent increase in sales volume.

Marketing Variables

For all of the branded regular margarines, the percent featured ad variable was significant at the 90% confidence level. Feature ad marketing was most effective for Land O' Lakes with a one percent increase in feature ad marketing leading to .08 percent increase in volume sold. Fleischmanns' sales increased by only .004 percent with a one percent increase in ad marketing.

Only two of the margarines, Imperial and Parkay, had significant results for display marketing. A one percent increase in display lead to an increase in sales of .0358 for Imperial and .023 for Parkay. The Private-Label composite did not use either marketing tool.

Media Advertising

A brand's own media advertising expenditure was hypothesized to be positively related to sales. Three of the branded margarines had significant results supporting this hypothesis. A one percent increase in advertising expenditure increased Land O' Lakes' sales by .138 percent. The results for Imperial and Parkay are less dramatic with

estimated coefficients of .029 and .011, respectively. Private-Label had no expenditures for media advertising.

Included in each brand's equation was the sum of rivals' advertising, which was hypothesized to be negatively related to sales. This negative relationship was found for Mazola, Imperial, and Parkay. Imperial's sales decrease by .155 percent with an additional percent of rival's advertising expenditure. Mazola and Parkay's sales decrease by only .049 and .017, respectively. Interestingly, Fleischmanns exhibited a positive relationship between rivals advertising expenditure and sales with an estimated coefficient of .028, suggesting this brand benefits from the advertising of its rivals more than from its own advertising. Land O' Lakes had a statistically insignificant result.

Unit per Pound

Only two of the branded regular margarines had significant estimated coefficients for unit per pound control variable. Fleischmanns' sales increased by 1.572 % as the sales units increased by 1%. Mazola's sales decreased by 2.205% as sales units increased by 1%. An increase in sales due to an increase in units per pound means that as the containers increase in size quantity increases. It may be that Flieischmanns significantly lowers its price per pound with larger containers leading to higher sales volume. Mazola may not significantly lower its average price per pound with its larger containers hence its drop in sales volume with larger packages. Further research is needed to determine the degree of differences in unit pricing across brands.

Trend

A time variable was included to account for any residual time trends existing in the data after differencing. The trend estimates, unlike the other parameter estimates, are not elasticities. The estimates should be interpreted as the percent change in sales volume due to an increase in time measured in quarters of a year. The sign indicates whether the sales volume is increasing or decreasing over time, given the effects of the other variables

The trend variable was significant for four of the six regular margarines at the 90% confidence level. Of the margarine brands with significant trend values only Fleischmanns has a negative trend coefficient (-.002). Imperial (.0107), Mazola (.007), and Private label (.002) all had positive estimated coefficients. Land O' Lakes and Parkay had an insignificant estimated trend coefficient.

The Spread Margarine Segment

This section will examine the results of the demand system for the margarine spread segment. Keeping with the preceding section, the order of presentation will be budget shares, price elasticities (own and cross) will be reported first. Then the results for the other variables included in the demand system are discussed. The model had a system weighted R^2 of 0.7556, similar to that found in the regular margarine segment.

Prices

The own-price elasticities for the spreads are along the main diagonal in table 7 below. The price effects for each regression equation are read as in table 5. For example, the estimated own-price elasticity for private label's price in the Promise equation is .096

and the estimated own-price elasticity for Promise's price in the private label equation is .155.

All of the own-price elasticities are significant at the 99% significance level in the spread segment. The elasticities range from the highly elastic Shedds (-3.473) to the relatively inelastic Country Morning Blend (-1.087). Interestingly, Shedds elasticity is twice that of Shedds Country Crock (-1.725); the two products are from the same brand family.

Of the cross-price elasticities, 36 of the 56 are statistically different from zero at the 90% confidence level. Of the 36 significant cross-price elasticities only five are negative - the cross-price elasticity of "I Can't Believe Its Not Butter" (ICBINB) on Shedds is the only estimate of the five that does not involve Private Label. Private Label has a negative cross-price elasticity for Country Morning Blend and Parkay Light. Conversely, both Country Morning Blend and Parkay Light have negative cross-price elasticities for Private Label. The prices for Blue Bonnet and Promise were significant in all system demand equations except for Blue Bonnet in the Shedds' equation.

Table 7

Spread Margarine Own- and Cross-Price Elasticities

Brands	Blue Bonnet	CMB	ICBINB	Parkay Light	Promise	Shedds	Shedds Cntry C.	Private-Label
Blue Bonnet	**-2.083**	0.228	0.110	0.173	0.259	-0.148	0.318	0.446
	-27.767	*3.998*	*2.992*	*4.115*	*4.085*	*-0.744*	*9.887*	*8.069*
CMB	0.072	**-1.087**	0.048	0.056	0.089	-0.112	-0.015	-0.369
	2.799	*-8.709*	*1.130*	*0.654*	*3.331*	*-1.383*	*-0.450*	*-4.633*
ICBINB	0.000	0.083	**-1.463**	0.318	0.090	-0.467	0.329	0.311
	-0.001	*0.598*	*-15.240*	*2.772*	*1.490*	*-2.482*	*5.352*	*2.503*
Parkay Light	0.019	0.022	0.052	**-1.443**	0.032	-0.024	0.005	-0.109
	2.073	*0.555*	*3.156*	*-20.308*	*3.097*	*-0.839*	*0.418*	*-3.305*
Promise	0.131	0.137	0.058	0.116	**-2.043**	1.913	0.078	0.155
	2.312	*2.612*	*1.700*	*2.663*	*-19.702*	*6.351*	*2.648*	*3.020*
Shedds	-0.007	-0.020	-0.026	0.017	0.571	**-3.473**	0.082	0.053
	-0.141	*-0.484*	*-0.927*	*0.563*	*7.186*	*-11.033*	*3.373*	*1.290*
Shedds Cntry C.	0.310	-0.096	0.353	0.016	0.147	0.182	**-1.725**	0.166
	6.251	*-0.888*	*5.804*	*0.187*	*2.731*	*1.072*	*-24.576*	*1.690*
Private-Label	0.158	-0.328	0.116	-0.199	0.096	0.025	0.068	**-1.835**
	6.992	*-4.548*	*3.367*	*-3.075*	*4.099*	*0.354*	*2.460*	*-20.293*

The top number in each cell is the estimated coefficient.
The bottom number is the t-statistic.

The results for the non-price variables in the spread segment model are included in table 8. Each variable's impact will be discussed separately.

Expenditures

All of the estimated expenditure elasticities are significant at the 99% confidence level and have the hypothesized positive sign. The estimates range from .751 for I Can't Believe its Not Butter to 2.104 for Shedds. Shedds' volume sold increases by over two percent as spread segment expenditures increase by one percent.

Marketing Variables

The estimated coefficients for Percent on Featured Ad, were positive and significant for three of the brands: Blue Bonnet, Country Morning Blend, and I Can't Believe its Not Butter. Surprisingly, two of the brands, Parkay Light and Parkay, had negative estimates. None of the estimates the for Percent on Featured Ad was greater than .025, indicating very week responses, if any, from featured ad.

The other marketing variable, Percent on Display, had a significant estimated coefficient for Blue Bonnet, Country Morning Blend, Shedds, and Shedds Country Crock. Shedds had the largest elasticity with a one percent increase in volume on display leading to an increase of .183 percent of sales volume. The elasticities for the other brands were much smaller.

Media Advertising

The effect of brand advertising should be to increase brand sales. Surprisingly, only Promise (.087) and I Can't Believe Its Not Butter (.054) had positive and significant estimates. Three of the branded spreads, Blue Bonnet (-.002), Parkay Light (-.002), and Shedds Country Crock (-.005), were negative and "significant" at the 90% significance

level. These results might be due to the lack of advertising data for each of the retail markets.

Rivals' advertising often decreases sales by luring customers to other products. This expectation held only for Blue Bonnet (-.047) and I Can't Believe Its Not Butter (-.027). Parkay Light (.100), Promise (.106), and Shedds Country Crock (.014) all had positive estimates for rival's advertising. Advertising could provide a free ride for a rival, increasing the rival's sales if the advertising does not significantly differentiate the brand from the general segment.

Unit per Pound

Only three of the five[10] branded spreads had significant estimates for Unit per Pound. Blue Bonnet (.359) and Promise (8.464) and Shedds Country Crock (.262) all had positive estimates - the Promise estimate is surprisingly large. Shedds and I Can't Believe Its Not Butter had negative estimates but were statistically insignificant. As with the regular margarine it may be that brands do not equally discount their larger containers.

Trend

Of the eight brands only Promise and Shedds had insignificant estimated coefficients for the time trend. Private Label (.002) and Blue Bonnet (.003) had positive estimates for the trend - sales have been increasing over time due to some factor not accounted for in the model. Country Morning Blend (-.004), I Can't Believe Its Not

[10] Unit of sale was not included in the Country Morning Blend equation. The unit of sale was constant over the time period resulting in zero for all values. Inclusion would have prohibited estimation of the equation.

Butter (-.003), Parkay Light (-.004), and Shedds Country Crock (-.002) all have had sales decrease when all other variables in the model are held constant.

Table 8

Spread Margarine Non-Price Regression Variables

Variable	Blue Bonnet	CMB	ICBINB	Parkay Light	Promise	Shedds	Shedds Cntry C.	Private-Label
Intercept	0.134	0.043	0.056	0.011	-0.029	0.259	0.027	0.010
	2.979	*1.304*	*2.503*	*0.453*	*-0.254*	*0.696*	*1.396*	*0.288*
Expenditure	1.399	1.062	0.751	0.946	0.758	2.104	0.859	1.182
	20.924	*21.561*	*21.897*	*24.080*	*6.676*	*5.410*	*28.882*	*27.255*
Trend	0.003	-0.004	-0.003	-0.004	-0.004	0.015	-0.002	0.002
	1.753	-3.161	-3.219	-4.108	-1.082	1.112	-2.982	1.852
Percent Featured	0.025	0.010	0.010	-0.007	-0.048	-0.030	0.006	-
	2.488	*4.303*	*2.281*	*-2.316*	*-2.772*	*-0.626*	*1.437*	-
Percent on Display	0.020	0.004	0.001	-0.001	-0.001	0.183	0.007	-
	3.131	*2.280*	*0.667*	*-0.448*	*-0.175*	*4.567*	*2.218*	-
Own Ad Expenditure	-0.002	-0.001	0.054	-0.002	0.087	-0.174	-0.005	-
	-1.616	*-0.988*	*4.180*	*-2.114*	*4.080*	*-1.520*	*-2.547*	-
Rivals Ad Expenditure	-0.047	-0.003	-0.027	0.100	0.106	-0.046	0.014	-
	-3.148	*-0.318*	*-3.659*	*10.540*	*2.790*	*-0.753*	*2.211*	-
Units per lb.	0.359	-	-0.071	-0.090	8.464	-1.607	0.262	-
	3.461	-	*-0.074*	*-1.455*	*2.153*	*-0.672*	*6.053*	-

The top number in each cell is the estimated coefficient.
The bottom number is the t-statistic.

Segment Level Regression Coefficients

The results from the segment level regressions are reported in this section. The segment level regressions are the aggregations of the regular and spread segments. The

segment model has two equations, one for the regular segment and one for the spread segment. The results for the segment level regressions are found in table 9.

Estimated own-price elasticities for the spreads and regular margarine at the segment level are very similar - -1.345 for spreads versus -1.386 for regular margarine. Both estimates are statistically significant at the 95% level. The cross-price elasticities are also very similar and significant; .345 for spreads and .386 for regular margarine.

Expenditure was significant with elasticity measures of .959 for spreads and 1.041 for regular margarine. Spread and regular margarine have equal market shares so the Engle aggregation restriction was $.5\, h_s + .5h_r = 1$. As a result the expenditure elasticity estimates average to 1.

The results for all of the elasticities are significant and of the hypothesized sign. Given the brand level elasticity estimates the segment results appear to be of the proper magnitude. It is expected that increases in aggregation will lead to less elastic measures. Only Country Morning Blend was less elastic than the segment elasticity measure and only Fleischmanns was less elastic than the regular margarine elasticity estimate.[11]

Advertising expenditures are hypothesized to have a positive effect on quantity demanded and a negative effect on rivals' quantity. While the estimated coefficients for regular and spread advertising have the hypothesized signs for each equation, only the estimated coefficient for advertising expenditures for regular margarine demand was significant.

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[11] Land O' Lakes was not considered because the estimate was not statistically significant.

The estimated effect of regular advertising on regular demand is .002 - a one percent increase in advertising expenditure yields a .002 percent increase in volume sold.

A time trend variable was also included in the segment level system. The trend was insignificant for the both Spread and Regular margarine segments. Suggesting that margarine sales volume has not been systematically increasing or decreasing over time when other variables are accounted for.

Table 9

Segment Regression Estimates

Variable	**Spreads**	**Regular**
Intercept	-0.023	-0.009
	-2.563	*-0.902*
Spreads	**-1.345**	0.345
	-65.379	*16.763*
Regular	0.386	**-1.386**
	21.359	*-76.756*
Expenditure	0.959	1.041
	79.591	*86.356*
Spread Advertising	0.005	-0.008
	0.858	*-1.251*
Regular Advertising	-0.000	0.002
	-0.259	*2.730*
Time	-0.000	-0.000
	-0.796	*-0.199*

The top number in each cell is the estimated coefficient.
The bottom number is the t-statistic.

Industry Level

The final level of analysis, and the most aggregated, is the industry regression equation. The results from the regression are reported in table 10. The results are presented in the same order as the previous models.

The results at the industry level are much less robust than the brand and segment level models. The R^2 for the regression was .4938 - much lower than the other regressions. The estimated coefficient for the industry price elasticity is -.584, but it is insignificant. The estimated coefficient for price of butter had an unexpected negative sign of -.7, but it too is insignificant at the 95% significance level. Only the population variable was significant with a parameter estimate of 31.373 -an unbelievable result given that it is unlikely that a one percent increase in the population would lead to a 31.373 percent increase in margarine sales. It is clear that the industry regression is not robust, possibly due to data limitations, improper model specification, or both. The use of a aggregated quantity measure from the truncated IRI data set may not be the most appropriate measure of industry demand for margarine. A future regression model that used a quantity measure from the Statistical Abstract of the United States, which was the source for the independent variables, might yield better results.

Table 10

Industry Results

Variable	Estimate	t-statistic
Price of Margarine	-0.584	-0.835
Price of Butter	-0.7	-1.287
Population	31.373	3.312
Income	-4.996	-0.634
Intercept	-0.072	-1.58

N=30, $R2 = .4938$

Due to the weak results of the industry regression , the calculation of unconditional elasticities will not be performed in this Thesis. Future analysis may lead to a robust model for industry level margarine demand. Using better data, the first order differential model may result in robust estimates of elasticities. These estimates could be used with the brand and segment level results to convert the conditional elasticities into unconditional price elasticities.

CHAPTER VI

CONCLUSIONS

The industrial organization literature is filed with a variety of theory and empirical work attempting to understand the structure of markets. The reason for this interest stems from the basic premise that competitive markets yield efficient allocations of society's scarce resources. When markets are not competitive resources are not put toward their optimal use. Assessing competitive performance is essential for designing and applying governmental policy designed to correct market imperfections.

Much of the early work in industrial organization focused on basic structural variables (e.g., number of firms, CR4, or H-index) to determine market performance. In the early 1980s economists began to look at more rigorous models derived from economic theory to examine market performance. Recent availability of detailed point of sale data has created opportunities to use more complex econometric models.

The research of this thesis takes advantage of supermarket scanner data to apply brand level demand models to the margarine industry. The demand models were used to estimate own- and cross-price elasticities that could be used to assess the degree of product differentiation, a form of market power. Before the empirical model was specified, a review of the conditions for consumer aggregation was presented in Chapter 3.

In Chapter 3 it was shown that the first order differential demand model will be consistent with consumer aggregation only if it has an elasticity structure consistent with a utility function of the Gormon form. This structure was derived by

substituting the general utility function of Hang and Hauhn with a Gormon form utility function. Even though this elasticity structure must be assumed, the derivation shows that the first order demand model is not inherently inconsistent with a utility structure needed for consumer aggregation. Many empirical demand models, such as the log-log model, are not derivable from a utility function and are therefore structurally inconsistent with demand theory.

The empirical estimation using scanner data was successful - the estimated price elasticities were largely significant and credible. The brand level model also estimated the effects of two in store marketing variables on demand, percent on featured advertising and percent on display. Most of the significant estimated coefficients were positive (sales volume increased) for brands that were 'featured' in store advertising. However, two brands had estimated coefficients that were negative when featured in an in-store advertisement.. All of the significant estimates for percent of a brand's sales that were on display were positive. Overall, in store marketing factors increase the quantity demanded for a brand.

Unlike the in store marketing factors, advertising were often not of the hypothesized sign. A brand's advertising expenditures should lead to greater sales for the brand. Many of the brand had negitive estimated coefficents for own-advertising effects, suggesting a decrease in sales volume. The advertising data were not as rich as the in store marketing variables - there was no variation in the advertising variables across markets. Of the 12 brands, nine were significant but only five of these had the expected positive sign.

Effects by rival's advertising can be hypothesized to be either negative or positive. While rivals' advertising may draw sales for a brand it is possible that rivals' advertising increases the brand's sales. If the advertising does not significantly differentiate the brands from the general product segment then rivals may be providing an advertising free ride for the brand. The estimated coefficients for rivals' advertising did differ by sign. Even though the results are not in conflict with theory they should be interpreted with caution in-light of the data issues discussed above.

The results at the segment level were robust. All of the price and expenditure elasticities were significant and had the hypothesized signs. Advertising expenditures were also significant for regular margarine, but not for the spread segment. Rival's advertising was not significant for either segment. As with the brand level regressions, the advertising data did not vary across markets, possibly reducing its impact.

While model estimation was successful, Land O' Lakes was an exception. Land O' Lakes brand margarine did not yield significant results in the demand estimation. It may be that as a cooperative-owned brand, Land O' Lakes may respond to market conditions differently than investor owned firms. But this would not explain why Country Morning Blend, another Land O' Lakes brand, was estimated successfully in the spread segment. Possibly data collection or processing errors are the cause of the weak results.

The robust brand level elasticity estimates clearly show that the margarine industry is significantly differentiated. In both the brand and the segment level estimations price elasticities revealed that 1 % price increases lead to a drop in sales of no

more than 3 % for any brand - considerably less than the 100% drop expected in the perfectly competitive market.

Major market structures are shown in Table 11 (a repeat of Table 1). Given that the margarine industry is differentiated, the industry's market structure can be narrowed down to just two possible structures - differentiated oligopoly or monopolistic competition. Either is sufficient to conclude the existence of market power. Re-quoting Scherer and Ross "Pure monopolists, oligopolists, and monopolistic competitors share a common characteristic: each recognizes that its output decisions have a perceptible influence on price . . . . All three types possess . . . *market power* [12]." (Scherer and Ross, 1990 p. 17)

Table 11

Principal Seller's Market Structure Types

	Number of Sellers		
	One	A Few	Many
Products			
Homogeneous	Pure monopoly	Homogeneous oligopoly	Pure competition
Differentiated	Pure multiproduct monopoly	Differentiated oligopoly	Monopolistic competition

The importance of finding market power in the margarine industry is not so much that consumers pay too high a price for margarine. The importance is more that it suggests that industries in general do not have a perfectly competitive structure. The

[12] italicized in original

margarine product is by its physical nature relatively homogenous. However, these results suggest firms have found ways to create brand differentiation with out resulting to physical changes. Consumers have responded to the various strategies firms have used to differentiate their brands. As the degree of product differentiation increases the probability for market power increases. If market power is prevalent, then perfect competition is not.

If scanner data were more readily available to researchers, both IO and demand economists would be able to improve their contributions. Scanner data afford the researcher the ability to model markets at the brand level and in the future possibly at the product level. Future studies might model the change of demand conditions over time or across markets. However, such scanner data are not widely available and typically include confidentiality clauses that limit their usefulness for public research. Thus, although the promise is exciting the reality is frustrating to public research.

APPENDIX

SAS Programs for Brand Level Demand

```
data thesis;
  Infile '/usr2/SAS/sas609/dat0411.csv' dlm=',' lrecl=100000;
  input Year Quarter MRKID v1 v2 v3 v4 v5 v6 v7
   vpls v8 v9 v10 v11 v12 vplr P1 P2 P3 P4 P5 P6 P7 p8
   p9 p10 p11 p12 ppl A1 A2 A3 A4 A5 A6 A7 A8 A9 A10 A11 A12
   ma1 mb1 ma2 mb2 ma3 mb3 ma4 mb4 ma5 mb5 ma6 mb6 ma7 mb7 ma8
   mb8 ma9 mb9 ma10 mb10 ma11 mb11 ma12 mb12
   Time u1 u2 u3 u4 u5 u6 u7 u8 u9 u10 u11 u12 EXPs expr
   sa1 sa2 sa3 sa4 sa5 sa6 sa7 sa8 sa9 sa10 sa11 sa12;
  If MRKID=1 then D1=1; else D1=0;
  If MRKID=3 then D3=1; else D3=0;
  If MRKID=4 then D4=1; else D4=0;
  If MRKID=5 then D5=1; else D5=0;
  If MRKID=8 then D8=1. else D8=0;
  If MRKID=11 then D11=1; else D11=0;
  If MRKID=12 then D12=1; else D12=0;
  If MRKID=13 then D13=1; else D13=0;
  If MRKID=14 then D14=1; else D14=0;
  If MRKID=15 then D15=1; else D15=0.
  If MRKID=16 then D16=1; else D16=0;
  If MRKID=18 then D18=1; else D18=0;
  If MRKID=23 then D23=1; else D23=0;
  If MRKID=24 then D24=1; else D24=0;
  If MRKID=25 then D25=1; else D25=0;
  If MRKID=26 then D26=1; else D26=0;
  If MRKID=27 then D27=1; else D27=0;
  If MRKID=29 then D29=1; else D29=0;
  If MRKID=31 then D31=1; else D31=0;
  If MRKID=32 then D32=1; else D32=0;
  If MRKID=33 then D33=1; else D33=0;
  If MRKID=34 then D34=1; else D34=0;
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  If MRKID=41 then D41=1; else D41=0;
  If MRKID=43 then D43=1; else D43=0;
  If MRKID=44 then D44=1; else D44=0.
  If MRKID=45 then D45=1; else D45=0;
  If MRKID=48 then D48=1. else D48=0;
  If MRKID=49 then D49=1; else D49=0;
  If MRKID=53 then D53=1; else D53=0;
  If MRKID=54 then D54=1; else D54=0;
  If MRKID=61 then D61=1; else D61=0;
  If MRKID=63 then D63=1; else D63=0;
  If MRKID=65 then D65=1; else D65=0;
run;
proc syslin itsur data=thesis converge=0.1 maxiter=200;
  a:  model v8= expr P8 P9 p10 P11 P12  Ppl TIME
   d3 d4 d5 d8 d11 d12 d13 d14 d15 d16 d18 d23 d24 d25 d26 d27 d29 d31 d32 d33 d34
   d35 d36 d37 d38 d39 d40 d41 d43 d44 d45 d48 d49 d53 d54 d61 d63 d65
   MA8 MB8 A8 sa8 u8;
restrict  p8+p9+p10+p11+p12+ppl+expr=0;
  b:  model v9=expr P8 P9 p10 P11 P12  Ppl TIME
```

```
  d3 d4 d5 d8 d11 d12 d13 d14 d15 d16 d18 d23 d24 d25 d26 d27 d29 d31 d32 d33 d34
   d35 d36 d37 d38 d39 d40 d41 d43 d44 d45 d48 d49 d53 d54 d61 d63 d65
   MA9 MB9 A9 sa9 u9;
restrict   p8+p9+p10+p11+p12+ppl+expr=0;
  c   model v10=expr P8 P9 p10 P11 P12  Ppl TIME
   d3 d4 d5 d8 d11 d12 d13 d14 d15 d16 d18 d23 d24 d25 d26 d27 d29 d31 d32 d33 d34
   d35 d36 d37 d38 d39 d40 d41 d43 d44 d45 d48 d49 d53 d54 d61 d63 d65
   MA10 MB10 a10 sa10 u10;
restrict   p8+p9+p10+p11+p12+ppl+expr=0;
  d:  model v11=expr P8 P9 p10 P11 P12  Ppl TIME
   d3 d4 d5 d8 d11 d12 d13 d14 d15 d16 d18 d23 d24 d25 d26 d27 d29 d31 d32 d33 d34
   d35 d36 d37 d38 d39 d40 d41 d43 d44 d45 d48 d49 d53 d54 d61 d63 d65
   MA11 MB11 a11 sa11 u11;
restrict   p8+p9+p10+p11+p12+ppl+expr=0;
  e:  model v12=expr P8 P9 p10 P11 P12  Ppl TIME
   d3 d4 d5 d8 d11 d12 d13 d14 d15 d16 d18 d23 d24 d25 d26 d27 d29 d31 d32 d33 d34
   d35 d36 d37 d38 d39 d40 d41 d43 d44 d45 d48 d49 d53 d54 d61 d63 d65
   MA12 MB12 a12 sa12 u12;
restrict   p8+p9+p10+p11+p12+ppl+expr=0;
  f:  model vplr=expr P8 P9 p10 P11 P12  Ppl TIME
   d3 d4 d5 d8 d11 d12 d13 d14 d15 d16 d18 d23 d24 d25 d26 d27 d29 d31 d32 d33 d34
   d35 d36 d37 d38 d39 d40 d41 d43 d44 d45 d48 d49 d53 d54 d61 d63 d65;
restrict   p8+p9+p10+p11+p12+ppl+expr=0;
srestrict
 .3825693*a.expr+.0828384*b.expr+.0997484*c.expr+.0358106*d.expr+.2680956*e.expr
   +.1309377*f.expr=1,
   2.6139*b.p8+b.expr-12.0717*a.p9-a.expr=0,
  10.0252*b.p10+b.expr-12.0717*c.p9-c.expr=0,
  27.9248*b.p11+b.expr-12.0717*d.p9-d.expr=0,
  3.73*b.p12+b.expr-12.0717*e.p9-e.expr=0,
  7.6372*b.ppl+b.expr-12.0717*f.p9-f.expr=0,
  10.0252*a.p10+a.expr-2.6139*c.p8-c.expr=0,
  27.9248*a.p11+a.expr-2.6139*d.p8-d.expr=0,
  3.73*a.p12+a.expr-2.6139*e.p8-e.expr=0,
  7.6372*a ppl+a.expr-2.6139*f.p8-f.expr=0,
  27.9248*c.p11+c.expr-10.0252*d.p10-d.expr=0,
  3.73*c.p12+c.expr-10.0252*e.p10-e.expr=0,
  7.6372*c.ppl+c.expr-10.0252*f.p10-f.expr=0,
  3.73*d.p12+d.expr-27.9248*e.p11-e.expr=0,
  7.6372*d.ppl+d.expr-27.9248*f.p11-f.expr=0,
  7.6372*e.ppl+e.expr-3.73*f.p12-f.expr=0;
run,
run,


data thesis;
  Infile '/usr2/SAS/sas609/dat0411.csv' dlm=',' lrecl=100000;
  input Year Quarter MRKID v1 v2 v3 v4 v5 v6 v7
   vpls v8 v9 v10 v11 v12 vplr P1 P2 P3 P4 P5 P6 P7 p8
   p9 p10 p11 p12 ppl A1 A2 A3 A4 A5 A6 A7 A8 A9 A10 A11 A12
   ma1 mb1 ma2 mb2 ma3 mb3 ma4 mb4 ma5 mb5 ma6 mb6 ma7 mb7 ma8
   mb8 ma9 mb9 ma10 mb10 ma11 mb11 ma12 mb12
   Time u1 u2 u3 u4 u5 u6 u7 u8 u9 u10 u11 u12 EXPs expr
   sa1 sa2 sa3 sa4 sa5 sa6 sa7 sa8 sa9 sa10 sa11 sa12;
  If MRKID=1 then D1=1; else D1=0;
  If MRKID=3 then D3=1; else D3=0;
  If MRKID=4 then D4=1; else D4=0;
  If MRKID=5 then D5=1; else D5=0;
  If MRKID=8 then D8=1; else D8=0;
  If MRKID=11 then D11=1; else D11=0;
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  If MRKID=13 then D13=1; else D13=0;
  If MRKID=14 then D14=1; else D14=0;
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  If MRKID=15 then D15=1; else D15=0;
  If MRKID=16 then D16=1; else D16=0;
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  If MRKID=23 then D23=1; else D23=0;
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  If MRKID=53 then D53=1; else D53=0;
  If MRKID=54 then D54=1; else D54=0;
  If MRKID=61 then D61=1; else D61=0;
  If MRKID=63 then D63=1; else D63=0;
  If MRKID=65 then D65=1; else D65=0;
run;
proc syslin itsur data=thesis converge=0.1 maxiter=200;
  a:  model v1= exps P1 P2 p3 P4 P5 p6 p7 Ppl TIME
   d3 d4 d5 d8 d11 d12 d13 d14 d15 d16 d18 d23 d24 d25 d26 d27 d29 d31 d32 d33 d34
   d35 d36 d37 d38 d39 d40 d41 d43 d44 d45 d48 d49 d53 d54 d61 d63 d65
   MA1 MB1 A1 sa1 u1;
restrict  p1+p2+p3+p4+p5+p6+p7+ppl+exps=0;
  b:  model v2= exps P1 P2 p3 P4 P5 p6 p7 Ppl TIME
   d3 d4 d5 d8 d11 d12 d13 d14 d15 d16 d18 d23 d24 d25 d26 d27 d29 d31 d32 d33 d34
   d35 d36 d37 d38 d39 d40 d41 d43 d44 d45 d48 d49 d53 d54 d61 d63 d65
   MA2 MB2 a2 sa2 ,
restrict  p1+p2+p3+p4+p5+p6+p7+ppl+exps=0;
  c:  model v3= exps P1 P2 p3 P4 P5 p6 p7 Ppl TIME
   d3 d4 d5 d8 d11 d12 d13 d14 d15 d16 d18 d23 d24 d25 d26 d27 d29 d31 d32 d33 d34
   d35 d36 d37 d38 d39 d40 d41 d43 d44 d45 d48 d49 d53 d54 d61 d63 d65
   MA3 MB3 a3 sa3 u3;
restrict  p1+p2+p3+p4+p5+p6+p7+ppl+exps=0;
  d:  model v4= exps P1 P2 p3 P4 P5 p6 p7 Ppl TIME
   d3 d4 d5 d8 d11 d12 d13 d14 d15 d16 d18 d23 d24 d25 d26 d27 d29 d31 d32 d33 d34
   d35 d36 d37 d38 d39 d40 d41 d43 d44 d45 d48 d49 d53 d54 d61 d63 d65
   MA4 MB4 a4 sa4 u4;
restrict  p1+p2+p3+p4+p5+p6+p7+ppl+exps=0,
  e:  model v5= exps P1 P2 p3 P4 P5 p6 p7 Ppl TIME
   d3 d4 d5 d8 d11 d12 d13 d14 d15 d16 d18 d23 d24 d25 d26 d27 d29 d31 d32 d33 d34
   d35 d36 d37 d38 d39 d40 d41 d43 d44 d45 d48 d49 d53 d54 d61 d63 d65
   MA5 MB5 a5 sa5 u5,
restrict  p1+p2+p3+p4+p5+p6+p7+ppl+exps=0;
  f.  model v6= exps P1 P2 p3 P4 P5 p6 p7 Ppl TIME
   d3 d4 d5 d8 d11 d12 d13 d14 d15 d16 d18 d23 d24 d25 d26 d27 d29 d31 d32 d33 d34
   d35 d36 d37 d38 d39 d40 d41 d43 d44 d45 d48 d49 d53 d54 d61 d63 d65
   MA6 MB6 a6 sa6 u6;
restrict  p1+p2+p3+p4+p5+p6+p7+ppl+exps=0;
  g:  model v7= exps P1 P2 p3 P4 P5 p6 p7 Ppl TIME
```

```
    d3 d4 d5 d8 d11 d12 d13 d14 d15 d16 d18 d23 d24 d25 d26 d27 d29 d31 d32 d33 d34
    d35 d36 d37 d38 d39 d40 d41 d43 d44 d45 d48 d49 d53 d54 d61 d63 d65
    MA7 MB7 a7 sa7 u7;
restrict   p1+p2+p3+p4+p5+p6+p7+ppl+exps=0;
  h.  model vpls= exps P1 P2 p3 P4 P5 p6 p7 Ppl TIME
    d3 d4 d5 d8 d11 d12 d13 d14 d15 d16 d18 d23 d24 d25 d26 d27 d29 d31 d32 d33 d34
    d35 d36 d37 d38 d39 d40 d41 d43 d44 d45 d48 d49 d53 d54 d61 d63 d65;
restrict   p1+p2+p3+p4+p5+p6+p7+ppl+exps=0;
srestrict .1705309*a.exps+.0725217*b.exps+.2344473*c.exps+.0335613*d.exps+.1492138*e.exps
    +.040336*f.exps+.2334696*g.exps+.0659194*h.exps=1,
    5.864*b.p1+b.exps-13 789*a.p2-a.exps=0,
    5.864*c.p1+c.exps-4.26535*a.p3-a.exps=0,
    5.864*d.p1+d.exps-29.7962*a.p4-a.exps=0,
    5.864*e.p1+e.exps-6.70179*a.p5-a.exps=0,
    5.864*f.p1+f.exps-24.7917*a.p6-a.exps=0,
    5.864*g.p1+g.exps-4.2832*a.p7-a.exps=0,
    5.864*h.p1+h.exps-15.17*a ppl-a.exps=0,
    13.789*c.p2+c.exps-4.26535*b.p3-b.exps=0,
    13.789*d.p2+d.exps-29.7962*b.p4-b.exps=0,
    13.789*e.p2+e.exps-6.70179*b.p5-b.exps=0,
    13.789*f.p2+f.exps-24.7917*b.p6-b.exps=0,
    13.789*g.p2+g.exps-4.2832*b.p7-b.exps=0,
    13.789*h.p2+h.exps-15.17*b.ppl-b.exps=0,
    4.26535*d.p3+d.exps-29.7962*c.p4-c.exps=0,
    4.26535*e.p3+e.exps-6.70179*c.p5-c.exps=0,
    4.26535*f.p3+f.exps-24.7917*c.p6-c.exps=0,
    4.26535*g p3+g.exps-4.2832*c.p7-c.exps=0,
    4.26535*h.p3+h.exps-15.17*c.ppl-c.exps=0,
    29.7962*e.p4+e.exps-6.70179*d.p5-d.exps=0,
    29.7962*f.p4+f.exps-24.7917*d.p6-d.exps=0,
    29.7962*g.p4+g.exps-4.2832*d.p7-d.exps=0,
    29.7962*h.p4+h.exps-15.17*d.ppl-d.exps=0,
    6.70179*f.p5+f.exps-24.7917*e.p6-e.exps=0,
    6.70179*g.p5+g.exps-4.2832*e.p7-e.exps=0,
    6.70179*h.p5+h.exps-15.17*e.ppl-e.exps=0,
    24.7917*g.p6+g.exps-4.2832*f.p7-f.exps=0,
    24.7917*h.p6+h.exps-15.17*f.ppl-f.exps=0,
    4.2832*h.p7+h.exps-15.17*g.ppl-g.exps=0;
run,
run;
```

BIBLIOGRAPHY

Aaker, David A. and Jacobson, Roberts, "Is Market Share All That It's Cracked Up To Be?". *Journal of Marketing* Vol. 49 (Fall 1985), 11-22.

Andonov, Tihomir 1994. *Influence of Cooperatives in Retail Pricing of Branded Food Products*. Masters Thesis. Amherst: University of Massachusetts.

Appelbaum. Elie, "The Estimation of the Degree of The Oligopoly Power". *Journal of Econometrics* Vol 19 No.2-3 (August 1982): 287-299.

Baker, Jonathan B., Timothy F. Baresnahan, "The Gains from Merger or Collution in Product-Differentiated Industries". *The Journal of Industrial Economics* Vol. 33 No. 4 (June 1985): 427-444.

Clarke, Roger, Stephen Davies, and Michael Waterson, "The Profitability-Concentration Relation: Market Power or Efficiency?". *The Journal of Industrial Economics* Vol. XXXII No. 4 (June 1984): 435-450.

Connor, John M., Everett B. Peterson, "Market-Structure Determinants of National Brand Private Label Price Differences of Manufactured Food Products". *The Journal of Industrial Economics* Vol. XL No. 2 (June 1992): 157-171.

Connor, John M., Richard T. Rogers, Bruce W. Marion, Willard F. Muller 1985. *The Food Manufacturing Industries*. Lexington MA: D.C. Heath and Company.

Cotterill, Ron 1993. *Competitive Strategy Analysis in the Food System.* Bouldr and Oxford: Westveiw Press.

Cotterill, Ron. "Scanner Data; New Opportunities for Demand and Competitive Strategy Analysis". *Ager. and Res. Econ Rev.* Vol 32 No. 2 (January 1994): 125-139.

Demsetz, Harold, "Industry Structure, Market Rivalry, and Public Policy". *The Journal of Law and Economics* (1972) : 1-9.

Greer, Douglas F. 1992. *Industrial Organization and Public Policy.* New York, New York: Macmillan Publishing Company.

Hahn, William F, Kuo S. Huang ,"U.S. Quarterly Demand for Meats". Food and Consumer Economics Division, Economic Research Service, U.S. Department of Agriculture. Technical Bulletin No. 1841, (February 1995).

Haller, Larence E., "Branded Product Marketing Strategies in the Cottage Cheese Market: Cooperative versus Proprietary Firms". Food Marketing Policy Center Research Report No. 16 (January 1992).

Hausman, Jerry, Gregory Leonard, Douglas J. Zona, "Competitive Analysis with Differentiated Products". Annales d' Economie et de Statistique Vol. 0 No. 34 (April-June 1994): 159-180.

Marion, Bruce W., Frederick Geithma, Leonard W. Weiss, ed. 1989. *Concentration and Price*. MIT: The MIT Press 1989: 213-218.

Montgomery, Cynthia A., "Product-Market Diversification and Market Power". *Academy of Management Journal* Vol. 28 No. 4 (1985): 789-798.

Ravenscraft, David J., "Structure-Profit Relationships at the Line of Business and Industry Level". *The Review of Economics and Statistics* : 22-31.

Scherer, F.M., David Ross 1990. *Industrial Market Structure and Economic Performance*. Boston: Houghton Mifflin Company.

Schmalensee, Richard, "Collusion Versus Differential Efficiency: Testing Alternative Hypotheses". *The Journal of Industrial Economics* Vol. XXXV No.4 (June 1987): 399-425.

Szymanski, David M., Sundar G. Bharadwaj, and P. Rajin Varadarajan, "An Analysis of the Market Share-Profitability Relationship". *Journal of Marketing* Vol. 57 (July 1993): 1-18.

Varian, Hal R.1992. *Microecomomic Analysis.* New York: W.W. Norton & Company, Inc.

Weiss, Leonard W 1989. *Concentration and Price.* MIT: The MIT Press.

Wills, Robert L. 1983 a. *The Impact of Market Structure and Advertising on Brand Pricing in Processed Food Products.* Ph.D. dissertation. Madison: University of Wisconsin.