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Analysis of the Relationship Between Advertising, Concentration and Profitability in the U.S. Manufacturing Industry

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B.A., University of Brescia (Italy), 1996

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Dissertation

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Introduction

The purpose of this dissertation is to investigate the relationship between advertising, concentration and profitability in the U.S. manufacturing industry. Chapter I presents a review of the vast literature that exists on this topic and the approaches employed to identify and estimate the interaction between the variables object of the study. Chapter II presents an analysis of the U.S. manufacturing industry at the two-digit Standard Industrial Classification ("SIC") code level over the period 1963-1997. Chapter III presents a similar analysis over the period 1980-2000 focusing on the automotive and the pharmaceutical sectors.

Chapter I shows that the majority of studies presented in the literature have been performed across all industries. Few studies focused on the cereal or sugar industries are too specific to produce general results. Based on the existing research there is a wide range of studies for which the results cannot be applied to specific industries; or there are very specific industry studies that are initiated to explain a characteristic of an industry, and that cannot be generalized. In addition, studies generally focus on one year or, at most, on the change between two years. This does not take into consideration the fact that industries evolve over time and that the interaction between advertising, concentration and profitability requires time lags to show its effects. The characteristics of these studies and of the data employed affect our ability to extend the results obtained in these studies to other industries or over time.

Chapter II describes the data and the methodology used for the estimation of the relationship across the U.S. manufacturing industries over the period 1963 to 1997. In this chapter I estimate a system of simultaneous equations intended to explain the relationship between advertising expenditures, concentration and profitability across the manufacturing sector over the period analyzed. The results from the estimation and the indications from the Granger causality test

confirm the existence of a rich pattern of relationship between the three variables in levels, first differences or lags.

The results obtained indicate that concentration and profitability are important factors in the determination of the advertising to sales ratio in an industry. Advertising also varies over time, due to changes in the economy, which increase the necessity of companies to compete. In addition, the progress of society increases the amount of information available to the consumers and makes necessary for a company to invest in marketing activities that introduce the products or services to potential buyers.

Concentration is a significant variable in determining profitability. The relation between the two variables is positive, indicating that an increase in the degree of concentration increases the profit in the industry and viceversa. The only result in contrast with our expectations is the sign of the estimated coefficient for Lag(Pbt)[1] in the regression with the concentration ratio, which is negative and suggests that previous values of profitability are negatively related with future values of concentration.

The lag of profitability has been determined to be a significant regressor for the variable advertising to sales ratio. The relationship is positive and confirmed by the results of the Granger Causality Test. The lag of profitability appears to influence negatively the four-firm concentration ratio, the estimated coefficient being significant at the 1% level. This result was in contrast with our expectations, but could reflect the fact that industries with increasing profits over the course of the forty years analyzed have experienced an increase in competition from new entrants attracted by the high returns of the market players. New entrants in the industry lead to a reduction of the degree of concentration. On the other hand, industries characterized by a low

[1] Pbt represents Profit Before Taxes.

profitability drive more companies out of business, or compel them to diversify into other markets in order to revive their profitability. As existing companies exit the market, the concentration level increases.

All the other relationships are found to be positive and consistent with our expectations. The concentration ratio is positively influenced by the lagged level of advertising to sales ratio. The variable advertising to sales ratio reflects the effort made by companies to differentiate their products and to compete in the market to gain additional market share. A system with two equations allowed me to estimate the significant and positive relationship that exists between profitability and concentration. Finally, given the complex relationship between profitability and concentration, an Ordinary Least Squares ("OLS") estimation of the concentration ratios through an OLS methodology reveals that this variable is positively influenced by both the first difference and the lag in the value of profit to sales ratio.

Chapter III of this dissertation verifies the relationship between advertising, concentration and profitability in the automotive and pharmaceutical sectors. The choice of these two sectors is due to the fact that in both cases advertising and marketing expenditures represents a significant but critical expense to ensure the ability of companies to introduce new products and to successfully compete with dominant products sold by other companies. The automotive and pharmaceutical industries are characterized by the existence of economies of scale in various aspects of their business, including Research and Development ("R&D") and production. For these reasons there has been a lot of consolidation which has reduced the number of players over the years. In the case of the pharmaceutical industry, consolidation has caused the disappearance of independent companies specialized in the production of specific products (for example, agrochemical manufacturers). Besides these similarities, the automotive industry sells durable goods and is heavily influenced by periods of recession, while the pharmaceutical industry sells consumable

goods, which are generally insulated from recession. The results of my analysis will be reviewed keeping into consideration these differences.

The analysis performed seeks to identify how the results of the previous chapter for the entire manufacturing sector are affected by the characteristics of the two industries chosen. The OLS estimation of the two separate panel data available over the period 1980-2000 did not yield significant results. The estimation of the systems of simultaneous equations used in chapter II also failed to show any relationship between the three variables or when applied to the two equations system between concentration and profitability. Finally, the estimation of advertising as a percentage of sales on the profitability and concentration yielded results in contrast with those of chapter II.

The only significant relationship was found between profitability and advertising in the pharmaceutical sector. I estimated a system of simultaneous equations between advertising and profitability and obtained that the two variables are positively related, as it was expected. This result is however overshadowed by the absence of significance in all other relationships. In most of the estimations performed dummies are significant, indicating that there is a time-related variability in the variables object of the analysis that cannot be explained by the simultaneous variation in profit, concentration or advertising. In addition, the Granger causality test indicates that the market share variable, introduced to substitute the concentration ratio, could be an autoregressive process. In both estimations for the automotive and pharmaceutical industries, the lagged share variable is the only significant variable, producing an R^2 greater than 85%. The coefficient of the lagged term is equal to 0.85 in the automotive industry and 0.88 in the pharmaceutical industry.

These results could be due to the fact that there is not sufficient variability to be explained with factors other than industry or company specific variation and with time effects. This hypothesis is confirmed by the evidence that the variable share is an autoregressive process of order one and therefore slightly changes over time, in our case declining by approximately 15% each year. Nevertheless, strong significance has been identified in the positive relationship between profit and advertising, with causality running in both directions. Investments in advertising have a positive effect on the company's profitability. In addition, the higher the company's profits, the larger is the budget that a company can spend on advertising and marketing campaigns.

The results of the analysis performed in this dissertation confirm the existence of a relationship between advertising, concentration and profitability. Advertising appears to be determined by the interaction of profitability and concentration, whether these two variables interact and influence each other simultaneously. The analysis performed at the single industry level indicates that there is not sufficient variability to clearly identify the direction of causality between advertising, concentration and profitability.

Chapter I: Literature Review on Market Concentration

1.1 Introduction

The purpose of this dissertation is to identify the factors that cause differences in market structure across industries. Market structure, defined as the number of sellers that control the majority of a product supply, is an essential aspect of the economic environment for the social planner in order to maximize the welfare of society. This analysis seeks to evaluate whether the degree of concentration in an industry is generally determined by the collusive behavior of few companies attempting to optimize their joint profits or as a result of market forces.

For the most part, few big players dominate the majority of the U.S. industries. In this oligopolistic framework, if the degree of concentration within an industry is determined by the seller's collusion through a restriction of the supply in order to earn additional profits, the social planner should act to encourage more competition and to facilitate new entries within the same industry. Concomitantly, if the limited number of companies competing within an industry is the result of the free operation of market forces, the social planner should abstain from intervening and let free competition lead to the utility of the optimum market equilibrium.

Given the large number of studies performed over the last fifty years, this chapter presents only a partial overview of the principal works done in this field of economic research. This comprehensive review highlights the results obtained and identifies new developments. This discussion will produce the framework of the dissertation, which is an attempt to solve the two major problems that characterize the majority of the existing studies, namely: the inadequacy of the data used and the inability to perform analyses by sector.

1.2 Advertising, Concentration and Profitability

There is a wide variety of studies on the relation between advertising, concentration and profitability. Joe S. Bain performed one of the first investigations on this topic in 1951 (Bain, 1951). In his empirical analysis, he verified the hypothesis that average profits earned by firms in concentrated industries are higher than those earned by firms in less concentrated industries. By calculating the average after tax-profit Return on Equity ("ROE") for the period 1936-1940 of leading companies in 42 U.S. manufacturing industries, Bain found that in industries with eight firm concentration ratios of 70 or higher, the average profit return was 12.1%, compared to 6.9% for industries with ratios below 70.

This study prompted researchers to investigate all possible factors that may influence profitability. This category of studies operates on the assumption that the profit earned depends on the characteristics of the industry in which the firm operates. These characteristics, also referred to as "market structure", consist of the number of players operating in an industry, the degree of competition among these companies, the ability to differentiate among products (i.e., if there are close substitutes for the product, like in the case of milk) and finally the profits earned by market players. Market structure is usually measured by a concentration ratio, which is a measure of the number of participants, or of the degree of competition, in an industry.

The number of players in an industry is determined by several factors, which can be generally viewed as being entry barriers. Entry barriers are those factors limiting the ability of a company to enter and compete in a market. Regulations may restrict the ability of competitors to enter a market for many reasons, including safety, national security, or protection of intellectual property. Economies of scale, in conjunction with a limited demand for a product, may determine that only one company producing all the demanded output can operate at the lowest point on the average

production cost curve. Moreover, capital requirements may reduce the ability of new entrants to access favorable credit required to purchase the necessary plants and equipment used in production processes. Lenders often charge a higher interest rate to a company that is not already established in a market to compensate for the increased risk of not being able to penetrate a new market and consequently to meet the loan obligations. By investing in advertising campaigns aimed at developing a brand name, and therefore increasing customers' loyalty, existing companies can generate entry barriers, since consumers are often unwilling to change products, even if new products are priced lower. In addition, pricing collusion between existing participants in an industry could temporarily reduce the price of a product below its production cost, acting as an entry barrier to new competitors.

1.2 Two Alternative Views of Market Structure

As the number of studies on the relationship between concentration and profitability increased, the framework for testing became more complex. Researchers asked themselves what determines market structure. According to the Chicago school, market structure reflects the most efficient way to use available resources within an industry. Consequently, the higher the concentration within an industry (i.e., fewer players controlling a large share of the market) the more efficient the market will be, since the smaller number of players will fully benefit from economies of scale. Starting with Bain, other elements besides efficiency were introduced in the debate. Concentration could be determined by the existence of economies of scale, by the ability of companies to differentiate their products from their competitors and finally by the existence of barriers to entry.

As an alternative to the approach introduced by the Chicago school, it could be argued that some of the factors determining market structure could be due to the existence of collusion between

companies aimed at restricting the competition and maximizing the profits of the business. Barriers to entry could in fact be created by existing companies in an industry through advertising, through lobbying aimed at introducing favorable legislation, price collusion, and other actions. Figure 1 presents these two different hypotheses:

Figure 1: Chicago School (Horizontal) Versus Modern School Started With Bain's Analysis (Vertical)

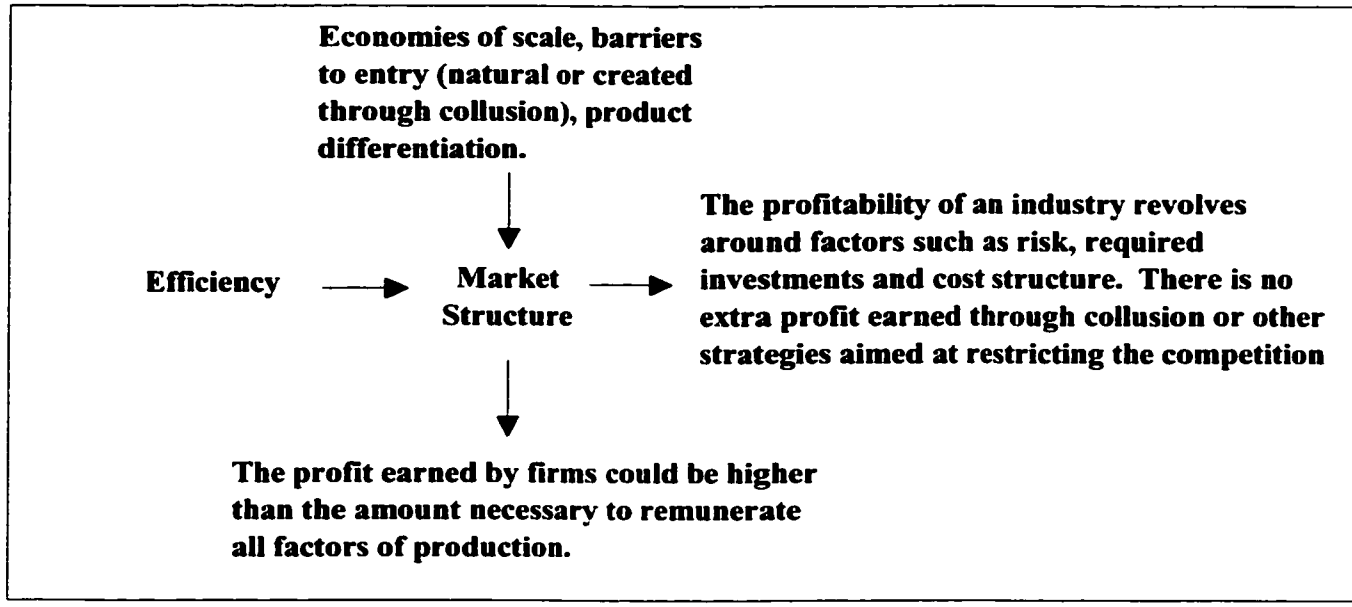

Figure 1 presents the two opposite views of market structure. When market structure reflects efficient allocation of resources, differences in profit rates can be explained by the characteristics of an industry. Such examples include capital requirements and bankruptcy risks. In the pharmaceutical industries, for example, the R&D budgets required to develop and bring to market a drug could justify the high price-cost margins earned from the sale of a drug. The high profitability allows the company to cover not only the costs incurred for development, but also to

compensate for any losses related to those drugs or chemical combinations that did not pass successfully through various stages of development.

An alternative interpretation of market structure claims that it is the result of collusion, or of strategies put in place by one or more companies to gain a leadership position in a particular market. This advantage may be obtained by gaining the loyalty of the consumers through advertising or marketing campaigns. It may also be obtained by having access to special factors of productions, which could be available in limited quantity. This type of market structure allows few players to earn profits above the average which cannot be justified by the theory of perfect competition.

The pharmaceutical industry can be used as an example to clarify the differences in the two schools of thought. This industry has been characterized by an increasingly competitive environment, where the life cycle for new products is being reduced due to the competition from generic brands. Non-patented products reduce the price and the sales volume of branded products. Some drug products have been shown, in fact, to experience a reduction of as much as 60% in sales in the five-year period following the patent expiration (Grabowski, Henry and John Vernon, 1989 and Drexel, Burnham and Lambert, 1998).

At the end of the 1970s and during the 1980s, drug companies began to increase their product prices at a rate faster than the rate of inflation. This practice has sparked an academic and political debate across the country, and became an important issue in the 2000 U.S. presidential campaign. There is disagreement on whether pharmaceutical companies are earning excessive profits by charging high prices for their drugs, or if the profits earned represent adequate compensation of the risks and the efforts required to introduce new drugs to the market.

The idea that drug companies are charging excessive prices to consumers and are earning higher profits, based on the legal protection offered by patents, presents one of the arguments in favor of modern theory. Drug companies face high business risks not only because of the high rate of failure in the R&D process, but also due to the possibility that a competitor could introduce a substitute product before the company completes the development and testing phases. However, more and more R&D is characterized by a "discover by design" approach, rather than a "random screening" approach (Grabowski and Vernon, 1990). A random screening was in the past a much riskier process to undertake, given the complete uncertainty existing over the outcome of the R&D effort. With a discover by design approach, a scientist can start from a more advantageous position since, with the help of a computer software program, the objective of the R&D effort and the path to developing a new chemical entity or a new drug has already been decided.

As we have seen, the modern theory has legitimate arguments to show that pharmaceutical companies, benefiting from the monopoly granted them by the patent protection, charge prices and earn profits above the level required to compensate a company for the functions performed and the risks incurred. In contrast with this view, many arguments typical of the Chicago school can be presented in defense of the pharmaceutical companies. Over time, R&D costs have been increasing significantly. The most recent estimate – by the Boston Consulting Group – shows that the pretax cost of developing a drug introduced in 1990 was $500 million, including the cost of research failures as well as interest costs over the entire period of the investment.[2] The higher cost of R&D increases the risk that a company will not to be able to profit adequately from the sales of a new product.

[2] Source: Pharma Publications – Pharmaceutical Industry Profile 1999, Chapter 2, page 7.

The product life-cycle has changed since the 1980s, particularly in the post-patent period where generic competition is now more intense. A study published by Grabowski and Vernon (1990) shows that the return on R&D for pharmaceutical companies is equal to their cost of capital, i.e., 9%. This result would favor the hypothesis that after accounting for costs and risks faced by pharmaceutical companies, the profit earned is consistent with the cost of capital required to finance their operations.

This example shows that the two schools of thought presented in this chapter are correctly identifying various aspects of a reality which is very complex. In the next sections of this chapter we will review the arguments in favor of one or other schools. The defenders of perfect competition would claim that in a concentrated market the reduction in the consumer surplus due to the higher price paid is not fully compensated by the increase in the profits of the oligopolists. This creates a dead weight loss for the society as a whole. On the other hand, Schumpeter (1950) argues that only in concentrated markets do companies have the availability of adequate budgets to invest in R&D. Without the prospective of earning above-average returns, a company would not undertake any risky project or would not invest huge budgets for the development of a new product or even a new technology. Micha Gisser (1991) also disagrees with the perfect competition argument, showing that if we analyze the oligopoly in a dynamic setting, there is no dead weight loss from the restriction in the number of companies operating in a market, but rather an increase in the consumer surplus.

1.4 Overview of Existing Studies on the Relationship Between Advertising, Concentration and Profitability

The relationship between advertising, concentration and profitability has been one of the most important topic of research over the last fifty years. The reason for the consistent attention paid

to this topic is twofold. First, from a company's perspective, it is important to determine what are the elements of success in an industry, and what winning strategies can be identified in order to maximize profits. Second, from the viewpoint of society, the equilibrium that maximizes the benefit (utility) received by consumers must be identified and attained by the social planner.

The environment in which a company operates is often very dynamic and competitive. Following the right strategy can lead to the achievement of a firm's objectives, which may include the maximization of shareholder value. Market knowledge is therefore critical for the survival of a company. Advertising and marketing decisions, pricing policies, and research and development expenditures lead to the strategic positioning of a company among its peers.

From a social planner's perspective, the interaction of competing firms and the effects of their strategies on consumer surplus need to be constantly monitored. This activity enables the social planner to identify any divergence between the overall goals of the society (maximization of the general welfare) and the goals of the market participants.

It should now be clear why so many studies of market structure have been performed in the last fifty years, given their paramount importance from the viewpoint of society. It is also not surprising that there is controversy over the results obtained and their interpretation, given the dynamic nature of this topic and the high degree of diversity that characterizes markets, firms and historical periods.

Table 1 presents a brief summary of the most relevant studies performed on the relationship between advertising, concentration and profitability. The third column of Table 1 (test performed) shows the equation(s) used to perform the various analyses followed by the fourth

column which identifies the results obtained. The purpose of Table 1 is to highlight the different and contrasting results obtained, in some cases, for the same estimation model.

Looking at the results of the analyses presented in Table 1, it is possible to identify two periods in which research diverged in the investigation of these relationships. For approximately twenty-five years, from 1956 until the end of the 1970s, research concentrated on evaluating the effects of concentration, either on advertising or on profitability. The second period of these studies, beginning in the 1980s, is characterized by the analysis of the interrelationship between advertising, concentration and profitability. The better perspective of the latter approach comes from the recognition of the interaction between the three variables. In general, most authors use systems of equations where each of the three variables is endogenous.

Table 1: Overview of Studies on the Relationships Between Advertising, Concentration and Profitability.

Legend: π represents profitability; C, concentration; Adv, Advertising Expenditures; C4, Four-firms concentration ratio; barrier, one or more dummy variables indicating the presence of entry barriers; ΔC, change in the concentration; ΔAdv, change in advertising expenditures, C^2, square value of concentration, K req, capital requirements, PCM, price-cost margin (the ratio of the difference between price and marginal cost and the price); S, sales; n, the number of companies into the industry; ICR, Initial value of Concentration Ratio; G, growth of sales; Size, total sales or total assets, used as a measure of the company's size; Std Dev, standard deviation of the concentration ratio. The inverted-U hypothesis, which will be explained later, claims that as concentration increases, advertising expenditures increase at a decreasing rate, until they reach a maximum value (generally under oligopoly) and then they decline.

Author(s)	Year of Publication	Test Performed	Results
Bain	1956	π = f(C, barrier)	Concentration has a positive effect on profits when barriers to entry are high.
Telser	1964	Adv = f(C4)	Not significant.
Mann	1966	π = f(C, barrier)	Concentration has a positive effect on profits when barriers to entry are high.
Mann, Henning and Meehan	1967	Adv = f(C4)	Strong positive relation.
Telser	1969	Adv = f(C4)	Not significant.
Weiss	1969	π = f(C, barrier)	Concentration has a positive effect on profits when barriers to entry are high.
Ekelund and Gramm	1970	C = f (Adv) Δ C = f (Δ Adv)	Not significant.
Greer	1971	Adv = f(C, C^2)	Confirmation of a quadratic relationship.
Sutton	1973	Adv = f(C) Adv = f(C, C^2)	Quadratic version performs better than the linear version, introducing the inverted-U hypothesis.
Reekie	1974	Adv = f(brand density ratios)	Not significant.
Rees	1975	Adv = f(C) Adv = f(C, C^2)	The relation is actually linear.
Comanor and Wilson	1976	π = f(Adv, K req, other var)	Advertising and capital requirements are significant barriers to entry and permit high profits.
Strickland and Weiss	1976	System of equations for Adv, C, PCM	Significant relationship.
Ornstein	1976	Adv = f(C,S) and Adv/S = f(C) Adv = f(C, C^2,S) and Adv/S = f(C, C^2)	Square term is not significant, rejecting the inverted-U hypothesis. Concentration has little effect on advertising.
Smith, Danford, and Stanhouse	1978	Adv/S = f(n/S, C) Adv/n = f(C, S/n)	Advertising is proportional to sales when concentration is low, but small firms advertise relatively more than large firms when concentration is high. All firms in concentrated industry advertise more than firms in less concentrated industries.

Table 1 (Cont.): Overview of Studies on the Relationships Between Advertising, Concentration and Profitability.

Author(s)	Year of Publication	Test Performed	Results
Ornstein	1978	Adv/S = f(n/S, C) Adv/n = f(C, S/n)	Opposite results with respect to those of Smith, Danford, and Stanhouse. The first equation is not significant whereas the second is (R-square of .781).
Brush	1978	Adv = f(C) Adv = f(C, C^2)	Introducing the square term leads to a loss of significance. The linear equation is significant.
Martin	1979	System of equations for Adv, C, π	Profitability and seller concentration are significant in the advertising equation. Lagged concentration is the most important variable in the concentration equation.
Ash	1979	Δ C = f(initial C, Growth, Adv/S)	The relation is not significant. Only the coefficient for initial concentration is relevant.
Mueller and Rogers	1980	ΔC=f(ICR, G, Size, Adv)	Significant relationship.
Lunn	1989	System of equations for R&D, Conc, and Adv	Concentration, advertising and capital requirements result significant.
Gisser	1991	System of equations for Adv, C, π	Only the equation of advertising is significant. Rejects the inverted-U theory and fails to support the barriers-to-entry hypothesis.
Willis and Rogers	1998	Adv = f(PCM, C, C^2, Std Dev, other)	Significant relationship.
Cortes	1998	Analysis of trends for industrial concentration in Japan	Market size and economies of scale is significant in determining concentration.
Gisser	1999	Granger Causality Test on adv, tech, concentration, price	Investment in technology Granger causes concentration.
Milyo, Wald, and Fogel	1999	Analysis of the effects of advertising in the natural experiment setting of Rhode Island and the Liquormart decision	Advertising is effective in creating more competition and in lowering prices.
Madden and Savage	2000	Analysis of the telecommunication industry with a theoretical model	Market concentration and competition are significant determinant of prices.

From the studies of the first period (1956-1979), it is noticeable that concentration is the independent variable in all the regressions. In some cases another variable is used, barriers to entry, which is related to concentration, since high concentration in an industry is always related with the presence of barriers to entry. This first part of Table 1 shows mixed results: depending on the data used or on the period studied, each test may confirm or reject the hypothesis that a relationship exists between advertising and concentration.

As Table 1 illustrates, during the 1970s research was mostly concentrated on the analysis of a possible nonlinear link between concentration and advertising or profitability. The results in this area are quite controversial. Greer (1971) and Sutton (1973) introduce the hypothesis of a quadratic relationship between advertising and profitability. Their regression analysis introduces the concept of the inverted-U relationship. When concentration increases, advertising initially increases, but as the number of players in the market declines, the incentives to incur advertising costs increase, since each company, now an oligopolist, is able to capture a share of the market through product differentiation or collusion. The same idea has been presented for the relationship between concentration and R&D.

Glenn C. Loury (1979) was the first to develop a general equilibrium model where each firm in an industry invests in R&D under both technological and market uncertainty. This economic setting is particularly realistic, since it reflects the environment in which many companies (for example in the pharmaceutical sector) operate. Their investment could fail to lead to the discovery of new products, new technologies or new processes and sometime jeopardize the independence of the company. A company without new products is not able to maintain market competitiveness and profitability. These factors which could lead to a lagging share price and even to an hostile takeover, or they could lead to a progressive loss in market share and

potentially to bankruptcy. Success in R&D activities could lead to the introduction of new products and therefore to the ability to expand a company's share of the market or to achieve a position of monopoly granted by patent protection or simply by making the product unavailable to potential competitors.

Loury introduces uncertainty in the model by assuming a stochastic relationship between a firm's R&D investment and the time at which the innovation may be introduced by the firm. One finding was that as the number of firms in the industry increases, the equilibrium level of firm investment declines. However, if a marginal increase in R&D investment by any single firm entering the market causes the investment of every other firm to fall by a smaller amount, then increasing the number of firms always reduces the expected industry introduction date of the innovation.

This study provides support to the idea that as the number of industry participants falls, the total amount of R&D investment increases. However, after introducing some modifications to Loury's framework, two different studies (Lee and Wilde, 1980 and Reinganum, 1985) show that the total amount of R&D falls as the number of competitors increases.[3] This confirms that the incentives for a monopolist to engage in R&D in order to develop new products or new processes are lower than for an oligopolist, since the monopolist is already able to fully maximize the profits.

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[3] Loury's model was based on the assumption that each company's investment in R&D consisted of acquiring a random variable by paying X at $t=0$. This random variable would then realize in the discovery of an innovation or in the failure of the R&D. In the case of Lee and Wilde, companies invest in R&D by paying a fixed cost of F and incurring a flow cost of X. The firm will continue to pay this flow cost until either this company or one of the other firms in the market produces a usable new technology. Finally, Jennifer Reinganum creates a generalized version of these models, were there exists a sequence of innovations with associated profit flows of R_0, R_1, ..., R_T, where R_i denotes the flow profit available from the current innovation when there are t innovations remaining. These profit flows are assumed to be known in advance; only the timing of the innovations is uncertain. At each stage t, a given number of firms n_t are competing to be the first to introduce the next innovation. Firm i pays a fixed cost F_t and invests at the constant rate x_i.

Even in oligopoly, as a company's market share increases, the ability of the company to earn extra profits improves, and the few remaining players have the incentive to compete on a non-price basis, such as the level of advertising.

Advertising can represent a barrier to entry if economies of scale exist in advertising (Scherer, 1980 and Vernon, 1972). Bain (1956) identified three elements of market structure as the main determinants of the nature of entry conditions: economies of scale, product differentiation, and absolute cost advantages of existing firms. In contrast, the Chicago school holds that advertising is an opportunity for new firms to make their way into the market (Telser, 1964). Through advertising new firms can inform the public of their presence and induce consumers to take a chance on the new product.

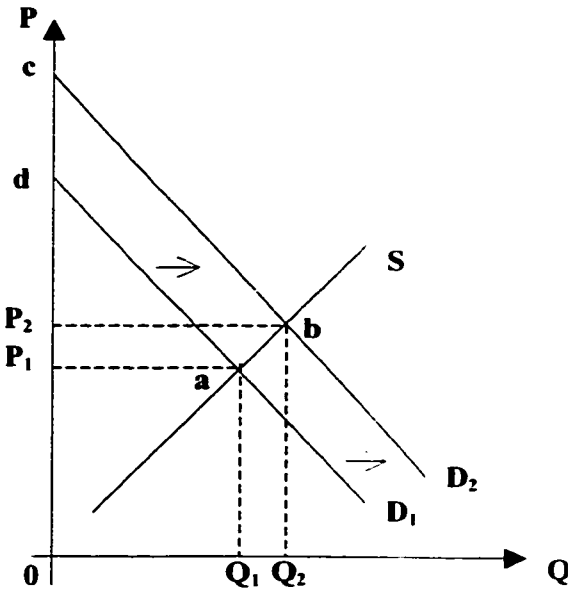
If past advertising has no effect on current demand, a new firm can enter into a market, invest in a major advertising campaign to differentiate its product and have the same probability of success as the established firms. If past advertising does not affect current demand, advertising is not a barrier. If instead the effect of advertising lasts over time, established firms inherit a positive brand image. A new firm will have to spend more on advertising in order to overcome the advantage accumulated by existing firms in the market. The rate at which the effect of advertising on demand depreciates varies from industry to industry. This market penetration cost creates a disadvantage between new and established firms upon which Bain (1956) based his analysis of product differentiation as a barrier to entry.

There will be economies of scale in advertising if some minimum amount of public exposure is needed before a sales campaign makes any impression on the public. In industries composed of regional submarkets, a firm may be able to enter and advertise in a regional market, establish a solid foothold, and then expand to other regional markets. There will also be economies of large

scale in advertising if repetition makes advertising more effective. For such goods, advertising puts the name of the product in front of the consumer, to increase the odds of a first purchase. The average cost of advertising could fall as its volume increases. Advertising can make a consumer conscious of a brand name, but only experience will indicate whether or not the consumer finds the brand satisfactory.

Advertising increases with the level of concentration and with the size of the market. Advertising is a prerequisite for expanded output in many industries, typically those initially limited to local or regional markets. Advertising causes a rightward shift in demand (See Figure 2 below). The higher the level of concentration, the greater the advantage from an increase in the demand that will accrue to the entity that incurred the investment in advertising. In addition, large firms have larger markets to serve and require wider exposure and more repetition.

Figure 2: Espansive Effect of Advertising on the Demand of a Product



As Figure 2 illustrates, advertising increases the consumers' desire for a particular product. This effect is represented by a rightward shift of the demand curve from D_1 to D_2. Consequently, consumers will demand a higher quantity, Q_2, at price P_2 and producers will enjoy an increase in revenues and consequently in profits. Alternatively, for the same quantity Q_1 of products sold, the consumer is now willing to pay a higher price, leading to a similar increase in the producers' revenues.

From the consumers' perspective, the willingness to pay a higher price is also reflected in the greater surplus enjoyed after the product becomes more desirable. The consumer surplus is given, for a determinate quantity of goods, by the difference between the maximum price that the consumer would be willing to pay and the price that she/he actually pays. Before the increase in demand, consumers were willing to pay the area $0Q_1ad$ for that particular product. Since the equilibrium price was P_1, the consumer surplus equaled the triangle P_1ad. After the advertising campaign, even though the price increased to P_2, the surplus for the consumer has now become the bigger area, P_2bc. This indicates that the "satisfaction" obtained by the consumer from the same product has increased. Even if fictitious, advertising has increased the benefit perceived by the consumer from purchasing and using a particular product.

There is reason to believe that incentives to advertise will be stronger when the number of sellers is limited. Demand might be shifted in favor of the general product line advertised at the expense of all other products, and it may be shifted in favor of the specific firm doing the advertising at the expense of other competitors selling similar products. The generalized increase is realized whether the company advertising is one among many or an oligopolist. The benefit received from the advertising practice of other companies in the market is an externality to the atomistic seller. It can be internalized completely only by a pure monopolist. If a company operates in a

perfectly competitive market or if there is close substitutability with the products sold by the competitors (for example, in the case of milk, sugar, or orange juice), advertising expenditures could benefit the competitors. For example, no individual orange grower has an incentive to advertise on a national basis. The incentive to advertise depends on the seller's ability to differentiate the product. In the case of the orange juice, the differentiation is attempted on a regional basis, as in the case of the Florida orange juice. According to the advertisement the Florida orange juice is superior to the orange juice produced in any other part of the country. A similar campaign is conduced for milk, given its high substitutability.

Although a pure monopolist has the maximum incentive to undertake advertising with broad market-expanding effects, it lacks any incentive for advertising. Oligopolist selling products that can be differentiated occupy the best (or worst) of both worlds. They have rivals from whom they can capture sales, and they benefit significantly in the overall expansion of market demand.

We could therefore expect advertising expenditures per dollar of sales to be higher under differentiated oligopoly than under either pure monopoly or monopolistic competition. This is the hypothesis set fourth by researchers defending an inverted-U relationship between advertising and concentration.

The second part or group of studies in Table 1 includes those approaches based on the estimation of a system of simultaneous equations. Several authors realized that there is interaction between advertising, concentration and profitability. Moreover, we can identify three contrasting views:

1 The existence of barriers to entry (concentration) may have a positive effect on profitability and may determine the budget allocated by the oligopolists to advertisement;

2 On the other hand, the existence of economies of scale in advertising may favor companies who have entered into the market first, creating a concentrated business that could ensure higher profits to the few players; and

3 Lastly, one could argue that the high profits characterizing certain industries give an incentive to the market participants to create entry barriers through the use of intensive advertising campaigns.

These three different interpretations of the relationship between advertising, concentration and profitability, have convinced researchers to leave open all possible kinds of interaction by estimating a system of simultaneous equations.

The limit of the linear approaches undertaken in analyzing the interaction between advertising, concentration and profitability represents their inability to account for the dynamic behavior of these variables. Each study attempts to use a static structure to interpret the actual relationship. The main problem of the single equation approach is that it allows only one causal relationship, which is less realistic than considering the interaction effect among these variables. It is not important whether the dependent variable is advertising, profitability or concentration, because in general also the dependent variable plays a role in influencing the variability of the independent variables.

The systemic approach solves this problem by allowing a multidirectional relationship among the variables studied. This feature increases the ability of the model to explain the real world, even though it is still difficult to identify the actual direction of causation between the variables used. Figure 3 illustrates the complex relationship between these variables. Given the limited results obtained from the use of systems of equations, it has not been demonstrated yet that the

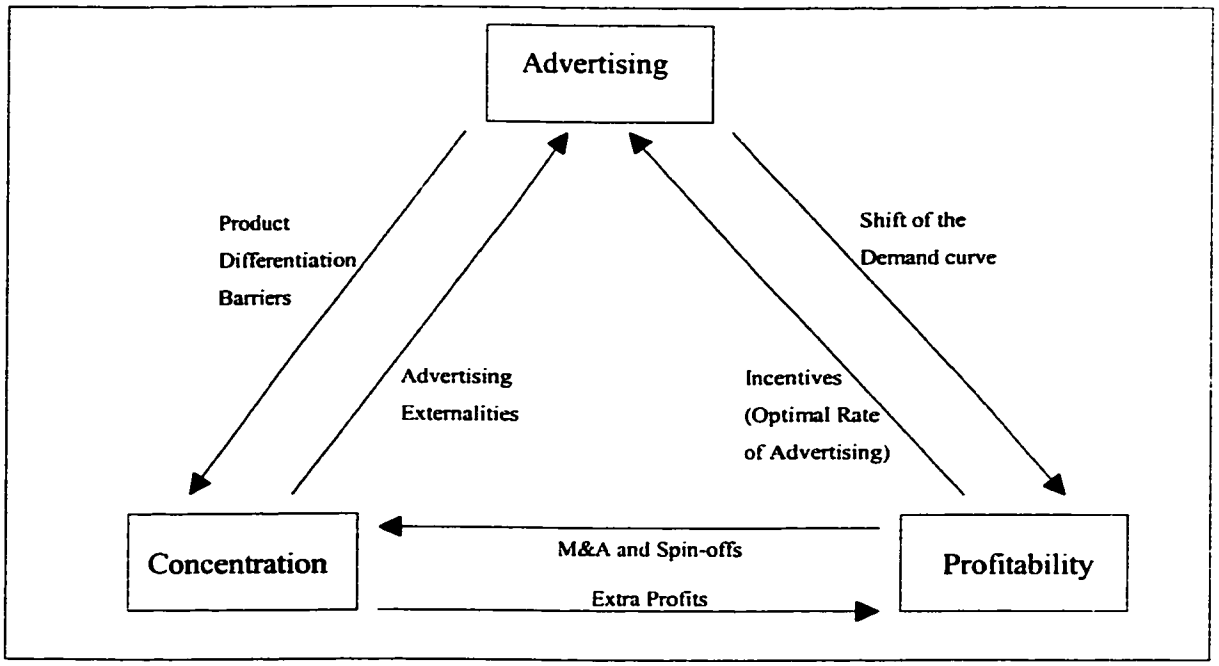
estimation of a single linear equation does not produce useful results in this field of studies. This is confirmed by the difficulty and sometimes by the failure of systems of simultaneous equations to better identify the relationship between advertising, concentration and profitability (see, for example, Strickland and Weiss, 1976).

In their paper, Strickland and Weiss present a simultaneous equation analysis of the relationship between structure and performance. Their results indicate that the simultaneous equation bias is not an important factor. The authors claim that advertising is expected to increase with concentration, but that at the same time an increase in advertising would have an effect on concentration through economies of scale in advertising.

Their results suggest that the relation between concentration and advertising is of an inverted-U form. In particular, advertising expenditures reach its maximum at a level of four-firm concentration ratio equal to 0.49. The numerous explanatory variables used in the estimation are strongly significant.[4] However, estimations performed by OLS and by 2 Stages Least Squares ("2SLS") do not lead to significantly different estimates. The only difference is that by using 2SLS, the coefficient of the variable "concentration" does not result significant. This result indicates that the use of a simultaneous technique of estimation does not significantly improve the explanatory power of the model.

[4] The variable used in the estimation are: advertising expenses over net sales, price cost margin, consumer demand over net sales, the concentration ratio and the square of the concentration ratio, the percentage growth rate in the industrial production, a dummy for durable goods industry, a variable to approximate the presence of economies of scale, the gross fixed value of assets, a dummy variable to approximate geographic dispersion. With the exception of growth and durability (consumer demand over net sales), all other variables are strongly significant.

Figure 3: Overview Of The Relationships Between Advertising, Concentration and Profitability



Advertising has a positive influence on profitability because the demand curve can shift rightward, increasing the price that consumers are willing to pay for a given quantity. This enables producers to earn a higher margin per unit of product sold. Advertising is expected to influence concentration because it creates barriers to entry that benefit the limited number of players with above average profits. The tests related with these two relationships, depicted by the external arrows of the triangle in Figure 3, represent the majority of the papers presented in the first part of Table 1. These tests are performed with a simple regression approach where the dependent variable is usually the level of advertising, or advertising as a percentage of sales, and the independent variable is a concentration indicator. Table 2 presents, as an example, the regression performed by Ornstein (1976) to shed some light on the advertising-concentration controversy.

Table 2: Ornstein's (1976) Regressions – Estimates from the Total Sample

Equation	Estimates	R^2
$\frac{\text{Adv}}{\text{S}} = f(CR)$	$\frac{\text{Adv}}{\text{S}} = 0.7881 + 0.0225^{**}\ CR$	0.03
$\frac{\text{Adv}}{\text{S}} = f(\text{CR}, \text{CR}^2)$	$\frac{\text{Adv}}{\text{S}} = 0.4489 + 0.0426\ CR - 0.0002\ CR^2$	0.03
$\text{Adv} = f(\text{CR}, \text{S})$	$\text{Adv} = -6.0017 + 0.0107^{**}\ CR + 1.0563^{**}\ S$	0.53
$\text{Adv} = f(\text{CR}, \text{CR}^2, \text{S})$	$\text{Adv} = -6.3060 + 0.0241^{*}\ CR - 0.0002\ CR^2 + 1.0563^{**}\ S$	0.53

Note: CR is the four-firm concentration ratio, and S represents log (sales). Sample of 328 observations.
* Significant at 0.01 level; ** Significant at 0.05 level.

Alternatively, the test could be carried out by using a profit ratio as the dependent variable and concentration and/or advertising as the regressors. As an example, Table 3 provides the estimated results from the pioneer work performed by Joe S. Bain (1956) which gave a decisive impulse to subsequent studies. Given the additional relations presented in Figure 3, it is clear that the approach undertaken by these tests cannot help explain such complex interaction between the three variables.

Table 3: Bain's (1956) Estimated Coefficients

Period Covered	Estimates	R^2
1936-1940	$\pi = 3.82 + 0.069\ CR*B_1 + 0.078^{*}\ CR*B_2 + 0.194^{**}\ CR*B_3$	0.78
1947-1951	$\pi = 9.26 + 0.06\ CR*B_1 + 0.062\ CR*B_2 + 0.119^{**}\ CR*B_3$	0.47

Note: π is the profit rate on equity after income taxes, B_1, B_2 and B_3 are dummy variables with a value of 1 when barriers to entry are "low to moderate", "substantial" and "high" respectively, and CR is the four-firm concentration ratio. Data on 20 industries.

Advertising can directly influence profitability by shifting the demand curve for the commodity. In addition, advertising can also influence profitability by creating barriers to entry which limit the level of competition in a market. If an advertisement campaign makes a consumer less willing to change a product, the effect of a marketing campaign is not only to increase the price that the consumer will pay for the same product, but to reduce the incentive for potential competitors to enter the market (creation of barriers to entry). A new company will have to incur high advertising expenditures to become a significant treat for the existing players. This advertising campaign is extremely risky, because if it fails, the company will loose all the investment spent to enter the market. Banks and financial institution are therefore less willing to lend money to new entrants, and will usually charge a higher interest rate than that required for the same type of loan to existing players.

We have now covered the external triangle in Figure 3. Advertising appears to be the relevant variable in the determination of profitability for an industry. However, the relationships analyzed run in both directions and in fact advertising can be seen as the result of high profits or high concentration, as represented in Figure 3 by the two internal arrows. The incentive to advertise is

certainly higher when profits are increasing, since there are more resources available for marketing campaigns. In addition, the higher the profitability of an industry, the higher the level of advertising which equalizes the marginal cost to the marginal revenue of a product. This situation is common in a fast growing industry, where consumers are eager to pay higher prices for products and where the suppliers are still expanding their markets and production. In this case advertising provides guidance to consumers about the existence of a company or of a product, and the costs incurred for advertising can be relatively high as are the benefits of advertising.

The incentive to advertise depends also on the ability of a company to appropriate the benefits from advertising. In a situation of perfect competition, there is no extra benefit from an advertising campaign, because any shift in the demand curve will still leave the market participants at an equilibrium level with zero extra profits. In a perfectly monopolistic market all the benefits from advertising are captured by the monopolist. Within these two extremes is the case of markets we find in the real world, where the company incurring the cost of advertising can receive greater benefits from advertising when the number of players in the market is fewer and it is easier to differentiate the products. Even in products such as water and gasoline, for example, large budgets are dedicated to advertising in order to develop a distinctive image of the product in the mind of the consumers.

Even the relationship between concentration and profitability is double-sided, since it is possible that profitability, or changes in profitability, affect concentration. An example is the case in which a market becomes mature and the profits start to decline. In that case a process of merger and acquisitions will start, in order to improve economies of scale and synergies among companies. The level of concentration will therefore increase, due to decline in profits. Another instance in which the profitability affects the concentration is the ability of successful companies

to invest more resources in R&D. In general this leads to a higher rate of innovation, but also to the development of technologies which eventually will create a barrier to entry within the industry. In fact, it becomes more difficult for a new company to acquire the adequate technology that would allow it to play a competitive role in a market, than it is to acquire an existing company.

1.5 Measurement of Advertising, Concentration and Profitability

The purpose of this section is to provide an overview of the most important variables considered in my study: advertising, concentration and profitability. The wide range of results obtained by researchers from investigating the relationship among these variables depends partly on the different time period studied, partly due to the causality relationships that do not flow in only one direction, but also due to different definitions of advertising, concentration and profitability used.

1.5.1 Advertising

For the purpose of this study, advertising includes expenses such as promotional, marketing, or advertising campaigns used to promote a company's products or services to the public. Advertising allows a company to differentiate itself from the competition, or to promote a new product to consumers. This variable can be expressed in U.S. dollars or as a percentage of sales. Given the absence of a specific requirement for companies to specifically indicate in their financial data the advertising, marketing, and promotional expenses incurred, there is not an official source of yearly data. Moreover, given the different practices to record advertising, data available is not always reliable. Companies have different policies on how to account for advertising expenditures. The yearly costs could be completely expensed (i.e., included in the company's income statement thereby reducing the profit by a corresponding amount) or they

could be partially capitalized as a long-term investment. If costs are capitalized, the profits of the company are overstated. With this accounting procedure, the advertising expenditures appearing in the income statement underestimate the actual resources deployed by the company to increase its visibility in the market. In addition, for certain advertising expenditures it is very difficult to track the cost for the company, as well as the benefits. For example, sponsorship of charitable activities is seldom included under marketing in the income statement of a company. Another example is the use of a company's shares (or options) as compensation for advertising, a practice often used by startup companies, Priceline.com being a notable example.

The majority of studies in which advertising is included as a variable rely on Bureau of Census data, in particular, the information from the Input-Output ("I/O") tables of the U.S. economy. The I/O tables provide information about the production and the use of commodities in the U.S. economy as intermediate or as final goods. For each industry the I/O table shows the value of the production used as an intermediate input in the production of another industry. In the case of advertising, the I/O table provides information about the use of this service by each industry. This use is considered intermediate, because advertising is an input for the industry requiring the service, that allows a company to market its products more successfully.

Three exceptions to the use of I/O tables are the studies of Willis and Rogers (1998), Nevo (1998) and Milyo and Waldfogel (1999). Willis and Rogers use data on consumer-oriented expenditures as published by the Leading National Advertisers. The disadvantage of this source of information is the unavailability of data on the advertising expenditures incurred to market products to other companies or retailers (advertisement of industrial products). Another disadvantage derives from the coding system for these advertising expenditures that does not match the SIC codes system and requires a reclassification, with consequent risk of bias. The other two approaches do not

make use of the I/O tables because of the peculiarity of their studies. Nevo measured the degree of advertisement for the single brands of cereal by visiting and surveying several supermarkets, and Milyo and Waldfogel verified the relation between liquor advertising and lower prices by directly surveying wine shops.

1.5.2 Concentration

The most widely used concentration indexes are provided by the U.S. Bureau of Census, "Concentration Ratios in the Manufacturing Industry." The U.S. Bureau of Census has publicized concentration ratios since 1935. Until 1982, these ratios provided information on the market share held by the largest 4, 8, 20 and 50 companies of an industry. Starting in 1982 the Bureau of Census adopted the Herfindahl-Hirschman index ("HHI") of concentration. The N-firm concentration ratio ("N-CR") is obtained by summing the market shares of the largest N companies (s_i):

$$N-CR=\sum_{i=1}^{N} s_i$$

For example, the widely used four-firm concentration ratio is obtained by summing the market shares of the four largest firms. HHI is obtained by calculating the sum of the squared market shares of all the companies operating in an industry:

$$HHI=\sum_{i} s^2{}_i$$

where s_i represents company i's market share.

Since its adoption in 1982 by the Department of Justice, there have been numerous studies on the virtues of HHI, as opposed to the four-firm concentration index.

There are three major interpretations of the HHI:

1. HHI is a weighted average of the individual market shares with greater weights assigned to larger market shares than to smaller market shares;

2. HHI provides a basis for a "numbers-equivalent" which is the number of equal-sized firms that would result in the same level of concentration. An industry with HHI of 2500 would be as concentrated as an industry with four equal-sized firms; and

3. HHI is a member of a family of indices concerning the distribution of market shares. The HHI has been shown by Hanna and Kay ("HK") to be a special case of a more general index of the distribution of S_i (defined as shares in decimals rather than percentages),

$$HK = \left(\sum_{i=1}^{N} S_i^{\alpha} \right)^{\frac{1}{1-\alpha}}$$

where α is greater than 0 and different from 1. The choice of α as an elasticity parameter determines the weights to put on the various S_i.

The four-firms concentration index ("4-CR") has two significant drawbacks. First, it does not take account the relative size of the four leading companies. A market in which each of the four companies has 20% of the market will show the same degree of concentration as another market in which the top four firms have shares of 55%, 20%, 4% and 1%. The second problem with an analysis based on 4-CR is that it does not take into account the total number of firms in the

market. However, the drawback of HHI is that it requires information about all the firms operating into a market.

In addition, even if the data requirements for HHI are more restrictive than for 4-CR, there is one relation between the two indices which allows one to obtain an approximation of HHI with the same amount of data required to obtain 4-CR. If one is interested in obtaining the HHI index for a particular industry and allows for a maximum error of 1% in HHI from its true value, it suffices to sum the squares of the 'k' largest firms and an amount ("HR") given by the following expression.

$$HR = 0.5 * [(1-C_k)(s_k + (1-C_k)/(n-k))]$$

where, as before, $C_k = s_1 + s_2 + \ldots + s_k$

The number of firms, k, required in the computation is implicitly given by the condition:

$$S_k (1-C_k) - HR \quad 0.01$$

To conclude, HHI has three major advantages over 4-CR:

1. By weighting each share by itself, the index reflects larger firms in the industry more than the long tail of small firms;

2. The HHI does not ignore entirely smaller firms; and

3. It incorporates each firm separately and differently.

However, given the unavailability of data for HHI before 1982, the 4-CR is generally used for long term studies on the evolution of concentration.

1.5.3 Profitability

In order to measure the effect of advertising and market structure on profitability, an objective measure of profit should be used. In economics, profit is the difference between the price and the long run average cost. This difference is equal to zero in the case of a perfectly competitive market, or in the case of monopolistic competition, but it is different from zero in an oligopolistic or in a monopolistic market. In addition, in the short run, profit is obtained by considering the short run cost curves and this could allow the existence of a profit also in a monopolistic competitive market. Figure 4 provides a graphical representation of the profit in the short and long run for a monopolist, oligopolist and for a firm operating under monopolistic competition.

Figure 4: Short-Run Equilibrium in Perfect Competition, Oligopoly, Monopolistic Competition, and Monopoly

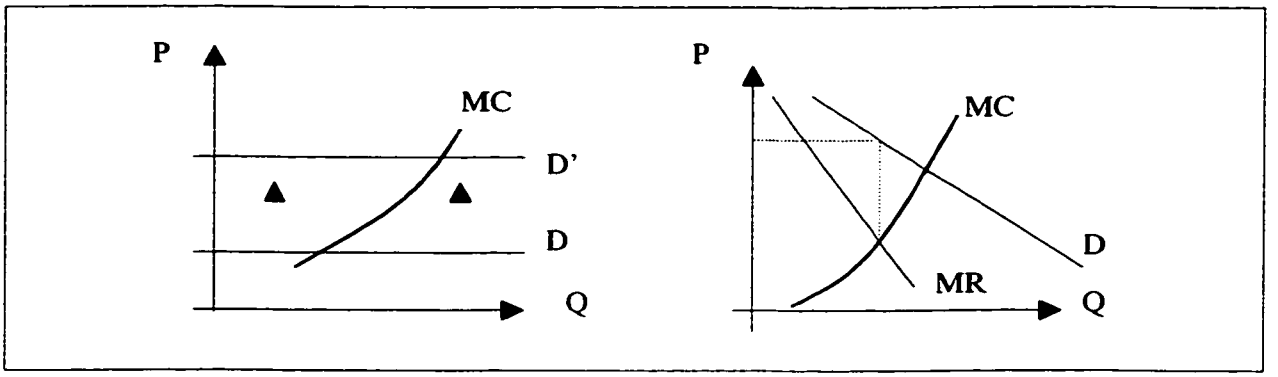


Figure 4 shows that under perfect competition (left chart) firms produce the quantity that equalize the marginal cost ("MC") to the marginal revenue (corresponding to the demand curve, D). If, in the short run, the demand increases to D', firms will earn a positive profit, until the entry of new

firms leads to an increase in the quantity sold and a decrease in the selling price until an equilibrium with no profit is reached.

In the case of monopoly or imperfect competition, the marginal revenue curve ("MR") does not coincide with the demand ("D") curve, because the seller can influence the sale price by controlling the quantity supplied. In this case, in the short run, the seller will maximize profits by producing and selling the quantity that equalizes MR to MC. The case of oligopoly is generally midway between the equilibrium under perfect competition and that under monopoly.

Even though in the long run profits tend to be reduced due to the entry in the market of other competitors, in reality the short run allows for profits also in a regime of monopolistic and perfect competition. Since supply cannot immediately adjust to changes in demand, an increase in the quantity demanded for a commodity will lead to an increase in the selling price, with a greater profit for the seller. Over time, this extra profit will attract more competitors in the market, until another breakthrough will reshuffle the industry or until the decline in price and in profit will lead to a restructuring of the companies in the industry.

In reality the measurement of economic profits presents several challenges, given the necessity to estimate the industry cost curves as well as the demand curve for each product. It is customary to rely on the notion of accounting profits, which consists of the financial information published by companies. In the United States and in other developed countries, public companies have the obligation to disclose periodically their financial results, through standardized financial statements called balance sheet, income statement and statement of cash flow, as well as accompanying financial footnotes. The use of financial data provided by these documents has the advantage of relying on publicly available data gathered according to predefined standards. However, only public companies are subject to this requirement.

Accounting profit represents only an estimate of the economic profit. Companies are allowed to decide whether certain costs (including advertising and R&D) should be capitalized or expensed. In the two cases there is a significant difference in how the income statement will reflect these accounting policies. Suppose, for example, that a company has incurred advertising and R&D expenses during the year. If it allocates these expenses to the year in which they were incurred, because they are recurring expenses or because their benefit is obtained in the same year, the company's income statement will reflect the marketing and research expenses incurred by the company in the course of the year. In the case the company considers these expenses as an investment which increases the value of the company and its ability to introduce new products in the market, the income statement would reflect only the partial allocation of these expenses. In this case, the profit of the company could be overstated and the advertising and R&D expenses underestimated.

In addition to the subjective nature of cost allocation, companies are free to use different accounting methods for evaluating their assets. In the case of inventories, a company can choose between LIFO (Last In, First Out) and FIFO (First In, First Out), which may lead to significantly different values of the company's inventory. Accounting is also based on the historical cost principle: with few exceptions, all the costs are recorded at their historical values. Profit indices are calculated as a percentage of net sales or net assets. The use of historical prices may hide the true value of a company's total investments and therefore could lead to a biased profit ratio.

Even though the notion of accounting profit may have some pitfalls, it is based on defined accounting rules and standard valuation methodologies.

1.6 Conclusion

This chapter was intended to give the reader a comprehensive overview of the existing literature on the investigation of the relationship between advertising, concentration and profitability. The characteristics shared by the majority of the studies performed to date are:

1 The studies are generally performed across all industries;

2 The studies generally focus on one year or, at most, on the change between two years; and

3 The data used is inadequate. In several studies the data for advertising expenditures required some aggregation before to be used in the regression analysis, or the concentration ratios were not provided at the level of detail of the other data.

Consequently, these characteristics affect the reliability of these studies. The following chapter presents the methodology introduced by this dissertation to overcome all the identified limitations, in order to provide the field of economics with a definite answer on the interrelation among these variables and across selected industries.

Chapter II: Panel Data Analysis at the Industry Level

2.1 Introduction

This chapter describes the data and the methodology used for the estimation of the relationship across the manufacturing industries of the U.S. economy over the period from 1963 to 1997. I estimate a system of simultaneous equations to explain the relationship between advertising expenditures, concentration and profitability across the manufacturing sectors over the period analyzed. The results obtained from the estimation and the indications from the Granger causality test confirm the existence of a rich pattern of relationship between the three variables in levels, first differences or lags.

In the following paragraphs I review the characteristics of the data obtained from the Census Bureau. I, then, present the tests performed to identify the relationships among these variables and the model used in their estimation. I conclude by presenting the results obtained and identifying issues that deserve further investigation.

2.2 Data Sources

Data for the concentration ratios in this analysis was obtained from the Bureau of Census.[5] Data for the I-O Tables of the U.S. economy and for the various sectors' sales were obtained from the

[5] www.census.gov/mcd/mancen/download/mc92cr.sum.

Bureau of Economic Analysis ("BEA").[6] This analysis focuses on the manufacturing industry, as identified by the SIC[7] codes under the categories SIC 2000 and SIC 3000.

2.3 Overview of the Concentration Ratios

Concentration ratios are available at the four-, eight-, 20-, and 50-digit level SIC codes for the years 1935, 1947, 1954, 1958, 1963, 1966, 1967, 1970, 1972, 1977, 1982, 1987, 1992 and 1997. Starting from 1982 the Herfindahl index is provided in addition to the concentration ratios for the four, eight, 20 and 50 largest companies. Since the economy has evolved over the years, several SIC codes have been added during each new census of the manufacturing industry. This factor creates potential problems when comparing 1997 data with previous census data. There are industries that have evolved into new ones over the last 50 years. Such examples are denoted by the electronics and telecommunication sectors. Thus, a comparison of the concentration ratios limited to the same SIC code looses importance if I do not take into consideration the evolution of the entire sector to which the SIC code under study belongs.

This problem is solved by analyzing the SIC codes at a broader level, which allows me to encompass all the activities that are part of the same industry. All the 4-digit SIC codes part of an industry are included in the same 2-digit SIC code and jointly analyzed. Even though I lose the ability to perform the analysis at the single-industry level, it is questionable whether such a specific analysis would produce meaningful results.

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[6] www.bea.gov.doc.

[7] The Standard Industrial Classification (SIC) is the statistical classification underlying all establishment-based federal economic statistics classified by industry. The SIC is used to promote the comparability of establishment data describing various facets of the U.S. economy. The classification covers the entire field of economic activities and defines industries in accordance with the composition and structure of the economy. It is revised periodically to reflect the economy's changing industrial organization.

Appendix I to this chapter provides a table comparing, over time, a sample set of 2000 SIC codes for each of the I-O tables used in this analysis. From this set I can see the evolution of the manufacturing industry from 1963 to 1992. As an example, the "Miscellaneous Chemical Products" category in 1963 evolved into the following industries as of 1967:

- Gum and wood chemicals, SIC 2861;
- Adhesives and gelatin, SIC 2891;
- Explosives, SIC 2892;
- Printing ink, SIC 2893;
- Carbon black, SIC 2895; and
- Chemical preparations, n.e.c. SIC 2899.

The evolution of various industries within the U.S. economy must be accounted for over time so that the causes of industry trends can be determined. Such an investigation may help avoid misinterpreting a causal factor such as a change in classification for a change in concentration. The analysis performed in this chapter is not biased by changes of this type occurring within industries because it is performed at the 2-digit SIC code level. Any change occurring over time in the classification of an industry or because of the creation of a new industry occurs in fact within the 2-digit SIC code.

2.4 Overview of the Concentration Ratios within the Manufacturing Sector Over Time

Several studies have been performed in the past fifty years to analyze the evolution of concentration over time and its effects on profitability, innovation and welfare. The review of

concentration performed in this section focuses more on understanding the main characteristics of the dataset and in identifying the main trends over time.

Having available a panel data of concentration ratios of U.S. manufacturing industries I will identify whether the degree of concentration has increased or decreased over time. In addition, it would be interesting to observe any different trends across industries. The SIC codes present ten major economic sectors of the economy: agriculture, forestry, and fishing; mining; construction; manufacturing; transportation, communications, electric, gas and sanitary services; wholesale trade; retail trade; finance, insurance, and real estate; services; and public administration. These major sectors are represented by a letter or by one number from zero to nine. Each of these sectors is then divided into major groups identified by two-digit numbers: the first digit identifies the major sector and the second, the group. Each group is then subdivided into industry numbers, which range from 0 to 99.

Even though the four-digit SIC codes represent a very detailed level of analysis for the industries that are part of a particular sector, an analysis of the concentration at this level should be performed with caution. Within each three-digit SIC code, the similarities among the four-digit industries make them complementary or substitutable and, therefore, subject to the same shocks over time. Consequently, the increase in the concentration level of an industry cannot be judged properly without taking into consideration the events taking place in other similar industries.

Table 4 provides a comparison of the concentration ratios over time between industries in the 2000 SIC category and those in the 3000 SIC category. Even though these two groups of SIC codes are not considered as two separate sectors, they may reveal some dissimilarities in the

goods that they manufacture. Industries under the 2000 SIC category are generally involved in the production of non-durable goods, whereas industries within the 3000 SIC category produce leather, stone, metal products and industrial or transportation equipment as further elaborated in appendix II.

Table 4: Change in the Concentration Ratios over Time

	Large 4	Large 8	Large 20	Large 50	Herfindahl
SIC 2000					
CR_{1992}- CR_{1982}	4.82	4.72	3.82	2.95	145.74
CR_{1992}- CR_{1972}	5.15	5.83	5.48	4.07	NA
CR_{1992}- CR_{1962}	6.50	7.76	8.70	8.20	NA
CR_{1992}- CR_{1947}	9.58	11.69	12.94	NA	NA
SIC 3000					
CR_{1992}- CR_{1982}	1.41	1.29	0.50	0.04	42.63
CR_{1992}- CR_{1972}	0.41	-0.16	-0.47	-0.88	NA
CR_{1992}- CR_{1962}	-0.21	-0.16	0.08	-0.17	NA
CR_{1992}- CR_{1947}	0.72	1.82	2.10	NA	NA

Values in percentage except for the Herfindahl Index.(available from 1982)
Source: Elaboration from the 1992 Census of Manufacturers Report MC92-S-2, "Concentration Ratios in Manufacturing."

The columns' header of Table 4 present the type of concentration ratios calculated. Large 4, also referred to as CR-4, indicates the concentration of the market share controlled by the four largest firms. By the same token, the market share of the largest 8, 20 and 50 companies is referred to as Large 8, Large 20 and Large 50. Starting with 1982, year of its adoption by the Department of Justice, the Herfindahl Index (HHI) provides a more comprehensive measure of concentration, which accounts for all the firms in an industry. HHI is obtained by calculating the sum of the squared market shares of all the companies operating in an industry:

$$HHI = \sum_i s^2{}_i$$

where s_i represents company i's market share. Positive numbers in Table 4 indicate an increase in the degree of concentration over time. The SIC 2000 shows a greater increase in the degree of concentration over time. The trend for this category demonstrates a steady increase: the wider the time period, the greater is the increase in concentration, independently from the concentration ratio used. For the SIC 3000 category, the trend is more uncertain, and the changes in concentration are scattered around zero.

To further investigate this increase in the concentration of market share, I focused on the evolution of concentrated industries over time. In particular, for all the years analyzed I selected the industries for which the CR-4 is greater than 80%. A CR-4 greater than 80% indicates that the largest four companies control more than 80% of that industry's output. Even though the choice of 80% is arbitrary, it represents a value of concentration that gives significant market power to the four largest companies operating in given industry. I then observed the evolution of the concentration and the type of industries operating in such a concentrated environment. Table 5 presents the evolution of the concentration ratio for manufacturing industries with concentration ratio of 80% and above, from 1935 to 1997.

Table 5: Overview of the Concentration (Values in % of Total Market Share) in Industries Characterized by CR-4 of 80%[8]

	1935	1947	1954	1958	1963	1966	1967	1970	1972	1977	1982	1987	1992	1997
SIC Code														
2043			88	83	86	87	88	90	90	89	86	87	85	NA
2062												87	85	NA
2067	97		86	89	90	88	86	85	87	93	95	96		
2076													89	NA
2082												87	90	NA
2111	89	90	82			81	81	84				92	93	83
2131										81	87	85	87	NA
2296						82	83	83	84		81	91		
2141		88												
2771											84	85	84	NA
2813		83	84											
2823					82	85	86		96				98	NA
2824					94	85	84							
2999							82	82						
3021	81	81												
3211			90	92	94	96	94	92	92	90	85	82	81	
3221													84	NA
3262													81	NA
3263													85	NA
3275		85	90	88	84									
3292													88	NA
3313		88												
3331				87						87			98	NA
3334		100	100											
3355										81	83		86	NA
3463					84									
3482									89	86	87	88	84	NA
3489													83	NA
3511					93	87		83	90	86	84			
3578							83							
3624		87	86	87	83	88	86	87						
3632								82	85	82	94	85	82	NA
3633								83	83	89	91	93	94	NA
3635					81					83				
3641												91	86	NA
3692				84	89	88	85	85	92	87	89	88	87	NA
3711							92	91	93	93	92	90	84	82.4
3795									95	87	85	92	88	NA
3996			87	83	87	89	89	92	91	90	99	82	83	NA

From table 5 above it appears that there are several industries which have been historically characterized by a high level of concentration (for example 2111, Cigarettes, or 3334, production of aluminum). Besides these industries, table 5 shows that concentration has evolved over time

[8] For a detailed description of these SIC codes, please refer to Appendix II.

with industries very concentrated in the early 40s and 50s becoming more competitive in the near future. An example is the case of SIC 3715, Truck trailers, where from a 1974 four-firm concentration ratio of 56, the index reduced to 33 in 1992. On the other hand, industries very competitive in the past may be influenced by consolidation, like in the case of SIC 2082, Manufacture of malt beverage, were the four-firm concentration index increased from 11 in 1935 to 90 in 1992.

2.5 Overview of Advertising Data

Advertising data were obtained from the I-O tables of the U.S. economy over the years 1963, 1967, 1972, 1977, 1982, 1992 and 1997. Advertising data is obtained by extracting from the I-O tables the sales from the advertising sector of the economy to other industries. This helped provide an estimate of the resources invested by each industry in advertising, marketing and promotion.

In the I-O tables the advertising industry is classified as SIC 7302. Advertising data is expressed at producers' prices. In order to adjust for fluctuations in prices during the years of our study, I calculated the ratio of advertising expenditures to sales.

Three industries appeared to invest the greatest amount in advertising and marketing expenditures. (1) Paper and allied products, SIC code 26, which demonstrated a 5.88% investment of total revenues in advertising in 1992; (2) Petroleum refining and related industries, SIC code 29, showed a 1992 investment of 22.37%, and (3), leather and leather products, SIC code 31, showed a 1992 investment of 6.78%.

Since the ratio of advertising to sales is obtained from the I-O tables, its ability to account for the total advertising and marketing expenses may be affected by some accounting issues. First, the purpose of the I-O tables is to investigate the interdependence of the economic factors rather than to indicate the amount that companies spend for services received from a particular industry. Second, companies may decide to capitalize some of the marketing and promotional expenses because of the type of benefits received from such services, which usually last longer than one year. Thirdly, a successful advertising campaign may lead to the development of a brand name which would allow a company to market its existing and new products at a premium price in the future. This would imply that advertising expenditures have their effects for the company and for the industry only after a period of time.

Another problem in obtaining advertising information from the I-O tables is that advertising expenditures, like R&D expenditures, do not need to be reported separately from general and administrative expenses unless the costs are greater than a minimum threshold. This may result in the loss of information related to small companies or to companies for which advertising costs are not very significant.

Even though the accuracy of the advertising data used in this dissertation may be negatively affected by problems highlighted above, the data provided by the I-O tables represent the most complete and reliable source of information available for this type of analysis.

2.6 Final Database

To complete the dataset required for this analysis, I needed an estimate of the sales and profitability generated by each of the manufacturing SIC codes. These indicators were obtained from the BEA. Sales were represented by the output originating by industry (using 1987 SIC

codes) in millions of current dollars. This variable is available for manufacturing industries over the period 1947 to 2000. Profitability was estimated as corporate profits before taxes at the industry level (using 1987 SIC codes) in millions of current dollars. Also the profitability variable was available from 1947 to 2000. In order to provide a preliminary overview of the relation among these variables, Table 6 shows the correlation existing among the variables used in the analysis performed in this chapter.

Table 6: Overview of Correlation Among Concentration Indexes, Profitability, Total Sales and Advertising Expenditures

Variable	CR-4	CR-8	CR-20	CR-50	Herfindahl	Pbt	SIC's Sales	Advertising Sales
CR-4		0.9809	0.9114	0.7772	0.1979	-0.045	0.0654	-0.118
Significance		*<.0001*	*<.0001*	*<.0001*	*0.0461*	*0.59*	*0.44*	*0.17*
CR-8			0.9658	0.8602	0.1907	0.0781	0.175	-0.0306
Significance			*<.0001*	*<.0001*	*0.0548*	*0.4355*	*0.0786*	*0.7598*
CR-20				0.9447	0.2180	0.0589	0.1659	0.058
Significance				*<.0001*	*0.0277*	*0.5567*	*0.0956*	*0.5624*
CR-50					0.2064	0.0589	0.1339	0.1379
Significance					*0.0374*	*0.5566*	*0.1798*	*0.1669*
Herfindahl						0.0046	0.6083	0.1289
Significance						*0.9632*	*<.0001*	*0.1968*
Pbt							0.7231	0.0164
Significance							*<.0001*	*0.85*
SIC's Sales								0.0478
Significance								*0.58*

Where:

Herfindahl Index of concentration is only available starting with 1982;

Pbt represents profit before taxes;

SIC's sales represents total sales of industries for the SIC code under analysis; and

Significance represents the probability > |r| under H_0: Rho = 0.

To evaluate the correlation coefficients among the variables, I performed the Pearson significance test. The null hypothesis is that the correlation coefficient is equal to zero.

Pearson Significance Test for the Correlation Coefficients

Evaluation of the Prob > |r| under H_0: Rho=0

Where r is the level of significance and Rho is the correlation coefficient

For example, a value of the test smaller than 0.01 indicates that, with a 99% level of confidence, we reject the null (H_0) hypothesis that Rho equals zero. Thus, we conclude that there is a correlation between the two variables.

As expected, the correlation is very high among the n-firm concentration ratios. However, there is not a high correlation between these indices and the Herfindahl Index of concentration. Since the Herfindahl Index includes information on the characteristics of the entire industry, the low correlation between the n-firm concentration ratios and the Herfindahl Index suggests that there are substantial differences between the two measures of concentration.

First, the n-firm concentration ratio is the sum of the largest n-firms' market share and it does not take account of the relative size of the four leading companies. A market in which each of the four companies has a 20% share of the market will show the same degree of concentration as another market in which the top four firms have shares of 55%, 20%, 4% and 1%. The second problem with the n-firm concentration ratio analysis is that it does not take into account the total

number of firms in the market. These two drawbacks are solved by the use of the Herfindahl index of concentration, which is the sum of the squares of each company's market share in a specific industry.

The Herfindahl index includes information from all the companies operating in the market, whether the n-firm concentration ratio does not take into consideration the companies outside the n-th largest. Even though the Herfindahl index is a more thorough measure of the market structure, its use is limited in this study because the index is available only starting with 1982.

Table 6 previously presented above indicates that the correlation between concentration indices and the profitability index is always lower than 0.10 and practically equal to zero compared with the Herfindahl index of concentration. This reflects the fact that concentrated industries may be very competitive, and could be characterized by limited profitability, given the efforts undertaken by the small number of players to increase their market share. The results are quite different in the case of total sales per industry: even when the concentration with the n-firm indexes is between 15% and 20%, the correlation with the Herfindahl index is high, equal to 0.6083. A similarly high correlation is found with profit before taxes.

The significance test for the correlation coefficients demonstrates interesting results. As expected, there is a high correlation among the CR-N firm concentration ratio. The correlation of these indicators with the Herfindahl index is quite low, but its significance increases as the number of firms in the N-firms concentration ratio increases. Results of the Pearson test suggest that there is no correlation between any concentration ratio and profit before taxes as a percentage of sales or between the ratio of advertising to sales.

Table 6 shows the interesting relationship between all the variables and total sales. The concentration coefficients are positively related with the level of sales, and the relationship becomes stronger as the number of companies in the CR-N firm concentration ratio decreases (with the exception of CR-4). This result could be related with the concept of economies of scale. Industries characterized by economies of scale tend to have a higher concentration, since the average production cost curve is negatively sloped and the larger is the amount produced, the lower the production cost. In this situation, the ability of a company to increase its market share could ensure that the company produces at the lowest possible cost, giving this company a price advantage over its competitors. This would explain a higher level of concentration for this industry. However, the correlation between the Herfindahl Index and sales is 0.6083, indicating a strong relationship between the two variables. In addition, a similar result is found in the relationship between profit before taxes and the level of sales, with a correlation coefficient of 0.6066.

The following sections present the steps followed to identify the relationships among these variables. These procedures will help me to interpret the results from the correlations obtained in Table 6.

2.7 Estimation of the Relationship Between Advertising, Concentration and Profitability over Time and Across Industries

This analysis attempts to expand the current knowledge of the relationship between market structure, profitability and advertising expenditures. In particular, special attention is devoted to the following issues:

1. Evaluation of the magnitude and direction of the relationship between advertising, concentration and profitability within the U.S. manufacturing sector at the two-digits SIC codes.

2. Determination of whether advertising and other marketing costs as a percentage of sales vary inversely with individual firm market share and verification of whether this inverse relationship occurs more significantly in industries of rapidly rising concentration.

3. Verification of the theory of optimal dynamic limit pricing. According to this theory, profit margins increase when an industry emerges from a period of rapidly rising concentration to a period of high and stable concentration.

This chapter focuses on the entire manufacturing sector, whereas the next chapter concentrates specifically on the auto and auto parts industry as well as on the pharmaceutical industry.

Given the main objectives of this dissertation, the estimation equations that most clearly explain the relationship among the variables advertising, concentration and profitability, are as follows:[9]

$$\begin{cases} Conc_{it} = f(\overset{+}{Adv}_{it}, \overset{+/-}{\pi}_{it}) \\ \left(\frac{Adv}{S}\right)_{it} = f(\overset{+}{Conc}_{it}, \Delta^2 \overset{-}{Conc}_{it}) \\ \pi_{it} = f(\Delta \overset{+}{Conc}_{it}, \Delta^2 \overset{+}{Conc}_{it}) \end{cases} \qquad (1)$$

Where Δ is the time difference operator, such that $\Delta\ Conc_{it} = Conc_{it} - Conc_{it-1}$ and $\Delta^2\ Conc_{it} = Conc_{it} - Conc_{it-2}$. The first equation of system (1) represents the object of a large

number of studies in the last fifty years. If significant, the estimated coefficients will shed light on the first of the three issues presented above: the magnitude and direction of the relationship between advertising, concentration and profitability within the U.S. manufacturing sector. It is expected that the sign of the advertising coefficient be positive, since advertising could be used to create barriers to entry in an industry and to ensure market dominance for the competing companies. In addition, advertising enables new companies to signal their entry in the market or to signal the introduction of a new product. From this perspective, advertising is a productive expense incurred to inform consumers of alternative choices of products available. The cost of advertising from this perspective is included as a necessary part of the cost of a product since it brings utility to the consumers under the form of additional choices of products and improved knowledge of what the market can offer.

The sign of the coefficient for profit is not certain because, as I have discussed in the previous chapter, there are two contrasting forces that run in opposite directions.[10] The increase in concentration could lead to an increase in profitability, and therefore the dependent variable of the first equation should be profit. On the other hand a decrease in profitability could lead to an increase in concentration due to a consolidation in the industry. These forces could be more or less relevant depending on the historical period analyzed. In a period of recession, restructuring in an industry could give rise to an increase in concentration and eventually, with the improvement of the economic situation, profits would start increasing. In this relationship the dependent variable would be concentration and the expected sign negative.

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[9] Superscripts represent expected signs of the estimated coefficients and will be discussed on the following pages.

[10] See Chapter 1, Figure 3.

The results from the estimation of the second equation could clarify if an increase in concentration reduces the marketing expenditures or increases them. Rather than focusing on successfully marketing a company's product based on its quality, companies often invest a large portion of their budgets in advertising campaigns to develop their image from which product sales will then benefit. In addition, it is also argued that advertising and marketing allow new companies to penetrate an existing market and to reduce the ability of existing players to collude and increase the price at the expense of consumers. If an increase in concentration is accompanied by a reduction in advertising and marketing expenses, then the collusion hypothesis would be confirmed. In this case advertising and marketing are a proxy of competition, and their reduction indicates a confidence that there is such an adequate level of barriers to entry that the existing players in the market are more concerned to maximize their profits at the expense of final consumers than to reduce prices or increase marketing to avoid new entries in the market. However, the sign of the first regressor in the second equation of (1) is expected to be positive, since an industry characterized by a consolidation trend is an industry where the existing players are using all the available strategies, including heavy advertising and marketing campaigns, to drive competitors out of business.

The $\Delta^2 Conc_{it}$ term in the second equation analyzes the relationship between advertising and concentration in the case of rapidly rising concentration. In particular, the greater the absolute value of the coefficient of $\Delta^2 Conc_{it}$, the more significant is the relation between advertising and concentration when the latter is rapidly rising. The rise in concentration could be due to the success in the competitive strategy to drive competitors out of business. In this case, the time required for the industry to attain a stable configuration could be long. In the case an industry consolidates as a result of a sharp recession or a market shock, the wave of mergers and

acquisitions could take place in a short timeframe. The analysis of the coefficient of $\Delta^2 Conc_{it}$ can help me to understand the behavior of advertising and concentration in these different situations. If there exists a quadratic relationship between concentration and advertising, this relation would be concave shaped, since advertising would rise fast as the industry is consolidating and concentration is rising rapidly. When the industry reaches an equilibrium level for concentration, the consolidation process slows and as the remaining players focus on maximizing profitability, the protection represented by the barriers to entry created in the market reduces the need for the previously aggressive advertising campaigns, interrupting the increasing trend for advertising. A concave shape curve between concentration and advertising requires that the coefficient of the second term derivative is negative. Thus, the coefficient of $\Delta^2 Conc_{it}$ is expected to be negative.

The third equation represents an attempt to identify how profitability varies as industries evolve over time. The hypothesized relationship between profit and concentration is quadratic. In particular, I expect that as concentration reaches an equilibrium level, profitability increases. The equilibrium level could be represented by an oligopolistic configuration, where few players dominate the market and have created sufficient barriers to entry such to avoid new competitors. In this case, fierce competition in the market during the initial period would limit the amount of profit to be earned, until the number of players in the industry stabilizes and the competition among them reduces. The coefficients of the third equation is expected to be positive, and their values indicate the strength of the relationship, as shown in Figure 1:

Figure 1: Possible Relationships Between Profit and Concentration

Figure 1 A

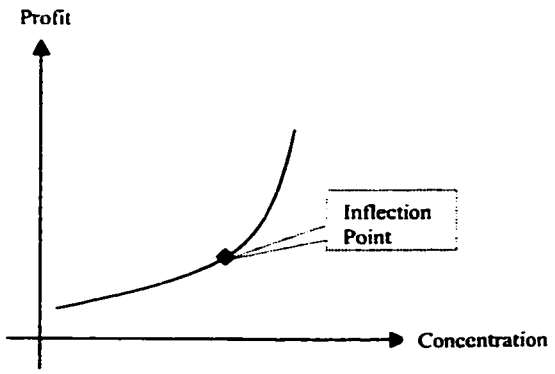
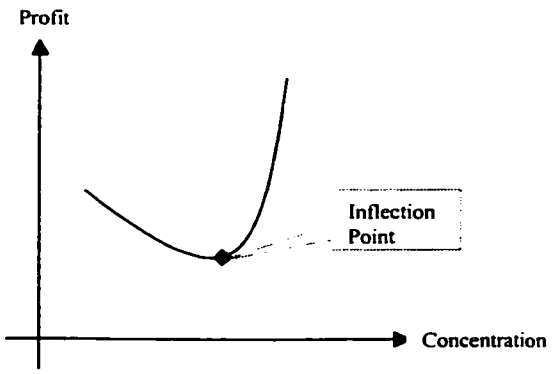


Figure 1 B



As Figure 1 illustrates, many different relationships are possible between profit and concentration. In Figure 1A profit increases slowly with concentration until equilibrium is found in a specific industry and consolidation takes place. After the inflection point, in fact, the few existing players can quickly maximize their profits and this explains the greater slope of the curve. Alternatively, profitability could be low or reduced as concentration increases since the strongest players in the industry forego profitability (for example, with a price war) to create barriers to entry and to drive competitors out of business. When a sustainable level of concentration has been reached the remaining players maximize their profit and the direction and slope of the curve changes to positive (see Figure 1B).

The inflection point in Figure 5 represents the end of a price war. The equilibrium in the industry and more generally the maturity of the market which has become a monopoly, an oligopoly or any other market structures in equilibrium until the next shock will occur. The signs of the coefficients estimated for the third equation of (1) will shed some light on the nature of the relationship between concentration and profit.

2.7.1 Overview of the Variables Used in the Analysis

This chapter analyses the relationship between concentration, profitability and advertising in the U.S. manufacturing sector of the economy. Data for the concentration ratio were obtained from the Bureau of Census and are available from 1935 to 1997. Data for the profitability, sales levels and advertising expenditures by SIC code was obtained from the I-O tables of the U.S. economy, published by the BEA and available for the years 1963, 1967, 1972, 1977, 1982, 1987, 1992 and 1997.

The dataset covers the manufacturing industry for each of the years of availability of I-O tables. Each observation pertains to a subsector of the economy represented by a two-digit industry. This aggregation is required to balance the attempt to perform a detailed analysis of the U.S. manufacturing industries with the necessity to avoid considering two competing companies as part of different industries. If the analysis would be performed at the four-digit SIC codes, it would not be uncommon to classify separately companies operating in the same environment or even with the same customer base. Table 7 presents a list and a brief description of the categories of SIC codes considered.

Table 7: Two-Digit SIC Codes Used in the Analysis

SIC	Description
20	Food and kinkred products
21	Tobacco products
22	Textile mill products
23	Apparel and other finished products made from fabrics and similar materials
24	Lumber and wood products, except furniture
25	Furniture and fixtures
26	Paper and allied products
27	Printing, publishing and allied industries
28	Chemicals and allied products
29	Petroleum refining and related industries
30	Rubber and miscellaneous plastics products
31	Leather and leather products
32	Stone, clay, glass and concrete products
33	Primary metal industries
34	Fabricated metal products, except machinery and transportation equipment
35	Industrial and commercial machinery and computer equipment
36	Electronic and other electrical equipment and components, except computer equipment
37	Transportation equipment
38	Measuring, analyzing, and controlling instruments: photographic, medical and optical goods; watches and clocks
39	Miscellaneous manufacturing industries

For each of these industries I gathered seven observations for each of the variables object of the analysis: concentration, as represented by CR-4, profitability, as represented by the profit before taxes and advertising and marketing expenditures. The panel data is therefore represented by 140 observations over a total of 20 industries of the manufacturing sector as shown by the summary statistics in Table 8.

Table 8: Summary Statistics of the Panel Data Used in the Analysis (Values in Percentage)

		Four-Firm Concentration				Profit Before Taxes (*)				Advertising to Sales Ratio (*)			
Overview by Year	**N**	**Mean**	**Std Err**	**Min**	**Max**	**Mean**	**Std Err**	**Min**	**Max**	**Mean**	**Std Err**	**Min**	**Max**
1963	20	36.88	3.83	12.92	74.63	11.69	3.33	-47.81	29.28	4.58	3.01	0.01	60.14
1967	20	38.52	4.16	14.05	76.61	14.49	1.34	-3.55	26.29	3.99	2.49	0.01	49.35
1972	20	36.76	3.41	18.23	73.21	13.55	1.06	6.33	23.66	3.93	2.28	0.00	44.59
1977	20	36.24	3.31	17.68	73.49	15.15	1.16	2.94	26.99	3.65	2.00	0.00	33.09
1982	20	35.01	3.04	17.28	69.14	5.22	2.29	-17.60	23.83	1.64	0.36	0.02	5.32
1992	20	37.50	3.69	21.44	90.45	9.12	1.77	-4.35	30.93	2.46	1.20	0.00	22.37
1997	20	28.45	4.21	9.60	83.40	12.18	1.53	-0.02	27.48	2.94	1.54	0.00	28.89
Overview by SIC Code	**N**	**Mean**	**Std Err**	**Min**	**Max**	**Mean**	**Std Err**	**Min**	**Max**	**Mean**	**Std Err**	**Min**	**Max**
20	7	38.08	1.56	32.52	45.53	13.04	0.79	9.01	15.01	0.28	0.05	0.11	0.52
21	7	54.79	12.33	17.32	90.45	24.78	1.47	20.36	30.93	0.02	0.01	0.00	0.11
22	7	32.54	1.65	23.10	35.80	10.12	1.23	5.15	13.53	1.08	0.15	0.75	1.81
23	7	18.52	1.88	13.11	29.03	9.59	0.90	5.82	12.14	0.56	0.13	0.23	1.02
24	7	18.55	1.57	12.92	22.22	11.61	2.77	-1.98	21.50	1.88	0.13	1.58	2.60
25	7	23.02	1.59	19.11	30.00	11.71	0.82	7.58	13.73	0.61	0.19	0.00	1.19
26	7	28.98	2.87	12.50	36.42	12.70	1.94	4.89	17.97	4.26	0.48	2.60	5.93
27	7	18.67	1.54	9.60	21.90	14.10	0.88	11.57	18.11	1.61	0.09	1.27	1.96
28	7	39.18	2.58	27.20	48.22	20.51	2.73	8.03	29.28	0.53	0.09	0.22	0.75
29	7	31.51	1.05	26.00	34.25	-3.44	8.33	-47.81	20.59	34.82	6.92	5.32	60.14
30	7	54.56	7.00	21.58	69.14	9.34	0.78	6.05	11.49	0.69	0.10	0.44	1.17
31	7	29.62	2.98	19.99	41.21	12.49	1.50	7.51	18.00	14.43	2.34	5.03	25.65
32	7	34.82	2.15	21.95	37.58	8.64	4.47	-15.71	19.12	2.63	0.15	2.29	3.17
33	7	37.93	2.69	23.13	44.51	3.83	4.45	-17.60	16.59	0.01	0.00	0.00	0.02
34	7	26.53	2.56	11.76	31.79	13.69	1.72	7.21	20.20	0.29	0.03	0.20	0.42
35	7	35.95	1.39	29.71	40.61	11.46	2.40	3.04	18.05	0.16	0.04	0.07	0.36
36	7	47.86	3.00	32.81	55.57	11.89	1.91	1.63	16.66	0.34	0.08	0.12	0.72
37	7	69.13	3.10	51.56	76.61	9.62	3.53	-1.88	22.02	0.47	0.23	0.15	1.83
38	7	46.17	5.53	16.30	56.14	12.72	3.02	2.62	23.03	0.90	0.19	0.22	1.39
39	7	26.08	2.70	10.19	29.99	14.20	1.07	8.65	17.46	0.70	0.25	0.00	1.80

(*) Profit Before Taxes and Advertising are expressed as a percentage of total sales.

The most concentrated industries are tobacco (SIC 21), miscellaneous plastic products (SIC 30) and transportation equipment (SIC 37). Tobacco resulted also the most profitable industry, but with a low level of average advertising to sales ratio. This industry benefited from the ban of advertising imposed by law, which had the effect that collusive behavior generally has, i.e., to reduce costs and increase profitability.

The summary statistics of the final dataset are presented in Table 9.

Table 9: Overall Summary Statistics of the Panel Data Used in this Chapter

	N	Mean	Std. Dev	Minimum	Maximum
CR-4	140	35.62	1.39	9.60	90.45
Profit Before Tax	140	11.63	0.76	-47.81	30.93
Advertising/Sales	140	3.31	0.75	0	60.14

The low value of the standard deviation indicates that the values of concentration, profitability and advertising are stable across the sample dataset analyzed.

2.7.2 OLS Estimation

The three equations presented in (1) can be estimated as single linear equations or as a system of equations, if it is argued that there is simultaneity between these three variables, namely, advertising, concentration and profitability. The preliminary analysis is based on an OLS technique. I then performed endogeneity tests to identify any interactions between the variables used in order to determine whether a system of equations could more realistically reflect the relationship between advertising, concentration and profitability.

Since our analysis is based on a panel data, it is important to control for fixed and time effects. The purpose of our estimation is to identify the relationship existing among profitability,

concentration and advertising expenditures, without being influenced by the volatility specific to the various SIC categories used or to the years object of the analysis. To control for fixed effects, each variable used in the analysis is expressed as the difference between the variable and its mean over time:

$$\text{Advertising}_{it} = \text{Advertising}_{it} - \frac{1}{t}\sum_{t} \text{Advertising}_{t}$$

$$\text{Pbt}_{it} = \text{Pbt}_{it} - \frac{1}{t}\sum_{t} \text{Pbt}_{t}$$

$$\text{4CR}_{it} = \text{4CR}_{it} - \frac{1}{t}\sum_{t} \text{4CR}_{t}$$

where

Advertising represents advertising expenditures as a percentage of net sales;

Pbt is profit before taxes; and

4CR is four-firm concentration ratio.

To control for time effects, I introduced a dummy variable for each of the years object of our analysis. These variables are: Time67, Time72, Time77, Time82, Time92, and Time97. Each dummy assumes the value one in the year in which it refers and zero otherwise. To avoid perfect multicollinearity, I estimated the equations using all the six dummy variables and dropping the intercept. Table 10 presents the results of the OLS estimation for the equations in (1).

Table 10: OLS Estimation Results of the Equations Presented in (1)

Dep. Variable		Advertising Sales	Profit Before Taxes	Time67	Time72	Time77	Time82	Time92	Time97
4CR		0.00487	0.21531	0.02515	0.00715	-0.00145	0.00777	0.02424	-0.07291
Prob.		0.9847	0.2179	0.2801	0.7482	0.9493	0.7586	0.2832	0.0012
R-Square	0.1223								
F Value	1.93								
Prob.>F	0.0618								
		1st Diff. 4CR	2nd Diff. 4CR	Time67	Time72	Time77	Time82	Time92	Time97
Profit Before Taxes		0.13026	-0.00026	0.02589	0.02064	0.0362	-0.0627	-0.02736	0.01432
Prob.		0.0553	0.561	0.0445	0.0859	0.0029	<.0001	0.0237	0.261
R-Square	0.3362								
F Value	7.03								
Prob.>F	<.0001								
		4CR	2nd Diff. 4CR	Time67	Time72	Time77	Time82	Time92	Time97
Advertising Sales		-0.00644	-0.000073	0.0069	0.006	0.003	-0.0168	-0.008	-0.005
Prob.		0.8571	0.7459	0.4287	0.4718	0.6753	0.0449	0.3311	0.5807
R-Square	0.0586								
F Value	0.86								
Prob.>F	0.5492								

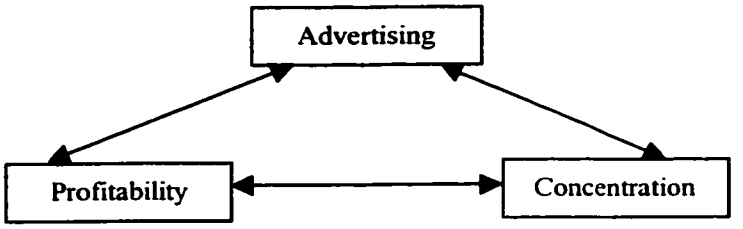
Prob. represents the results of the t-test of significance. For each of the coefficient estimates, the statistic indicates the probability level of the t-test (Prob. > |t|). A lower value than 0.1, for example, indicates that at the 10% level of significance, I reject the null hypothesis that the coefficient is equal to zero. For the F-Statistic, the probability indicates the significance from the one-tail test for all the coefficients of the regression (Prob. > F).

The equations previously identified are not significant. The only variable that is significant is the first difference of the concentration ratio in the second equation. In particular, and as expected, the two variables are positively related: an increase in concentration leads to an increase in profit. This suggest that the relationships analyzed are either non-significant or that there are problems in using the OLS in these estimations.

2.8 Endogeneity Test

To determine whether the poor results obtained from the estimations are due to the existence of simultaneity among the three variables analyzed, I performed a causality test. By testing for causality in each of the possible relationships presented in Figure 2 I determine whether it is necessary to use a system of equations.

Figure 2: Possible Relationships Among the Variables Tested for Granger Causality



The test performed utilizes the concept of Granger causality. As an example, consider the relationship between advertising and concentration. As I have explained in the previous chapter, it is possible that advertising expenditures lead to an increase in profits by stimulating products brand awareness, which enables the seller to charge higher prices. Consequently, advertising is a factor influencing profitability. Conversely, profitability allows a company to spend more resources on advertising. If this were true, profitability becomes a critical factor in the determination of the level of advertising. Depending on whether the first hypothesis holds, the

second or both are true, the analysis should be performed by regressing profitability on advertising, advertising on profitability or by employing a system of simultaneous equations. The Granger causality test helps me to verify the existence of these relationships.

The Granger causality test was first performed by regressing advertising on its lagged values and on the lagged values of profitability. If the coefficient for the lagged profitability were not significant, it could be concluded that past values of profitability did not provide additional information to what has already been provided by the lagged values of advertising. To obtain information on the existence of feedback effects, this test is then performed among the three variables: advertising, profitability and concentration.

As presented in the previous chapter, the relationships among these three variables could run in both directions. Advertising may lead to the formation of barriers to entry in an industry and therefore to an increase in concentration. On the other hand, an industry characterized by an increasing concentration could be associated with lower levels of advertising as the second analysis presented in section 2.5 illustrated. For what concerns the interaction between advertising and profitability, the higher the profit earned by a company, the larger the budget available for investment in advertising. However, investments in advertising could lead to the creation of barriers to entry in the form of brand name that could allow a company to charge higher prices and earn extra profits. The last interaction depicted in Figure 2 is between profitability and concentration. Concentration could influence profitability because the smaller the number of companies competing in a market, the higher the possibility of collusion among them aimed at maximizing their profits. Profit could however be the factor influencing the concentration since after a period of recession and therefore of low profits companies restructure and the degree of concentration in an industry changes. When profits are very high, instead, new

companies are attracted in that industry and, as the competition in the industry increases, the degree of concentration decreases.

In order to determine the relevance of all these possible relationships, I performed the Granger causality test. Granger causality or non-causality is concerned with whether lagged values of the regressors do or do not improve the explanation of the dependent variable obtainable from only lagged values of the dependent variable itself. I regressed each of the three variables on their lagged values and on the lagged values of the remaining two variables. If the coefficients of the lagged regressors result significant, then it is said that the regressor Granger causes the dependent variable. The results of this test are presented in Table 11.

Table 11: Granger Causality Test

Dep. Variable		Intercept	Lag(Advs)	Lag(4CR)	Lag(Pbt)	Time72	Time77	Time82	Time92	Time97
4CR		0.00265	0.3319	0.000013	-0.13731	0.00518	0.00128	-0.0157	-0.0144	-0.007
Prob.		0.7082	<.0001	0.9675	0.0069	0.0069	0.8978	0.12	0.1882	0.4938
R-Square	0.3301									
F Value	6.84									
Prob.>F	<.0001									
		Intercept	Lag(4CR)	Lag(Advs)	Lag(Pbt)	Time72	Time77	Time82	Time92	Time97
Profit Before Taxes		0.02061	0.00417	0.22759	0.39339	-0.0342	-0.0282	0.04389	0.02977	-0.0884
Prob.		0.2996	<.0001	0.2831	0.0058	0.2238	0.3126	0.12	0.3322	0.0024
R-Square	0.2985									
F Value	5.91									
Prob.>F	<.0001									
		Intercept	Lag(Pbt)	Lag(4CR)	Lag(Advs)	Time72	Time77	Time82	Time92	Time97
Advertising Sales		0.02906	0.24727	-0.00069	0.01887	-0.015	0.00205	-0.1015	-0.0384	-0.0159
Prob.		0.0142	0.0034	0.204	0.8798	0.3633	0.9008	<.0001	0.0354	0.3472
R-Square	0.3721									
F Value	8.22									
Prob.>F	<.0001									

As demonstrated by these regressions, profitability can be considered a significant factor according to the Granger causality test. At the 10% level of significance profitability Granger-causes concentration and advertising to sales ratio. The remaining two variables are also significant: advertising to sales ratio is significant at the 1% level in the equation for 4CR and concentration is significant at the 1% level in the equation for profitability and at the 20% significance level in the equation for advertising.

The results of the test confirm the existence of simultaneity among the variables of the study. In addition, a causality relation may exist even if not detected by the Granger test. The next paragraphs show the analysis performed to estimate this relationship and the results obtained.

2.9 Simultaneous Equation Estimation

Based on the results obtained from the Granger Causality Test, I performed a simultaneous equation estimation to verify whether I can better explain the evolution and interaction between advertising, concentration and profitability. The model is based on the following three equations:

$$\begin{cases} 4CR = \alpha_1 * \overset{+}{\frac{\pi}{S}} + \alpha_2 * \overset{+}{\frac{Adv}{S}} + \alpha_3 * Time67 + \alpha_4 * Time72 + \alpha_5 * Time77 + \alpha_6 * Time82 + \alpha_7 * Time92 + \alpha_8 * Time97 \\ \frac{\pi}{S} = \beta_1 * \overset{+}{4CR} + \beta_2 * \Delta \overset{+}{4CR} + \beta_3 * Time67 + \beta_4 * Time72 + \beta_5 * Time77 + \beta_6 * Time82 + \beta_7 * Time92 + \beta_8 * Time97 \\ \frac{Adv}{S} = \gamma_1 * \overset{+}{4CR} + \gamma_2 * \Delta \overset{+}{\frac{\pi}{S}} + \gamma_3 * Time67 + \gamma_4 * Time72 + \gamma_5 * Time77 + \gamma_6 * Time82 + \gamma_7 * Time92 + \gamma_8 * Time97 \end{cases}$$

(2)

Where:

4CR = the four-firm concentration ratio;

$\frac{\pi}{S}$ = profit before taxes as a percentage of each industry's total sales;

$\frac{Adv}{S}$ = advertising expenditures of an industry as a percentage of that industry's total sales;

$\Delta\frac{\pi}{S}$, Δ4CR = first difference of the profit ratio and of the four-firm concentration ratio.

The endogenous variables of the system are the four-firm concentration ratio, industry profitability as a percentage of sales, and advertising expenditures, also calculated as a percentage of sales. The remaining variables, the time dummy variables and the first difference of the concentration ratio as well as the first difference of profit before taxes (as a percentage of sales), are exogenous, or predetermined variables.

The equations of the system share common characteristics. I have included six dummy variables (Time67, Time72, Time77, Time82, Time92 and Time97) in each equation of (2) to ensure that if there are any shifts over time or across industries in the way the variables interact, I can identify the period of the shift and better control for this change. Two endogenous variables appear in the system with their first differences ($\Delta\frac{\pi}{S}$, Δ4CR). I can think of them as proxies for their first-order derivatives. The change in the concentration ratio indicates whether the industry is consolidating and the effect it has on its profit. It is expected that their estimated coefficients are positive, since an increase in concentration (and therefore of Δ4CR) should increase the ability of a company to earn extra profits. In the third equation of (2) it is expected that an increase in the profitability (and therefore of $\Delta\frac{\pi}{S}$) would increase the resources available to the company to reinforce its position in the market, including advertising and marketing expenditures.

Advertising does not appear as an explanatory variable in the second part of equation (2). If there is a relationship between advertising and profitability, this is probably only an indirect one. Advertising expenditures can lead to the development of, or the increase in awareness of a brand. This awareness allows a company to charge higher prices for products and to earn higher profits. This influence, however, may take place over a long period of time, and advertising expenditures for a particular year may not be indicative of the effect of advertising on profitability for the same

year. Advertising is part of the first equation of (2), where it is expected that its estimated coefficient assumes a positive sign. Since the purpose of advertising and marketing is to create intangible assets which increase the marketability of a company's products, the larger the advertising budget, the higher the probability that a company would be successful in increasing its market share.

As in the case of the second equation in system (2), the third equation does not include one of the endogenous variables, profitability. Advertising expenditures are influenced more by past profitability rather than by current profitability. The more profitable a company is, the greater is its ability to undertake new investments, not only because of the resources created and available to the company, such as retained earnings, but also because of the greater trust that investors would have that the new investment will lead to a further increase in the current level of profitability. The absence of the variable profit is, therefore, compensated by the presence of the first difference for profit, which is a proxy for the industry trend. If sales are decreasing because of an unfavorable cycle in the economy, companies would reduce the level of certain expenses, including advertising. In an expanding cycle, the company would increase its outlays to reflect the expected increase in business for that sector.

The variable profits over sales appears in the first equation, and it is expected to have a positive sign, since in general an increase in the company's profitability indicates that a company is operating in an environment where competition is limited. However, if as discussed before, the relationship between profitability and concentration is not linear, the coefficient of profit over sales could be negative for the period of time required by a company to build barriers to entry. The coefficient of profit over sales would then increase as soon as the concentration in the market reaches a stable concentration rate.

The concentration ratio, 4CR, appears as a regressor in the second and third equations. The sign for the coefficient of 4CR is expected to be positive in both equations, since an increase in concentration should enable a company to earn extra profits by charging higher prices. For the last equation, a positive sign for the coefficient of 4CR will indicate that a company having a large share of the market must invest heavily into advertising to maintain high barriers to entry.

As appendix III of this chapter shows, the system is exactly identified. Table 12 presents the results from the Full Information Maximum Likelihood (FIML) estimation.

Table 12: Simultaneous Equation Estimation Results – Full Information Maximum Likelihood

Dep. Var	Advertising Sales	Profit Before Taxes	Time67	Time72	Time77	Time82	Time92	Time97
4CR	-17.225	5.50547	-0.01171	0.0121	-0.1299	0.0588	0.0097	-0.166
Prob.	0.3848	0.3871	0.9477	0.9425	0.5728	0.7957	0.9556	0.3918
	4CR	1st Diff. 4-CR	Time67	Time72	Time77	Time82	Time92	Time97
Profit Before Taxes	-2.18184	1.347378	0.069744	0.0677	0.0556	-0.0609	-0.0176	-0.02899
Prob.	0.1069	0.0875	0.1398	0.1634	0.1736	0.1188	0.6554	0.5576
	4CR	1st Diff. Pbt	Time67	Time72	Time77	Time82	Time92	Time97
Advertising Sales	0.001689	0.128169	0.003145	0.0074	0.0013	-0.004	-0.0136	-0.0075
Prob.	0.9757	0.0067	0.6968	0.3438	0.8679	0.6601	0.0944	0.3882

The equation has been estimated using the FIML methodology, using as a starting point the coefficients obtained from the OLS estimation. The intercept has been omitted to allow the estimation of all the time dummy variables without introducing perfect multicollinearity.

Unfortunately, all the coefficients from the first equation of (2) are not statistically significant. However, the parameter estimates of the second equation are significant at the 10% level. The sign of the first lag of the concentration ratio's coefficient is consistent with my expectations, since it is positive and significant. The coefficient for the four-firm concentration ratio is significant at the 15% confidence level, but the sign is negative. This estimate suggests that an increase in concentration is associated with a decrease in the profit to sales ratio, perhaps because the lower the number of players in the market, the higher the barriers to entries that reduce the possibility of new companies entering the market and driving down profitability. For this reason, large companies dominating a market do not increase their investment in advertising as a percentage of sales, once they have reached a high level of market power. Their budgets for advertising are already very significant because of the efforts to obtain an advantageous market position by creating barriers to entry such as brand name, customers' loyalty and other types of marketing intangibles.

In the last equation, the only parameter estimate that appears to be significant is the coefficient for the first difference of the profit to sales ratio. This coefficient is significant at the 1% confidence level. As expected, the sign is positive, indicating that an increase in profitability leads to an increase in advertising expenditures. Since our analysis includes the manufacturing sector, profitability is a sign of the economy condition: an increase in profitability indicates better perspectives for companies. In order to take advantage of the improved economic environment companies increase their advertising and marketing expenditures, with the objective of capturing additional market share. This behavior is consistent with the results from our estimation.

The results of this estimation are very similar to those obtained from the OLS estimation of (1), as shown in Table 10. In both cases advertising to sales and profit before taxes (as a % of sales) do

not appear to significantly influence the variability of concentration. On the other hand, the change in the concentration ratio (1^{st} diff. 4CR) positively affects profit before taxes, since the parameter estimate is in both cases positive and significant. Finally, the coefficient of 4CR is not significant in the regression with advertising to sales ratio as the dependent variable.

The results of this estimation cast some doubt on the existence of a simultaneous causality relationship among the three variables of this study. The next chapter will verify if the absence of significance is related with the fact that I performed the analysis using the entire manufacturing sector of the economy. Even though the elimination of fixed effects controls for any differences between the two main categories of industries in this sector, there could be significant differences within the various industries that cannot be identified by estimating the entire sector. Since the next chapter focuses on the pharmaceutical and automotive industries, if I obtain significant results I will have a clear indication that this type of analysis requires a focus on specific rather than global industries.

2.10 Simultaneous Equation Estimation for Profit and Concentration

The Granger Causality Test and the results from the estimation of system (2) indicated that advertising (expressed as a percentage of sales) is influenced by profit. In this section, I modified the analysis of the three variables by performing an OLS estimation of a revised equation for advertising and by analyzing in a simultaneous setting the relationship between profitability and concentration.

Since there were no signs that advertising influenced concentration or profitability, the following linear equation may provide better results:

$$\frac{Adv}{S} = \delta_1 * \overset{+}{4CR} + \delta_3 * Lag(\overset{+}{\frac{\pi}{S}}) + \delta_4 * Time67 + \delta_5 * Time72 + \delta_6 * Time77 + \delta_7 * Time82 + \delta_8 * Time92 + \delta_9 * Time97$$

(3)

Advertising is influenced by the degree of concentration in an industry and by the lag of profitability. In addition, time dummy variables already considered in system (2) control for time effects for each of the I-O tables. The signs of the regressors' coefficients are expected to be positive. The higher the concentration, the higher the advertising to sales ratio, considering the large expenditures in advertising required to establish barriers to entry such as brand name and image of the products sold. However, the higher the concentration, the lower could be the advertising to sales ratio due to the lack of competition in the industry. The limited number of players could collude and limit their expenses to maximize profits. The sign of $Lag(\frac{\pi}{S})$ is expected to be positive since an increase in profit provides an industry with a larger budget available for advertising and marketing expenses to ensure that the current status of the industry, with increasing profits, is maintained.

The relationship between profitability and concentration is analyzed using the following system of equations:

$$\begin{cases} 4CR = \alpha_1 * \overset{+}{\frac{\pi}{S}} + \alpha_2 * Lag(\overset{+}{\frac{\pi}{S}}) + \alpha_3 * Time67 + \alpha_4 * Time72 + \alpha_5 * Time77 + \alpha_6 * Time82 + \alpha_7 * Time92 + \alpha_8 * Time97 \\ \frac{\pi}{S} = \beta_1 * \overset{+}{4CR} + \beta_2 * \Delta\overset{+}{4CR} + \beta_3 * Time67 + \beta_4 * Time72 + \beta_5 * Time77 + \beta_6 * Time82 + \beta_7 * Time92 + \beta_8 * Time97 \end{cases}$$

(4)

The system presented in equation (4) is exactly identified, as shown in Appendix IV. The endogenous variables are the four-firm concentration ratio and profitability as a percentage of sales. The exogenous variables are the time dummies, the profit to sales ratio, the four-firm

concentration ratio, the lag of the profit to sales ratio and the first difference of the concentration ratio. As indicated in equation (4), all the coefficients of the exogenous variables are expected to be positive. Tables 13a and 13b present the results from the OLS estimation of equation (3) and the FIML estimation of system (4).

Table 13a: OLS Estimation of the Advertising Equation

Dep. Var		4 Firm Conc. Ratio	Lag(Pbt)	Time67	Time72	Time77	Time82	Time92	Time97
Advertising Sales		0.03309	-0.24312	0.00597	0.01277	0.00782	-0.00796	-0.02476	-0.00743
Prob.		0.322	<.0001	0.4311	0.0968	0.3026	0.3041	0.0033	0.3478
R-Square	0.2223								
F Value	4								
Prob.>F	0.0003								

As shown in Table 13a, the F-test rejects at the 1% confidence level the hypothesis that the parameters of the regression are jointly equal to zero. The four-firms concentration ratio appears not to be significant. The results of this regression indicate that concentration is not a determinant variable for advertising to sales ratio. One possible reason is related with the fact that the regression results cannot account for the differences in trends among the various industries. Our analysis of the pharmaceutical and automotive industries will help explain this relationship by focusing on particular industries, rather than on the entire manufacturing sector of the economy.

Surprisingly, the coefficient for the lag of profit to sales ratio is strongly significant but negatively related with advertising to sales ratio. An increase in the lag of the operating margin (ratio of profit over net sales) by one percentage point leads to a decrease in the ratio of advertising over

sales by little less than a quarter of a percentage point. It is generally expected that a company with increasing profits would have greater resources to spend in advertising, and that a company with declining profits, for instance, in a period of recession, would curtail advertising expenses. An alternative interpretation could be that the advertising to sales ratio increases when the profitability decreases, reflecting the attempt of the company to regain market share or brand awareness and to move back to profitability. If the company's earnings are increasing, the incentive to incur additional advertising costs decreases. Table 13b presents the results from the estimation of equation (4).

Table 13b: Simultaneous Equation Estimation Results – Full Information Maximum Likelihood

Dependent Variables	Profit Before Taxes	Lag(Pbt)	Time67	Time72	Time77	Time82	Time92	Time97
4CR	6.880178	-1.25953	-0.16691	-0.08495	-0.2118	0.479319	0.110588	-0.14136
Prob.	0.0956	0.2508	0.2371	0.3721	0.1562	0.1215	0.243	0.1286
	4CR	1st Diff. 4-CR	Time67	Time72	Time77	Time82	Time92	Time97
Profit Before Taxes	1.00973	-0.47246	0.007069	-0.00055	0.026548	-0.06373	-0.03229	0.035186
Prob.	0.1156	0.2074	0.7699	0.9822	0.2168	0.0025	0.1248	0.1686

The results of this equation confirm the existence of simultaneity between profitability and concentration. The first equation leads to the acceptance, at the 10% level of significance, the hypothesis that profit before taxes (as a percentage of net sales) influences positively the level of concentration in the manufacturing industry. The coefficient is positive as expected. The lagged values of profit are not significantly different from zero. In the second equation the four-firm concentration ratio also turns out to be significant at the 15% level, even though this indicates that the relationship is weaker than in the first equation. However, the positive sign of the coefficient supports our expectations that an increase in the concentration is associated with an increase in

profit. The first difference of the concentration ratio variable does not result significant. Overall, system (4) supports the simultaneous relationship between profitability and concentration in the United States manufacturing sector of the economy.

2.11 Conclusion

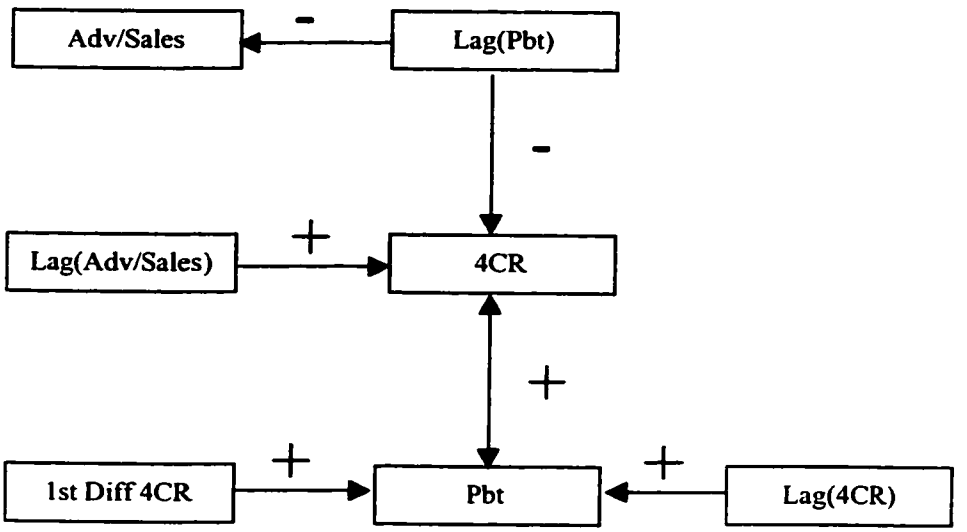
Our analysis has been performed across the U.S. manufacturing sector of the economy. The peculiarities of each industry within this sector have not been taken into account since, with the exception of controlling for fixed effects, I have assumed that the interaction between advertising, concentration and profitability does not vary across industries. The results obtained were not significant in the case of the estimation of a system with three endogeneous variables but significant and consistent with the expectations when estimating a single equation for the advertising to sales ratio and a system of two equations for the relationship between profitability and concentration.

The main objective of this dissertation is the analysis of the relationship between advertising, concentration and profitability in the U.S. manufacturing sector. The results indicate that concentration and profitability are important factors in the determination of the advertising to sales ratio in an industry. Advertising also varies over time, due to changes in the economy which increase the necessity of companies to compete among the themselves. In addition, the progress of society increases the amount of information available to the consumers and makes necessary for a company to invest in marketing activities that introduce the products or the service to the potential buyers.

Concentration is a significant variable in determining profitability. The relation between the two variables is positive, indicating that an increase in the degree of concentration increases the profit

in the industry and viceversa. The only result in contrast with out expectations is the sign of the estimated coefficient for Lag(Pbt) in the regression with the concentration ratio, which is negative and suggests that previous values of profitability are negatively related with future values of concentration. Figure 3 presents the results of this chapter.

Figure 3: Results of the Analysis at the Two-Digit SIC Code



Notes: The direction of the arrow indicates the causality relationship between the variables. The signs on the arrows refer to the direct or inverse causality relation between the variables.

The lag of profitability has been determined to be a significant regressor for the advertising to sales ratio. The relationship is positive and confirmed by the results from the Granger Causality Test (Table 12). The lag of profitability appears to influence negatively the four-firm concentration ratio, the estimated coefficient being significant at the 1% level. This result was in contrast with our expectations, but it could reflect the fact that industries with increasing profits over the course of the forty years analyzed have experienced an increase the competition, attracted by the high returns of the industries. New entrants in the industry have reduced the

degree of concentration. On the other hand, industries characterized by a low profitability have driven out more companies, which have diversified into other markets to revive their low profitability. As existing company exit the market, the concentration level increases.

All the other relationships found are positive and consistent with our expectations. The concentration ratio is positively influenced by the lagged level of advertising to sales ratio (see table 12). The advertising to sales ratio indicates the effort made by companies to differentiate their products and to compete in the market to gain additional market share. A system with two equations allowed me to identify the significant and positive relationship existing between profitability and concentration. These results were presented in table 9b. Finally, given the complex relationship between profitability and concentration, an OLS estimation of the concentration ratios through an OLS methodology reveals that this variable is positively influenced by both the first difference and the lag in the value of the profit to sales ratio.

In the next chapter our analysis will focus on two specific industries, namely automotive and pharmaceutical. The ability to analyze specifically two industries will allow me to identify the peculiarities of the industry and to control for factors that may bias our ability to explain the interaction between advertising, concentration and profitability.

Chapter III: Panel Data Analysis of the Automotive and Pharmaceutical Industries

3.1 Introduction

The analysis presented in Chapter II was based on a dataset reflecting the U.S. manufacturing sector. By concentrating on a specific industry I will identify any specific forces whose effects could not be distinguishable at the overall economy level. This chapter focuses on the automotive and the pharmaceutical industries. The choice of these two industries is motivated by their peculiarities. Advertising and marketing expenditures are an important factor of success for companies operating in these two industries and are expected to reveal their interaction with profitability and concentration in the results of the estimation. In addition, the consolidation that has taken place in the two industries should enable me to analyze the effect of a change in concentration on the companies' performance.

The next paragraphs review the identification and the estimation of the significant relations existing among advertising, concentration and profitability in the automotive and in the pharmaceutical industries. The results of the analysis will verify whether by focusing on a specific industry can yield more accurate and significant estimate of the interaction between market structure and profitability.

3.2 Data Sources

The analysis performed in this chapter covers the period 1980-2000. Financial data for the companies analyzed were obtained from Standard & Poors' Compustat PC Plus. This database provides financial data for over 12,000 public companies and industry groups. Missing data were cross checked with Laser Disclosure U.S. and International, FIS Online and Moody's Industrial Manual. Laser Disclosure US and International provides images of annual reports, 10K's, and proxy statements for companies on NYSE, AMEX, NASDAQ and OTC since 1989. Data from annual reports for non-US companies are available since 1994. FIS Online provides reports, statistics and information on more than 21,000 U.S. and international companies, including 10,000 NYSE, AMEX and Nasdaq exchange companies. Moody's Manuals[11] include Bank & Finance, Industrial, International, Municipal & Government, OTC Industrial, OTC Unlisted, Public Utilities and transportation. Publication date varies from 1909- to date. This source summarizes information from annual reports.

In addition to the sources cited above, advertising data was also obtained from in the publication "AD $ summary", from Leading National Advertisers, Inc. For a complete list of database and publications used in the data gathering stage, please refer to the biographic reference at the end of this chapter.

3.3 Overview of Automotive and Pharmaceutical Datasets

To identify companies operating in the Automotive industry we relied on the following 1987 SIC codes:

- SIC 371: Motor Vehicles and Motor Vehicle Equipment
  - 3711: Motor Vehicles and Passenger Car Bodies;
  - 3713: Truck and Bus Bodies;
  - 3714: Motor Vehicle Parts and Accessories;
  - 3715: Truck Trailers; and
  - 3716: Motor Homes.
- SIC 501: Motor Vehicles and Motor Vehicles Parts and Supplies:
  - 5012: Automobiles and Other Motor Vehicles;
  - 5013: Motor Vehicle Supplies and New Parts;
  - 5014: Tires and Tubes; and
  - 5015: Motor Vehicles Parts, Used.

Using Compact Disclosure, this search produced 69 companies. The identification of pharmaceutical companies was more complex, due to the fine line between companies producing pharmaceutical products, agrochemicals and also cosmetic products. The following industries were considered part of the pharmaceutical sector:

- Animal Health: SIC 2834, 2835, 2836.
- Agrochemical Manufacturers: SIC 2873 and 2879. This set of SIC codes did not yield any companies. This is due to the significant consolidation that has taken place in this business. The agrochemical manufacturers are now well diversified and their primary SIC codes reflect the fact that these companies consider themselves pharmaceutical companies.

[11] Currently renamed "Mergent Manuals".

- Agrochemical Distributors: SIC 5191, 5148, 5153, 3443, 2038, 5169, 1474, 2879, 0171 and 5083. This set of SIC codes produced only 17 companies, in consistency with the trend highlighted for the agrochemical manufacturers.
- Medical Products Manufacturers and Distributors: SIC 2844, 3826, 3841, 3842, 3845, 5047, 5084, 5122, and 8731.

Using Compact Disclosure, the search produced 830 companies. Companies with an average Operating Margin ("OM") lower than –100% over the twenty-year period analyzed were eliminated from the set. The losses incurred by these companies are generally the result of the business environment and the level of competition of the sector in which they operate and should not justify their elimination from the sample. However, in most of the cases considered, companies with a loss of more than 100% of total revenues are not a business concern and generally face bankruptcy. Their elimination from the dataset reduces the number of outliers that do not represent the competitive environment of the business characterizing that particular sector of the economy.

The analysis performed in this chapter focuses on the automotive and on the pharmaceutical sectors because I expect that the relationships existing between advertising, concentration and profitability are strong. The products sold by industries operating in these two sectors are highly diversifiable and their development requires significant investment of time and financial resources. Given these characteristics, these industries invest significant resources in advertising and marketing activities, to attract the interest of the consumers in the company's products. In addition, these industries are highly concentrated given the existence of economies of scale in the development and in the production of automotive and pharmaceutical products. These two industries require large resources for the development of new products and to whether periods of

downturn in the economy. Chart 1 below presents the evolution of CR-4 for the two industries over the period 1980-2000.

Chart 1: Overview of CR-4 in the United States

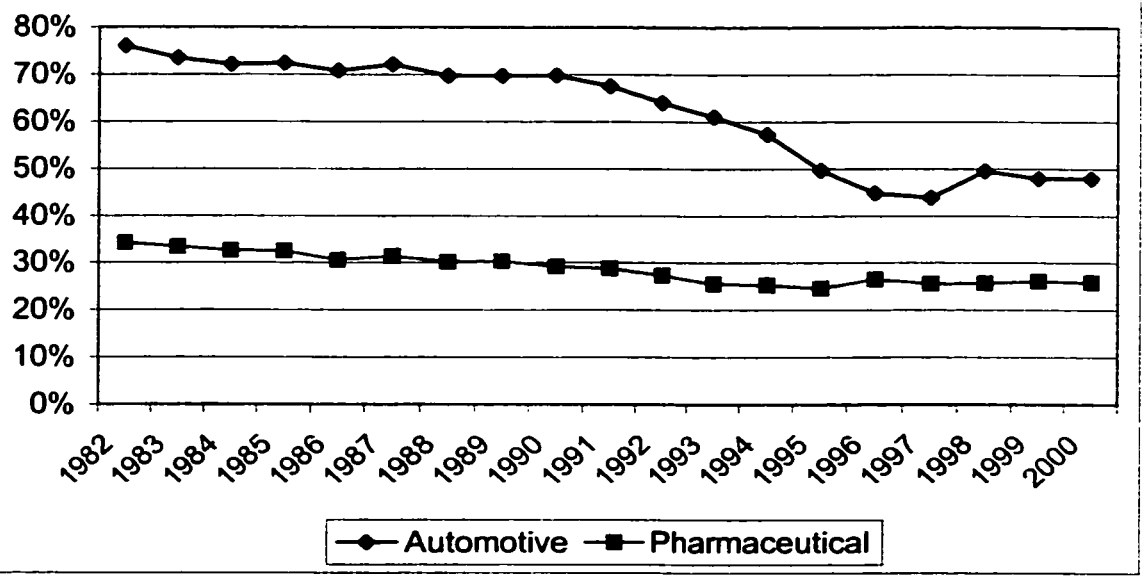


Chart 1 shows the significant reduction in the market share of the four largest automotive companies in the United States over the last twenty years. This reduction is related to the increased competition that the three large U.S. carmakers had to face over time. The reduction in the market share of the four largest pharmaceutical companies has not been as steep, even though from a total market share of 34% in 1980, the four largest companies control now only 26% of the total sales in the pharmaceutical sector.

Before starting the analysis of the relationship between advertising, concentration and profitability it is necessary to review the limitations of the two datasets used. In both cases the first source of bias is that information is limited to public companies with stocks or American

Depository Receipts ("ADR") traded in a U.S. stock exchange. If an automotive or pharmaceutical company does not have its shares publicly traded in the United States, its data were not collected for this analysis. This problem affects more the automotive dataset, where some players are not quoted in the U.S. stock market. The second source of bias arises from the use of consolidated data for the companies part of the automotive and pharmaceutical sectors. This means that sales data, profitability and advertising expenditures reflect the overall company. Since these companies are generally multinational corporations operating in several countries, this analysis utilizes data reflecting global operations. This problem becomes more significant for foreign companies, since their financial data used in the analysis reflect operations in different markets.

The data limitations highlighted above must be taken into consideration when interpreting the results of this analysis. However, these problems are not expected to affect significantly the reliability of the analysis for two reasons. First, the United States is the largest economy and the biggest market where any company operating in an open economy competes. Given the opportunities in terms of sales that the United States offers to any company, the financial data of the firms operating in the United States reflect sales and profits earned mostly in the United States and therefore representative of this country's automotive and pharmaceutical sectors. The second reason is that the United States is clearly the most competitive market in the world. Being the largest and the most developed economy, the United States has become the focus of strategies for each major multinational corporation. For this reason, if there is a significant relationship among the variables considered in this study, it is most likely that an analysis focusing on the United States will be able to identify it. In addition, even though the financial data of the companies

included in the dataset reflect operations around the world, they are mainly influenced by the performance in the United States.

3.4 Preliminary Analysis of the Variables Considered in this Study

Before performing the estimation of the relationship between advertising, concentration and profitability, I calculated the summary statistics of these variables and their correlation. Table 14 presents the correlation results.

Table 14: Summary Statistics and Correlation for the Variables Used in this Analysis

Automotive Industry					Pharmaceutical Industry				
	EBTDA (%)	**Advertising Sales**	**Sales ($ million)**	**Share**		**EBTDA (%)**	**Advertising Sales**	**Sales ($ million)**	**Share**
MEAN	-0.76324	1.5985	1642	0.04931	**MEAN**	-6.10944	5.42946	686.8004	0.01011
Standard Error	6.70831	1.83478	3551	0.13012	**Standard Error**	19.42779	8.05933	2652	0.05353
N	770	143	770	770	**N**	5,626	1,700	5,626	5,626
0 ≤ ρ ≤ 1	**EBTDA (%)**	**Advertising Sales**	**Sales ($ million)**	**Share**	**0 ≤ ρ ≤ 1**	**EBTDA (%)**	**Advertising Sales**	**Sales ($ million)**	**Share**
EBTDA		-0.33022	0.05295	0.04352	**EBTDA**		-0.10119	0.081	0.05931
Significance		<.0001	0.1421	0.2277	Significance		<.0001	<.0001	<.0001
Advertising Sales			-0.14685	0.01907	**AdvertisingSales**			0.03163	-0.00335
Significance			0.0801	0.8211	Significance			0.1924	0.8904
Sales				0.45859	**Sales**				0.36798
Significance				<.0001	Significance				<.0001

Where EBTDA indicates earnings before tax, depreciation and amortization, as a percentage of the company's total sales; OM indicates the operating margin; share is the ratio of a company's total sales over the sum of the sales respectively for the automotive or the pharmaceutical sectors. Share is a proxy for concentration, since the higher a company's share, the greater the value of CR-4. Finally, ρ represents the correlation coefficient between the variables in the matrix.

The average profitability of the automotive industry is higher than that of the pharmaceutical: from an average loss of –0.76% we drop to an average operating loss of –6.11%. These values are not weighted by the level of sales. In the two datasets there is a significant number of companies which incur significant losses as they start operating as public companies. The future of these companies depends on the possibility to be acquired by a larger conglomerate with greater scale and financial resources. In alternative, the company will file for protection under the bankruptcy law or will be transformed into a private company. In the pharmaceutical industry this type of companies is more common. These firms are small laboratories involved in research and development or biotechnology research and are publicly traded because they require continuous injection of significant financial resources until the object of research is achieved. Given the length of the pharmaceutical research process and the high risk of failure, it is understandable why there are so many companies without products to sell but which are incurring large costs to develop a formulation or a product which, if successful, could generate very large returns. As mentioned before, we have eliminated those companies for which OM was below –100%. This step was required because for these companies the OM index is unreliable, given the limited or negligible level of sales as compared to the significant development costs.

The investment in advertising expenditures appears to be more significant in the pharmaceutical industry, where there is a ratio of 5.43%, versus a ratio of 1.60% in the automotive industry. A

possible explanation of this result is that the average sales for pharmaceutical companies is below $1 billion, as compared to $1.642 billions in the automotive sector. The same ratio of advertising to sales expenditures translates into a significantly higher absolute amount of advertising expenditures for the automotive industries, given the larger denominator. Thus, even though the ratio for the pharmaceutical industry is higher, some of the difference is due to the lower average total sales per company in this sector.

Looking at the correlations among variables, the majority are significantly different from zero as confirmed by the Pearson test.[12] These results represent an improvement from those obtained in chapter II, were the analysis showed no strong correlation between advertising to sales ratio, sales and profitability. By focusing on a specific industry we can identify the interaction among variables that were not identifiable when analyzing the overall manufacturing sector. As an example we can observe the relationship between advertising to sales ratio and Sales. In chapter II this relationship did not result significant. In this chapter the correlation is significant and negative for the automotive sector, but significant and positive in the pharmaceutical sector. An analysis at the overall manufacturing sector level is influenced by these contrasting forces and produces a result that is not significant.

The relationship between advertising and sales is expected to be positive, since companies tend to expand their marketing and selling efforts as the production or the customer base increase. However, the reason for different signs in the correlation between sales and advertising in the automotive and pharmaceutical industries lies in the characteristics of the industries. In the

[12] Table 14 presents the level of significance for the Pearson test, where the null hypothesis is that the correlation coefficient is equal to zero. The smaller is the significance value, the higher the probability that the correlation coefficient is significantly different from zero. At the extreme, when significance is smaller that 0.0001, we are fully confident that there is a correlation between the two variables considered.

pharmaceutical sector, advertising has an important informational content, since it allows companies to inform consumers about the availability of treatment for certain pathologies. When a company obtains a patent, in order to expand sales for the product that will sell in monopolistic conditions, advertising expenditures are significantly expanded, to ensure consumer awareness and brand name development. Since the market for pharmaceutical products is generally not cyclical, the positive relation between advertising and sales is expected to be stable.

The automotive sector is more influenced by economic cycles. As durable goods, cars suffer from the reduction in consumption during a period of recession. In periods of sales' slumps, automakers step up their efforts by offering incentives to prospective buyers and by increasing the selling and marketing activities to win back consumers. Often, the additional discounts offered to clients are considered marketing expenditures and tend to increase during periods of slow sales. The negative correlation coefficient, although only significant at the 10% level, is the result of this practice.

The correlation analysis has been performed using earnings before tax, depreciation and amortization, or EBTDA. EBTDA is preferable to OM since it represents the net value created by a company that is available for distribution under the form of dividends. OM however can be influenced by the evolution of the tax legislation and by policies followed by the company to minimize the tax burden. The value of the OM may not represent the economic profits generated by the company, since by accelerating the depreciation and amortization of an asset or by taking advantage of tax planning opportunities, the company may try to minimize the accounting profits and therefore its tax liabilities. EBTDA could represent a more realistic approximation of a company's economic profit. Table 14 indicates that EBTDA is significantly correlated to the other variables object of our analysis, at least in the automotive sector.

The review of the relationship existing between EBTDA and Advertising to sales shows that in the automotive and pharmaceutical industries, consistently with the results obtained in chapter II, the correlation is significant and negative.[13] The explanation for this result could be similar to that given for the negative relationship between advertising and sales in the automotive sector. When profitability slows, companies step up their marketing efforts to increase sales. However, this argument is not applicable to the pharmaceutical industry which, as previously mentioned, is not greatly influenced by slowdowns in the economy.

An additional aspect to be taken into account reflects the informational content of advertising and marketing campaigns. A new pharmaceutical company, especially laboratories, must incur in significant advertising and marketing efforts to gain customer base and to attract investors in the initial period of their activity, when the company is in its development stage and requires significant financial resources to finance its losses. Since the development period may last for several years, if the company does not receive continuous investments, it will not be able to bring to market its products or technologies. Marketing and promotional expenditures play therefore a crucial role in this stage of a company's life. The negative association between advertising and profitability can be partially explained by this situation.

3.5 Estimation of the Relationship Between Advertising, Concentration and Profitability in the Automotive and Pharmaceutical Industries

The purpose of the previous chapter was threefold:

[13] See chapter II, table 3.

1. Evaluation of the magnitude and direction of the relationship between advertising, concentration and profitability within the U.S. manufacturing sector at the two-digit SIC code level;
2. Determination of whether advertising and other marketing costs as a percentage of sales vary inversely with individual firm market shares and verification of whether this inverse relationship occurs more significantly in industries of rapidly rising concentration; and
3. Verification of the theory of optimal dynamic limit pricing. According to this theory, profit margins increase when an industry emerges from a period of rapidly rising concentration to a period of high and stable concentration.

The results obtained in the previous chapter provided answers to the first area of investigation, supporting the hypothesis that advertising expenditures are determined by the interaction of concentration and profitability and that there is a strong relationship between profitability and concentration. The estimation of the two-equation system showed that concentration has an important role in influencing the profitability of an industry. The results did not allow the testing of the second and third area of investigation. The analysis performed in this chapter will attempt to shed some light on the objective of this dissertation focusing my attention on the automotive and pharmaceutical industries.

To obtain preliminary insights on the relationship between advertising, concentration and profitability, the following equations were estimated using the OLS technique:

$$Share = \alpha_1 + \alpha_2 * \frac{Adv}{Sales} + \alpha_3 * EBTDA \qquad (1)$$

$$\frac{Adv}{Sales} = \alpha_1 + \alpha_2 * Share + \alpha_3 * \Delta^2 Share \qquad (2)$$

$$EBTDA = \alpha_1 + \alpha_2 * \Delta Share + \alpha_3 * \Delta^2 Share \qquad (3)$$

$$EBTDA = \alpha_1 + \alpha_2 * Share + \alpha_3 * \Delta Share \qquad (4)$$

where Δ is the difference operator, such that $\Delta Share = Share_t - Share_{t-1}$ and EBTDA is expressed as a percentage of the company's total sales.

Since the analysis is performed using panel data sets for the automotive and pharmaceutical industries, I controlled for fixed effects and time effects to obtain accurate information on the relationship between advertising, concentration and profitability.

To control for fixed effects each variable is redefined as the difference between the variable and its mean. This transformation is aimed at eliminating company specific variability. To control for time specific effects, I introduced time dummies. I first inserted a dummy variable for each of the twenty years analyzed, but then limited the time dummies to one every two years. The reduction of dummy variables is an attempt to avoid a significant reduction in the degrees of freedom in the estimation due to additional parameters to estimate for each equation that could affect the robustness of the estimation. Thus, the time dummies used in the analysis are ten and will control for the variability in the model due to the passing of time.

The results of the estimation presented in the following tables do not show the values of the time dummies. The complete estimation results obtained for each of the tables presented in this chapter are included as Appendix I to this chapter. The results of the estimation of the equations (1) to (4) are presented in Table 15. None of the equations estimated for the automotive industry are significantly different from zero, as illustrated by the lower value of R Square and by the F

statistics, whose values lead to the acceptance of the null hypothesis that all the coefficients are equal to zero. The results of the estimation for the pharmaceutical industry do not represent a significant improvement since all the parameters of the independent variables are not significant at the 10% level.

Table 15: OLS Estimation for the Automotive and the Pharmaceutical Industries

		Analysis of the Automotive Industry			
Dep. Variables	**Intercept**	**Advertising/Sales**	**EBTDA**	**R-Square**	**F**
Share	-0.21514	-0.18935	-0.04932	0.108	1.31
Prob.	0.6855	0.275	0.4484		0.2275
	Intercept	**Share**	**2nd Diff. Share**		
Advertising/Sales	-0.25151	-0.03343	0.06145	0.0836	0.99
Prob.	0.3879	0.5244	0.4123		0.4621
	Intercept	**1st Diff. Share**	**2nd Diff. Share**		
EBTDA	0.11047	0.12191	0.02477	0.0688	0.8
Prob.	0.8871	0.7509	0.9113		0.641
	Intercept	**Share**	**1st Diff. Share**		
EBTDA	0.09935	-0.0636	0.14423	0.0704	0.82
Prob.	0.8984	0.6354	0.6626		0.6206
		Analysis of the Pharmaceutical Industry			
Dep. Variables	**Intercept**	**Advertising/Sales**	**EBTDA**	**R-Square**	**F**
Share	-0.14106	0.00036977	0.00173	0.0634	9.36
Prob.	0.0501	0.9478	0.4037		<.0001
	Intercept	**Share**	**2nd Diff. Share**		
Advertising/Sales	0.49218	0.00779	0.06526	0.0065	0.91
Prob.	0.1363	0.9490	0.6648		0.5294
	Intercept	**1st Diff. Share**	**2nd Diff. Share**		
EBTDA	0.59264	0.27465	-0.11343	0.0098	1.36
Prob.	0.5109	0.7701	0.7977		0.1848
	Intercept	**Share**	**1st Diff. Share**		
EBTDA	0.63474	0.26553	0.13542	0.0102	1.42
Prob.	0.4817	0.4091	0.8726		0.1579

The results of this estimation indicate that there is not a linear and unidirectional relation between any of the variables analyzed. The performance of the Granger test will clarify the direction of the causality relationship between advertising, concentration and profitability.

3.6 Endogeneity Test

In order to determine the existence of simultaneity among the three variables analyzed, I performed the Granger causality test. As explained in section 2.7, the Granger test is performed by regressing a variable on its lagged values and on the lagged values of the variable that can be considered a causing factor. I regressed advertising, market share and profitability on the lagged variables of the remaining two. Table 16 presents the results of the OLS estimation.

Table 16: Estimated Coefficients from the Granger Causality Test

Automotive Industry						
Dep. Variables	**Intercept**	**Lag(Advertising/Sales)**	**Lag(Share)**	**Lag(EBTDA)**	**R Square**	**F**
Advertising/Sales	-0.26186	0.27157	-0.01756	0.00411	0.1516	1.62
Prob.	0.3744	0.0064	0.6993	0.762		0.0956
	Intercept	**Lag(Share)**	**Lag(Advertising/Sales)**	**Lag(EBTDA)**		
Share	-0.10121	0.85923	-0.04517	-0.00122	0.8767	64.61
Prob.	0.6367	<.0001	0.5266	0.9017		<.0001
	Intercept	**Lag(EBTDA)**	**Lag(Share)**	**Lag(Advertising/Sales)**		
EBTDA	0.11489	0.10255	-0.06664	0.11126	0.1371	1.44
Prob.	0.8834	0.0053	0.5821	0.6697		0.1577
Pharmaceutical Industry						
Dep. Variables	**Intercept**	**Lag(Advertising/Sales)**	**Lag(Share)**	**Lag(EBTDA)**	**R Square**	**F**
Advertising/Sales	0.74962	0.31129	-0.00670	0.01337	0.0928	11.67
Prob.	0.0307	<.0001	0.9499	0.1421		<.0001
	Intercept	**Lag(Share)**	**Lag(Advertising/Sales)**	**Lag(EBTDA)**		
Share	-0.03795	0.88707	0.00190	0.00024508	0.8887	910.54
Prob.	0.1871	<.0001	0.4026	0.7458		<.0001
	Intercept	**Lag(EBTDA)**	**Lag(Share)**	**Lag(Advertising/Sales)**		
EBTDA	-0.38941	0.30384	0.07907	0.22470	0.1118	14.37
Prob.	0.6698	<.0001	0.7785	0.0019		<0.0001

The Granger test does not confirm the presence of any simultaneous relation between any of the variables in the automotive panel data. The analysis of the pharmaceutical panel data shows the existence of simultaneity between advertising as a percentage of sales and EBTDA. The coefficient of Lag(EBTDA) in the regression of $\frac{\text{Advertising}}{\text{Sales}}$ is significant at the 15% level. In

addition, the coefficient of Lag($\frac{\text{Advertising}}{\text{Sales}}$) in the regression of EBTDA is significant at the 1%. It appears that advertising expenditures as a percentage of sales is an influential factor in the determination of profitability. This relationship did not result significant in the analysis performed in the previous chapter at the manufacturing industry level. The specific analysis performed on the pharmaceutical sector enables to identify this relation.

Table 16 illustrates some surprising results, namely the absence of a causality relationship, which is contrast with the results obtained in the previous chapter and with the expectations deriving from the literature existing on the relationship between advertising, concentration and profitability. However, the Granger test cannot rule out the existence of any relationship among the variables analyzed. In the next paragraphs I will estimate the models from the previous chapter to verify and understand any differences with respect to the analysis at the industry level.

The last indication from table 16 pertains to the equation with share as the dependent variable. The results for automotive and pharmaceutical are very similar, since in both cases the only significant coefficient is that of the lagged dependent variable. Its coefficient is strongly significant and the R-square is in both cases above 85%, with a very large F-statistic supporting the significance of the regression. The parameter of Lag(Share) in the two equations suggest that the concentration in both the automotive and pharmaceutical sectors decline over time by approximately 10 to 15 percent, since the coefficients are 0.86 and 0.88.

3.7 Simultaneous Equation Estimation

The analysis of this chapter focuses on the period 1980-2000 and on the automotive and pharmaceutical industries. Since the time frame of the analysis is limited to twenty years of data and the subject of our analysis is a specific industry, there is no need to introduce dummy variables as in chapter II. The system of equations that relates advertising, concentration and profitability is obtained from system (2) in chapter II and modified as follows:

$$\begin{cases} Share = \alpha_0 + \alpha_1 * \overset{+/-}{\frac{\pi}{S}} + \alpha_2 * \overset{+}{\frac{Adv}{S}} + \alpha_3 * Time82 + \alpha_4 * Time84 + \alpha_5 * Time86 + ... + \alpha_{11} * Time98 \\ \frac{\pi}{S} = \beta_0 + \beta_1 * \overset{+/-}{Share} + \beta_2 * \overset{-}{\Delta Share} + \beta_3 * Time82 + \beta_4 * Time84 + \beta_5 * Time86 + ... + \beta_{11} * Time98 \\ \frac{Adv}{S} = \gamma_0 + \gamma_1 * \overset{+/-}{Share} + \gamma_2 * \Delta \overset{+}{\frac{\pi}{S}} + \gamma_3 * Time82 + \gamma_4 * Time84 + \gamma_5 * Time86 + ... + \gamma_{11} * Time98 \end{cases} \quad (5)$$

Where:

Share is the market share of each company considered in the analysis;

Δ Share is the first difference of the variable;

Time82, Time84, Time86, ..., Time 98 are nine dummy variables assuming value one in the year to which the variable is referred to and in the year before. Each variable has therefore two ones and the rest of its elements is zero. I have considered creating one dummy every two years because an excessive use of such variables reduces the degrees of freedom of the estimation and increases significantly the complexity of the model and of the estimation process.

Since I am analyzing a single industry, rather than using the concentration ratio as the dependent variable, I used the market share of each single company, whose expenditures in advertising as a

percentage of sales and whose EBTDA (π/S) are included as regressors in the analysis. Appendix II to this chapter shows that each equation of (5) is exactly identified.

Before performing the estimation, it is not clear what is the expected sign of all the regressors' coefficients. In the first equation of (5), the expected sign for α_2 is positive, since an increase in advertising expenditures is aimed at improving the marketability of the company's products and eventually its sales and its share of the market. Even though many advertising campaigns have failed to expand the company's market share, it is generally expected that such an investment would benefit the company and its profitability. The sign of α_1 in (5) is however not certain. As we have shown from the results of the OLS estimation (see table 15), the relation between market share and profit is complex. In particular, this quadratic and convex relation in the medium term is positive, but in the short term is negative. The increase in the company's market share is obtained through strategic moves to reinforce its position over its competitors. This strategy may rely on the temporary reduction in the products' sales price and therefore in the overall profits, which will be more than compensated with positive returns if the strategy is successful. For these reasons, the relationship between share and profit does not have a definite and clear sign.

In the second equation of (5) the sign of β_1 is not certain because of the same reason why α_1 could assume a negative or a positive sign. In the case of β_2, however, a negative sign is expected if a convex and quadratic relation between profit and market share is confirmed. The third equation of (5) attempts to interpret the variability of the advertising to sales ratio using the market share variable and the first difference in EBTDA. The sign of γ_1 is uncertain as explained in the case of α_2. The sign of γ_2 is expected to be positive, since an increase in the company's profits creates more resources that can be reinvested into the company's advertising expenditures

to strengthen or even to expand its position. On the other hand, the lower the company's profitability, the more incentives will the company have to cut expenses and focus on its bottom line, so also the advertising expenditures will be negatively affected.

Table 17 below presents the results of the FIML estimation of (5). The results obtained do not add information to what I already found by performing the OLS estimation. In particular, none of the coefficients of the variables in the automotive or the pharmaceutical industries result significant. The results presented in table 17 confirm that there is not a simultaneous relationship among the three variables.

Table 17: Simultaneous Equation Estimation Results – FIML

Automotive Industry			
Dependent Variables	**Intercept**	**Advertising/Sales**	**EBTDA**
Share	-0.23188	-0.23532	0.003489
Prob.	0.8965	0.9738	0.9968
	Intercept	**Share**	**1st Diff. Share**
EBTDA	5.736171	32.76785	-0.23426
Prob.	0.8992	0.8937	0.9755
	Intercept	**Share**	**Lag(EBTDA)**
Advertising/Sales	-0.95323	-4.07196	0.000927
Prob.	0.944	0.9582	0.9971
Pharmaceutical Industry			
Dependent Variables	**Intercept**	**Advertising/Sales**	**EBTDA**
Share	-0.40892	0.549740	0.000311
Prob.	0.3509	0.4957	0.9890
	Intercept	**Share**	**1st Diff. Share**
EBTDA	60.06694	421.1328	-52.2047
Prob.	0.7720	0.7718	0.7752
	Intercept	**Share**	**Lag(EBTDA)**
Advertising/Sales	0.743575	1.818404	-0.00012
Prob.	0.1489	0.4947	0.9890

The estimates obtained could be due to the fact that in reality there is not a relationship among these variables that follows the pattern identified in (5). The next paragraph will explore the possibility that there is a more direct relationship that can help describe and explain the variation in advertising to sales ratio, concentration and profitability.

3.8 Alternative Estimation of the Relationship Between Advertising, Concentration and Profitability

In order to describe the evolution of the advertising to sales ratio, I considered two specifications. The first specification is similar to equation (3) in chapter II, with the exclusion of the dummy variables:

$$\frac{Adv}{S} = \delta_0 + \delta_1 * \overset{+}{Share} + \delta_2 * lag(\overset{+}{\frac{\pi}{S}}) + \delta_3 * Time82 + \delta_4 * Time84 + ... + \delta_{11} * Time85 \qquad (6)$$

where lag(.) is the lag operator, such that lag(x) = x_{t-1} and π/S is EBTDA over total sales. In this specification, advertising is influenced by the company's market share and by the trend in the profitability of the company. The sign of δ_1 will be positive if an increase in the company's market share stimulates investment in advertising expenditures to consolidate and improve the position of the company. The sign of δ_2 is expected to be positive since an increase in the company's profitability provides economic resources to be invested for the continuation of the company's success. These resources are invested also in advertising campaign to expand the company's markets and to attract more customers. Table 18 below presents the results of the analysis.

Table 18: OLS Estimation of the Advertising Equation

Automotive Industry					
	Intercept	**Share**	**Lag(EBTDA)**	**R Square**	**F**
Advertising/Sales	-0.2825	-0.04721	-0.01059	0.094	1.04
Prob.	0.3517	0.345	0.4097		0.4192
Pharmaceutical Industry					
	Intercept	**Share**	**Lag(EBTDA)**	**R Square**	**F**
Advertising/Sales	0.67099	0.01778	0.06617	0.0189	1.69
Prob.	0.0749	0.8702	0.0543		0.07

The estimation results for equation (6) do not appear significant for either of the two industries. In particular, at the 10% level of significance, the F test accepts the null hypothesis that the coefficients of the regression are equal to zero for the automotive industry. The term Lag(EBTDA) in the equation for the pharmaceutical industry is significant and has the expected sign, indicating that for this industry the past value of profits influences positively the investment into advertising as a percentage of sales.

Unfortunately, the R Square of the regressions is close to zero and the t-test of significance confirms that all the variables' coefficients are individually equal to zero at the 10% level of significance. The estimated results for equation (6) confirm what was found in chapter II for the market share. This variable does not seem to have an important role in the determination of the advertising to sales ratio. Table 18 shows that the market share is never a significant variable in any of the estimations. This result may be related to the fact that as explained in the discussion of the expected sign, the effect of market share on the advertising and marketing expenditures is mixed.

In addition to estimate equation (6), I also estimated system (4) from chapter II, modified as follows:

$$\begin{cases} Share = \alpha_0 + \alpha_1 * \overset{+}{\frac{\pi}{S}} + \alpha_2 * Lag(\overset{+}{\frac{\pi}{S}}) + \alpha_3 * Time82 + \alpha_4 * Time84 + ... + \alpha_{11} * Time98 \\ \frac{\pi}{S} = \beta_0 + \beta_1 * \overset{+}{Share} + \beta_2 * \Delta\overset{+}{Share} + \beta_3 * Time82 + \beta_4 * Time72 + ... + \beta_{11} * Time98 \end{cases}$$

(7)

This estimation is performed to compare the results with those obtained in chapter II even though the expectations are to find a poor or non existing relationship. After this estimation, this analysis will focus on the relationship between profitability and advertising, which is expected to be significant in the case of the pharmaceutical industry as indicated by the results of the Granger causality test. Table 19 below presents the results of the estimation of (7) for the automotive and the pharmaceutical industries.

Table 19: Simultaneous Equation Estimation of the Relation between Concentration and Profits - FIML

Automotive Industry			
Dependent Variables	**Intercept**	**EBTDA**	**Lag(EBTDA)**
Share	-0.18107	0.083455	-0.00522
Prob.	0.7374	0.9588	0.9742
	Intercept	**Share**	**1st Diff. Share**
EBTDA	5.736175	32.76783	-0.23419
Prob.	0.8992	0.8937	0.9755
Pharmaceutical Industry			
Dependent Variables	**Intercept**	**EBTDA**	**Lag(EBTDA)**
Share	-0.41740	0.888563	-0.18288
Prob.	0.8157	0.8639	0.8642
	Intercept	**Share**	**1st Diff. Share**
EBTDA	60.06716	421.1339	-52.2109
Prob.	0.7720	0.7718	0.7752

As a confirmation of the results obtained from the Granger causality test, none of the parameters estimated appears to be significantly different from zero. There is not a stable relationship between the two variables in the panel data analyzed, after having controlled for the company-specific variability and for time specific effects. This result is clearly in contrast with my expectations and with the results obtained by other researchers.

In addition to estimating the advertising to sales equation, I also revised the relationship between market share and profitability as follows:

$$\begin{cases} \dfrac{Adv}{S} = \alpha_0 + \alpha_1 * \dfrac{\pi}{S} + \alpha_2 * Lag(\dfrac{\pi}{S}) + \alpha_3 * Time82 + \alpha_4 * Time84 + \ldots\ldots + \alpha_{11} * Time98 \\ \dfrac{\pi}{S} = \beta_0 + \beta_1 * \dfrac{Adv}{S} + \beta_2 * Lag(\dfrac{Adv}{S}) + \beta_3 * Time82 + \beta_4 * Time72 + \ldots\ldots + \beta_{11} * Time98 \end{cases}$$

(8)

As discussed before, the higher the profits earned by a company, the greater the financial resources available for the company to invest in advertising expenditures with the purpose of strengthening the company's position in the market. The second equation in system (8) shows that an increase in advertising expenditures is expected to benefit the company with greater profits. All the signs of the coefficients are expected to be positive as shown in (8). Table 20 below presents the results of the FIML estimation.

Table 20: Simultaneous Equation Estimation of the Relationship between Advertising and Profits – FIML

Automotive Industry			
Dependent Variables	**Intercept**	**EBTDA**	**Lag(EBTDA)**
Advertising / Sales	-0.51809	2.103749	-0.21341
Prob.	0.7629	0.6103	0.5972
	Intercept	**Advertising / Sales**	**Lag(Adv.)**
EBTDA	6.288817	23.73593	-6.44185
Prob.	0.7527	0.7416	0.7369
Pharmaceutical Industry			
Dependent Variables	**Intercept**	**EBTDA**	**Lag(EBTDA)**
Advertising / Sales	1.31	1.386987	-0.40824
Prob.	0.3422	0.0041	0.005
	Intercept	**Advertising/ Sales**	**Lag(Adv.)**
EBTDA	-17.4831	22.74927	-6.85761
Prob.	0.23	0.1518	0.1602

Based on the results presented in table 20, the relation described in system (8) does not hold for the automotive industry. On the other hand, this relation is significant at the 5% level for the pharmaceutical industry. The signs of α_2 and of β_2 are positive and consistent with my expectations. An increase in profitability increases the advertising to sales ratio, since there are more resources available for marketing and advertising expenditures. In a slowing environment, instead, a reduction in profit would lead to a contraction in the advertising and marketing

expenditures. The second equation of the system for the pharmaceutical industry also shows that advertising to sales has a weaker but also positive effect on profitability. The results confirm that an investment in advertising leads to an improvement of the company's ability to increase sales, taking advantage of the economies of scale in R&D or in production. The t-test of significance rejects the hypothesis that $\alpha_2 = 0$ at the 1% level, whether the same test for β_2 is rejected at the 20% level. Finally, the signs of the coefficients of the lags of advertising and profitability are not consistent with our expectations. Past advertising is seen as being negatively related with current profitability and, by the same token, past profitability is negatively related with advertising.

3.9 Conclusion

The purpose of this chapter is to verify the relation between advertising, concentration and profitability in the automotive and pharmaceutical industries. The choice of the two industries is due to the fact that in both industries advertising and marketing expenditures represent a significant and critical expense to ensure the ability of companies to introduce new products and to successfully compete with dominant products sold by other companies. The automotive and pharmaceutical industries are characterized by the existence of economies of scale in various aspects of their business, including R&D and production. For these reasons there has been a lot of consolidation which has reduced the number of players over the years and, for example in the case of the pharmaceutical industry, caused the disappearance of independent companies specialized in the production of specific products (for example, agrochemical manufacturers). Besides these similarities, the automotive industry sells a durable good and is heavily influenced by periods of recession, while the pharmaceutical industry sells consumable goods which are generally insulated from recession.

The analysis of this chapter sought to identify how the relationships obtained in the previous chapter for the entire manufacturing sector are affected by the characteristics of the two industries chosen. The OLS estimation of the two separate panel data available over the period 1980-2000 did not yield significant results. In addition, the estimation of the systems of simultaneous equations used in chapter II failed to show any relationship between the three variables or when applied to the two equation system between concentration and profitability. Finally, the estimation of advertising as a percentage of sales on the profitability and concentration yielded results in contrast with those of chapter II.

The only significant relationship was found between profitability and advertising in the pharmaceutical sector. I estimated a system of simultaneous equations between advertising and profitability and obtained that the two variables are positively related, as expected. This result is however overshadowed by the absence of significance in all the other relationships. As shown in Appendix I, in most of the estimations performed in this chapter a large number of time dummies are significant, indicating that there is a time-related variability in the variables object of the analysis that cannot be explained by the simultaneous variation in profit, concentration or advertising. In addition, the Granger causality test indicates that the market share variable, introduced in this chapter to substitute the concentration ratio, could be an autoregressive process. In both estimations for the automotive and pharmaceutical industries, the lagged share variable is the only significant variable, producing an R^2 greater than 85%. The coefficient of the lagged term is equal to 0.85 in the automotive industry and 0.88 in the pharmaceutical industry.

These results could be due to the fact that there is not sufficient variability in the variables object of the study to be explained with factors other than industry or company specific variation and

time effects. This hypothesis is confirmed by the evidence that the variable share is an autoregressive process of order one and therefore slightly changes over time, in this case declining by approximately 15% each year. Nevertheless, strong significance has been identified in the positive relationship between profit and advertising, with causality running in both directions. Investments in advertising have a positive effect on the company's profitability. In addition, the higher the company's profits, the larger is the budget that a company can spend on advertising and marketing campaigns.

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Laser Disclosure US and International. Provides images of Annual Reports, 10K's, and proxy statements for companies on NYSE, AMEX, NASDAQ and OTC since 1989. Images of Annual Reports for non-US companies since 1994. Updated weekly.

Moody's Industrial Manual – New York: Moody's Investor Service, various editions. Covers New York, American & regional stock exchanges & international companies. The database is updated semi-weekly.

Standard and Poors Compustat PC Plus Statistics. Provides financial data analysis of over 12,000 public companies, industry groups including special software for spreadsheet analysis. Updated monthly.

Appendix 1 to Chapter II

1963 SIC codes (Selection)		1967 SIC codes (Selection)	
20	Lumber & wood products, except containers		
20.01	Logging camps, & logging contractors	2411	
20.02	Sawmills & planning mills, general	2421	
20.03	Hardwood dimension & flooring	2426	
20.04	Special product sawmills, n.e.c.	2429	
20.05	Millwork	2431	
20.06	Veneer & plywood	2432	
20.07	Prefabricated wood structures	2433	
20.08	Wood preserving	2491	
20.09	Wood products, n.e.c.	2499	
2 1	Wooden containers		
21	Wooden containers	244	
2 2	Household furniture		
22.01	Wood household furniture	2511, 2519	
22.02	Upholstered household furniture	2512	
22.03	Metal household furniture	2414	
22.04	Mattresses & bedsprings	2515	
2 3	Other furniture & fixtures		
23.01	Wood office furniture	2521	
23.02	Metal office furniture	2522	
23.03	Public building furniture	2531	
23.04	Wood partitions & fixtures	2541	
23.05	Metal partitions & fixtures	2542	
23.06	Venetian blinds & shades	2591	
23.07	Furniture & fixtures, n.e.c.	2599	
2 4	Paper & allied products except containers & xes		
24.01	Pulp mills	2611	
24.02	Paper mills, except building paper	2621	
24.03	Paperboard mills	2631	
24.04	Envelopes	2642	
24.05	Sanitary paper products	2647	
24.06	Wallpaper & building paper & board mills	2644, 2661	
24.07	Converted paper products, n.e.c. except containers & boxes	2641, 2643, 2645, 2646, 2649	
2 5	Paperboard containers & boxes		
25	Paperboard containers & boxes	265	
		200100	Logging camps, & logging contractors — 2411
		200200	Sawmills & planning mills, general - 2421
		200300	Hardwood dimension & flooring — 2426
		200400	Special product sawmills, n.e.c — 2429
		200500	Millwork — 2431
		200600	Veneer & plywood — 2432
		200700	Prefabricated wood structures — 2433
		200800	Wood preserving — 2491
		200900	Wood products, n.e.c. — 2499
		210000	Wooden containers — 244
		220101	Wood household furniture — 2511
		220102	Household furniture, n.e.c. — 2519
		220200	Upholstered household furniture — 2512
		220300	Metal household furniture — 2414
		220400	Mattresses & bedsprings — 2515
		230100	Wood office furniture — 2521
		230200	Metal office furniture — 2522
		230300	Public building furniture — 2531
		230400	Wood partitions & fixtures — 2541
		230500	Metal partitions & fixtures — 2542
		230600	Venetian blinds & shades — 2591
		230700	Furniture & fixtures, n.e.c. — 2599
		240100	Pulp mills — 2611
		240200	Paper mills, except building paper — 2621
		240300	Paperboard mills — 2631
		240400	Envelopes — 2642
		240500	Sanitary paper products — 2647
		240601	Wallpaper — 2644
		240602	Building paper & board mills — 2661
		240701	Paper coating & glazing — 2641
		240702	Bags, except textile bags — 2643
		240703	Die cut paper & board — 2645
		240704	Pressed & molded pulp goods — 2646
		240705	Converted paper products, n.e.c. — 2649
		250000	Paperboard containers & boxes — 265
		260100	Newspapers — 2711
		260200	Periodicals — 2721

1963 SIC codes (Selection)		1967 SIC codes (Selection)	
2 6	Printing & publishing		
26.01	Newspapers	2711	260301 Book publishing — 2731
26.02	Periodicals	2721	260302 Book printing — 2732
26.03	Book printing & publishing	273	260400 Miscellaneous publishing — 2741
26.04	Miscellaneous publishing	2741	260500 Commercial printing — 2751, 275
26.05	Commerical printing	2751, 2752	260601 Manifold business forms — 2761
26.06	Manifold business forms, blankbooks & binders	2761, 2782	260602 Blank books & Looseleaf binders — 2782
26.07	Greeting card publishing	2771	260700 Greeting card publishing — 2771
26.08	Miscellaneous printing services	2753, 2789, 279	260801 Engraving & plate printing — 2753 260802 Bookbinding & related work — 2789
2 7	Chemicals & selected chemical products		260803 Typesetting — 2791 260804 Photoengraving — 2793 260805 Electrotyping & stereotyping — 2794
27.01	Industrial inorganic & organic chemicals	281 exc. 28195	270100 Industrial inorganic & organic chemicals — 281 exc.
27.02	Fertilizers	2871, 2872	270201 Fertilizers — 2871 270202 Fertilizers, mixing only — 2872
27.03	Agricultural chemicals, n.e.c.	2879	270300 Agricultural chemicals, n.e.c. — 2879
27.04	Miscellaneous chemical products	2861, 289	270401 Gum & wood chemicals — 2861 270402 Adhesives & gelatin — 2891 270403 Explosives — 2892 270404 Printing ink — 2893 270405 Carbon black — 2895 270406 Chemical preparations, n e.c. — 2899
2 8	Plastics & synehetic materials		
28.01	Plastics materials & resins	2821	280100 Plastics materials & resins — 2821
28.02	Synethetic rubber	2822	280200 Synthetic rubber — 2822
28.03	Cellulosic man-made fibers	2823	280300 Cellulosic man-made fibers — 2823
28.04	Organic fibers, noncellulosic	2824	280400 Organic fibers, noncellulosic — 2824
2 9	Drugs, cleaning & toilet preparations		290100 Drugs — 283
29.01	Drugs	283	290201 Soap & other detergents — 2841 290202 Polishes & sanitation goods — 2842 290203 Surface active agents — 2843
29.02	Cleaning preparations	284 except 2844	290300 Toilet preparations — 2844
29.03	Toilet preparations	2844	300000 Paints & allied products — 2851
3 0	Paints & allied products		
30	Paints & allied products	2851	
3 1	Petroleum refining & related industries		310100 Petroleum refining & related products — 2911, 299
31.01	Petroleum refining & related products	2911, 299	
31.02	Paving mixtures & blocks	2951	310200 Paving mixtures & blocks — 2951
31.03	Asphalt felts & coatings	2952	

1972 SIC codes (Selection)		1977 SIC codes (Selection)	
200100	Logging camps, & logging contractors	200100	Logging camps, & logging contractors
2411		2411	
200200	Sawmills & planning mills, general	200200	Sawmills & planning mills, general
2421		2421	
200300	Hardwood dimension & flooring	200300	Hardwood dimension & flooring
2426		2426	
200400	Special product sawmills, n.e.c.	200400	Special product sawmills, n.e.c.
2429		2429	
200501	Millwork	200501	Millwork
2431		2431	
200502	Wood kitchen cabinets	200502	Wood kitchen cabinets
2434		2434	
200600	Veneer & plywood	200600	Veneer & plywood
2435-6		2429	
200701	Structural wood members, n.e.c.	200701	Structural wood members, n.e.c.
2439		2439	
200702	Prefabricated wood buildings	200702	Prefabricated wood buildings
2452		2452	
200800	Wood preserving	200800	Wood preserving
2491		2491	
200901	Wood pallets and skids	200901	Wood pallets and skids
2448		2448	
200902	Particle board	200902	Particle board
-2492		2492	
200903	Wood products, n.e.c.	200903	Wood products, n.e.c.
2499		2499	
			2441,
210000	Wooden containers	210000	Wooden containers
244		2449	
220101	Wood household furniture	220101	Wood household furniture
2511		2511	
220102	Household furniture, n.e.c.	220102	Household furniture, n.e.c.
2519		2519	
220200	Upholstered household furniture	220200	Upholstered household furniture
2512		2512	
220300	Metal household furniture	220300	Metal household furniture
2514		2514	
220400	Mattresses & bedsprings	220400	Mattresses & bedsprings
2515		2515	
230100	Wood office furniture	230100	Wood office furniture
2521		2521	
230200	Metal office furniture	230200	Metal office furniture
2522		2522	
230300	Public building furniture	230300	Public building furniture
2531		2531	
230400	Wood partitions & fixtures	230400	Wood partitions & fixtures
2541		2541	
230500	Metal partitions & fixtures	230500	Metal partitions & fixtures
2542		2542	
230600	Venetian blinds & shades	230600	Venetian blinds & shades
2591		2591	
230700	Furniture & fixtures, n.e.c.	230700	Furniture & fixtures, n.e.c.
2599		2599	
240100	Pulp mills	240100	Pulp mills
2611		2611	
240200	Paper mills, except building paper	240200	Paper mills, except building paper
2621		262	
240300	Paperboard mills	240300	Paperboard mills
2631		263	
240400	Envelopes	240400	Envelopes
2642		2642	
240500	Sanitary paper products	240500	Sanitary paper products
2647		2647	
240602	Building paper & board mills	240602	Building paper & board mills
2661		266	
240701	Paper coating & glazing	240701	Paper coating & glazing
2641		2641	
240702	Bags, except textile bags	240702	Bags, except textile bags
2643		2643	
240703	Die cut paper & board	240703	Die cut paper & board
2645		2645	
240704	Pressed & molded pulp goods	240704	Pressed & molded pulp goods
2646		2646	
240705	Stationery products	240705	Stationery products
2648		2648	

1972 SIC codes (Selection)		1977 SIC codes (Selection)	
240706	Converted paper products, n.e.c.	240706	Converted paper products, n.e.c.
250000	Paperboard containers & boxes	250000	Paperboard containers & boxes
260100	Newspapers	260100	Newspapers
260200	Periodicals	260200	Periodicals
260301	Book publishing	260301	Book publishing
260302	Book printing	260302	Book printing
260400	Miscellaneous publishing	260400	Miscellaneous publishing
260501	Commercial printing	260501	Commercial printing
260502	Lithographic plate making and services	260502	Lithographic plate making and servic
260601	Manifold business forms	260601	Manifold business forms
260602	Blank books & Looseleaf binders	260602	Blank books & Looseleaf binders
260700	Greeting card publishing	260700	Greeting card publishing
260801	Engraving & plate printing	260801	Engraving & plate printing
260802	Bookbinding & related work	260802	Bookbinding & related work
260803	Typesetting	260803	Typesetting
260804	Photoengraving	260804	Photoengraving
260805	Electrotyping & stereotyping	260805	Electrotyping & stereotyping
270100	Industrial inorganic & organic chemicals	270100	Industrial inorganic & organic chemi
270201	Nitrogenous and phosphatic fertilizers	270201	Nitrogenous and phosphatic fertilize
270202	Fertilizers, mixing only	270202	Fertilizers, mixing only
270300	Agricultural chemicals, n.e.c.	270300	Agricultural chemicals, n.e.c.
270401	Gum & wood chemicals	270401	Gum & wood chemicals
270402	Adhesives & gelatin	270402	Adhesives & gelatin
270403	Explosives	270403	Explosives
270404	Printing ink	270404	Printing ink
270405	Carbon black	270405	Carbon black
270406	Chemical preparations, n.e.c.	270406	Chemical preparations, n.e.c.
280100	Plastics materials & resins	280100	Plastics materials & resins
280200	Synthetic rubber	280200	Synthetic rubber
280300	Cellulosic man-made fibers	280300	Cellulosic man-made fibers
280400	Organic fibers, noncellulosic	280400	Organic fibers, noncellulosic
290100	Drugs	290100	Drugs
290201	Soap & other detergents	290201	Soap & other detergents
290202	Polishes & sanitation goods	290202	Polishes & sanitation goods
290203	Surface active agents	290203	Surface active agents
290300	Toilet preparations	290300	Toilet preparations
300000	Paints & allied products	300000	Paints & allied products
310100	Petroleum refining & related products	310101	Petroleum refining
310200	Paving mixtures & blocks	310102	Lubricating oils and greases
310300	Asphalt felts & coatings	310103	Products of petroleum and coal, nec
		310200	Paving mixtures & blocks

1972 SIC codes (Selection)	1977 SIC codes (Selection)
2649	2649
265	265
2711	271
2721	272
2731	2731
2732	2732
2741	274
2751, 2752, 2754	2751, 2752, 275
-2795	2795
2761	276
-2782	2782
2771	277
2753	2753
2789	2789
2791	2791
2793	2793
2794	2794
281 exc. 28195, 2865, 2869	281 exc. 28195, 2869
2873-4	2873-4
2875	2875
2879	2879
2861	2861
2891	2891
2892	2892
2893	2893
2895	2895
2899	2899
2821	2821
2822	2822
2823	2823
2824	2824
283	283
2841	2841
2842	2842
2843	2843
2844	2843
2851	2844
2911, 299	285
2951	291
2952	2992
	2999
	2951

Appendix I

1982 SIC codes (Selection)		1992 SIC codes (Selection)	
200100	Logging camps and logging contractors		
200200	Sawmills and planing mills, general	20+21	Lumber and wood products:
200300	Hardwood dimension and flooring mills	20.01	Logging 241
200400	Special product sawmills, n.e.c.	20.02	Sawmills and planing mills, general 2421
200501	Millwork	20.03	Hardwood dimension and flooring mills 2426
200502	Wood kitchen cabinets	20.04	Special product sawmills, n.e.c. 2429
200600	Veneer and plywood	20.0501	Millwork 2431
200701	Structural wood members, n.e.c.	20.0502	Wood kitchen cabinets 2434
200702	Prefabricated wood buildings	20.06	Veneer and plywood 2435-6
200800	Wood preserving	20.0701	Structural wood members, n.e.c. 2439
200901	Wood pallets and skids		
200902	Particleboard	20.0702	Prefabricated wood buildings and components 2452
200903	Wood products, n.e.c.	20.0703	Mobile homes 2451
210000	Wood containers	20.08	Wood preserving 2491
		20.0901	Wood pallets and skids 2448
220101	Wood household furniture	20.0903	Wood products, n.e.c. 2499
220102	Household furniture, n.e.c.	20.0904	Reconstituted wood products 2493
220103	Wood TV and radio cabinets		
220200	Upholstered household furniture	21	Wood containers, n.e.c. 2441, 2449
220300	Metal household furniture	22.0101	Wood household furniture, except upholstered 2511
220400	Mattresses and bedsprings	22.0102	Household furniture, n.e.c. 2519
230100	Wood office furniture	22.0103	Wood television and radio cabinets 2517
230200	Metal office furniture	22.02	Upholstered household furniture 2512
230300	Public building furniture	22.03	Metal household furniture 2514
230400	Wood partitions and fixtures	22.04	Mattresses and bedsprings 2515
230500	Metal partitions and fixtures	23.01	Wood office furniture 2521
230600	Drapery hardware and blinds and shades	23.02	Office furniture, except wood 2522
230700	Furniture and fixtures, n.e.c.		
240100	Pulp mills	23.03	Public building and related furniture 253
240200	Paper mills, except building paper		
240300	Paperboard mills	23.04	Wood partitions and fixtures 2541
240400	Envelopes		
240500	Sanitary paper products	23.05	Partitions and fixtures, except wood 2542
240602	Building paper and board mills	23.06	Drapery hardware and window
240701	Paper coating and glazing		
240702	Bags, except textile		
240703	Die-cut paper and board		
240704	Pressed and molded pulp goods		
240705	Stationery products		
240706	Converted paper products, n.e.c.		

Appendix I

1982 SIC codes (Selection)		1992 SIC codes (Selection)	
		blinds and shades	2591
250000	Paperboard containers and boxes	23.07 Furniture and fixtures, n.e.c.	2599
260100	Newspapers	24.01 Pulp mills	261
260200	Periodicals	24.04 Envelopes	2677
260301	Book publishing	24.05 Sanitary paper products	2676
260302	Book printing		
260400	Miscellaneous publishing	24.0701 Paper coating and glazing	2671-2
260501	Commercial printing	24.0702 Bags, except textile	2673-4
260502	Lithographic platemaking and services	24.0703 Die-cut paper and paperboard and cardboard	2675
260601	Manifold business forms		
260602	Blankbooks and looseleaf binders	24.0705 Stationery, tablets, and related products	2678
260700	Greeting card publishing	24.0706 Converted paper products,	
260801	Engraving and plate printing	n.e.c.	2679
260802	Bookbinding and related work		
260803	Typesetting	24.08 Paper and paperboard mills	262-3
260804	Photoengraving, electrotyping, and stereotyping	25 Pap erboard containers and boxes:	
270101	Alkalies and chlorine	25 Paperboard containers and boxes	265
270102	Industrial gases		
270103	Inorganic pigments	26A New spapers and periodicals:	
270104	Industrial inorganic chemicals, n.e.c. excluding alumina	26.01 Newspapers	271
270105	Industrial organic chemicals except gum and wood chemicals	26.02 Periodicals	272
270201	Nitrogenous and phosphatic fertilizers	26B Oth er printing and publishing:	
270202	Fertilizers, mixing only	26.0301 Book publishing	2731
270300	Agricultural chemicals, n.e.c.	26.0302 Book printing	2732
270401	Gum and wood chemicals	26.04 Miscellaneous publishing	274
270402	Adhesives and sealants	26.0501 Commercial printing	275
270403	Explosives	26.0601 Manifold business forms	276
270404	Printing ink	26.0602 Blankbooks, looseleaf binders and devices	2782
270405	Carbon black	26.07 Greeting cards	277
270406	Chemical preparations, n.e.c.	26.0802 Bookbinding and related work	2789
280100	Plastics materials and resins	26.0803 Typesetting	2791
280200	Synthetic rubber	26.0806 Platemaking and related services	2796
280300	Cellulosic man-made fibers	27A Ind ustrial and other chemicals:	
280400	Organic fibers, noncellulosic	27.01 Industrial inorganic and organic chemicals	281, 2865, 2869
290100	Drugs	27.0401 Gum and wood chemicals	2861
290201	Soap and other detergents	27.0402 Adhesives and sealants	2891
290202	Polishes and sanitation goods	27.0403 Explosives	2892
290203	Surface active agents	27.0404 Printing ink	2893
290300	Toilet preparations	27.0405 Carbon black	2895
300000	Paints and allied products	27.0406 Chemicals and chemical preparations, n.e.c.	2899
		27B Agr icultural fertilizers and chemica ls	
		27.0201 Nitrogenous and phosphatic	

1992 SIC codes (Selection)

	fertilizers	2873-4
27.0202	Fertilizers, mixing only	2875
27.03	Pesticides and agricultural chemicals, n.e.c.	2879
28	Plastics and synthetic materials:	
28.01	Plastics materials and resins	2821
28.02	Synthetic rubber	2822
28.03	Cellulosic manmade fibers	2823
28.04	Manmade organic fibers, except cellulosic	2824
29A	Drugs:	
29.01	Drugs	283
29B	Cleaning and toilet preparations:	
29.0201	Soap and other detergents	2841
29.0202	Polishes and sanitation goods	2842
29.0203	Surface active agents	2843
29.03	Toilet preparations	2844
30	Paints and allied products:	
30	Paints and allied products	285

Appendix 2 to Chapter II: Industry Classification of the 1992 Benchmark Input-Output Accounts

An asterisk preceding a Standard Industrial Classification (SIC) code indicates that the SIC industry is included in more than one I-O industry. For a description of the systems used in the I-O accounts, see the section "Definitions and conventions for classification" in the November 1997 Survey of Current Business article dealing with the 1992 benchmark analysis.

I-O industry number and title Related 1987 SIC codes

AGRICULTURE, FORESTRY, AND FISHERIES

1 Livestock and livestock products:

1.0100 Dairy farm products 024,*019, *0259, *029
1.0200 Poultry and eggs 0251-3, *0259, *019, *0219, *029
1.0301 Meat animals 0211-4, *0219, *019, *0259, *029
1.0302 Miscellaneous livestock 0271-3, *0279, *019, *0219, *0259, *029

2 Other agricultural products:

2.0100 Cotton 0131, *019, *0219, *0259, *029
2.0201 Food grains *011, *019, *0219, *0259, *029
2.0202 Feed grains *011, *0139, *019, *0219, *0259, *029
2.0203 Grass seeds *0139, *019, *0219, *0259, *029
2.0300 Tobacco 0132, *019, *0219, *0259, *029
2.0401 Fruits 0171-2, 0174-5, *0179, *019, *0219, *0259, *029
2.0402 Tree nuts 0173, *0179, *019, *0219,*0259, *029
2.0501 Vegetables 0134, *0139, 016, *019, *0219,*0259, *029, *0119
2.0502 Sugar crops 0133, *019, *0219, *0259, *029
2.0503 Miscellaneous crops *0119, *0139, *019, *0219, *0259, *029
2.0600 Oil bearing crops 0116, *0119, *0139,*0219, *0259, *029
2.0701 Forest products *018, *019, *0219,*0259, *029
2.0702 Greenhouse and nursery products *018, *019,* 0219,*0259, *029

3 Forestry and fishery products:

3.0001 Forestry products 081, 083, 097
3.0002 Commercial fishing 091

4 Agricultural, forestry, and fishery services:

4.0001 Agricultural, forestry, and fishery services 0254, *0279, 071-2,075-6, 085, 092
4.0002 Landscape and horticultural services 078

MINING

5+6 Metallic ores mining:

5.0001 Iron and ferroalloy ores, and miscellaneous metal ores, n.e.c. 101, 106, 1099
6.0100 Copper ore 102
6.0200 Nonferrous metal ores, except copper 103-4, 1094, *108

7 Coal mining:

7.0000 Coal 122-3, *124

8 Crude petroleum and natural gas:

8.0001 Crude petroleum and natural gas 131-2, *138

9+10 Nonmetallic minerals mining:

9.0001 Dimension, crushed and broken stone 141-2
9.0002 Sand and gravel 144
9.0003 Clay, ceramic, and refractory minerals 145
9.0004 Nonmetallic mineral services and miscellaneous minerals *148, 149
10.0000 Chemical and fertilizer minerals 147

CONSTRUCTION

11 New construction:

11.0101 New residential 1-unit structures, nonfarm *15, *17, *6552
11.0102 New residential 2-4 unit structures, nonfarm *15, *17
11.0105 New residential additions and alterations, nonfarm *15, *17
11.0108 New residential garden and high-rise apartments *15, *17, *6552
11.0400 Highways and streets *16-17
11.0501 New farm housing units and additions and alterations *15, *17
11.0601 Petroleum and natural gas well drilling *138
11.0602 Petroleum, natural gas, and solid mineral exploration *138, *108, *124, *148
11.0603 Access structures for solid mineral development *108, *124, *148
11.0800 Office, industrial, and commercial buildings *15, *17
11.0900 Other new construction *15-17

12 Maintenance and repair construction:

12.0101 Maintenance and repair of farm and nonfarm residential structures *15, *17
12.0214 Maintenance and repair of highways and streets *16-17

12.0215 Maintenance and repair of petro-leum and natural gas wells *138
12.0300 Other maintenance and repair *15-17

MANUFACTURING

13 Ordnance and accessories:

13.0100 Guided missiles and space vehicles 3761
13.0200 Ammunition, except for small arms, n.e.c. 3483
13.0300 Tanks and tank components 3795
13.0500 Small arms 3484
13.0600 Small arms ammunition 3482
13.0700 Ordnance and accessories, n.e.c. 3489

14 Food and kindred products:

14.0101 Meat packing plants 2011
14.0102 Sausages and other prepared meat products 2013
14.0105 Poultry slaughtering and processing 2015
14.0200 Creamery butter 2021
14.0300 Natural, processed, and imitation cheese 2022
14.0400 Dry, condensed, and evaporated dairy products 2023
14.0500 Ice cream and frozen desserts 2024
14.0600 Fluid milk 2026
14.0700 Canned and cured fish and seafoods 2091
14.0800 Canned specialties 2032
14.0900 Canned fruits, vegetables, preserves, jams, and jellies 2033
14.1000 Dehydrated fruits, vegetables, and soups 2034
14.1100 Pickles, sauces, and salad dressings 2035
14.1200 Prepared fresh or frozen fish and seafoods 2092
14.1301 Frozen fruits, fruit juices, and vegetables 2037
14.1302 Frozen specialties, n.e.c. 2038
14.1401 Flour and other grain mill products 2041
14.1402 Cereal breakfast foods 2043
14.1403 Prepared flour mixes and doughs 2045
14.1501 Dog and cat food 2047
14.1502 Prepared feeds, n.e.c. 2048
14.1600 Rice milling 2044
14.1700 Wet corn milling 2046
14.1801 Bread, cake, and related products 2051
14.1802 Cookies and crackers 2052
14.1803 Frozen bakery products, except bread 2053
14.1900 Sugar 2061-3
14.2002 Chocolate and cocoa products 2066
14.2004 Salted and roasted nuts and seeds 2068

14.2005 Candy and other confectionery products, including chewing gum 2064, 2067
14.2101 Malt beverages 2082
14.2102 Malt 2083
14.2103 Wines, brandy, and brandy spirits 2084
14.2104 Distilled and blended liquors 2085
14.2200 Bottled and canned soft drinks 2086
14.2300 Flavoring extracts and flavoring syrups, n.e.c. 2087
14.2400 Cottonseed oil mills 2074
14.2500 Soybean oil mills 2075
14.2600 Vegetable oil mills, n.e.c. 2076
14.2700 Animal and marine fats and oils 2077
14.2800 Roasted coffee 2095
14.2900 Edible fats and oils, n.e.c. 2079
14.3000 Manufactured ice 2097
14.3100 Macaroni, spaghetti, vermicelli, and noodles 2098
14.3201 Potato chips and similar snacks 2096
14.3202 Food preparations, n.e.c. 2099

15 Tobacco products:

15.0101 Cigarettes 211
15.0102 Cigars 212
15.0103 Chewing and smoking tobacco and snuff 213
15.0200 Tobacco stemming and redrying 214

16 Broad and narrow fabrics, yarn and thread mills:

16.0100 Broadwoven fabric mills and fabric finishing plants 221-3, 2261-2
16.0200 Narrow fabric mills 224
16.0300 Yarn mills and finishing of textiles, n.e.c. 2269, 2281-2
16.0400 Thread mills 2284

17 Miscellaneous textile goods and floor coverings:

17.0100 Carpets and rugs 227
17.0600 Coated fabrics, not rubberized 2295
17.0700 Tire cord and fabrics 2296
17.0900 Cordage and twine 2298
17.1001 Nonwoven fabrics 2297
17.1100 Textile goods, n.e.c. 2299

18 Apparel:

18.0101 Women's hosiery, except socks 2251
18.0102 Hosiery, n.e.c. 2252

18.0201 Knit outerwear mills 2253
18.0202 Knit underwear and nightwear mills 2254
18.0203 Knitting mills, n.e.c. 2259
18.0300 Knit fabric mills 2257-8
18.0400 Apparel made from purchased materials 231-8

19 Miscellaneous fabricated textile products:

19.0100 Curtains and draperies 2391
19.0200 Housefurnishings, n.e.c. 2392
19.0301 Textile bags 2393
19.0302 Canvas and related products 2394
19.0303 Pleating and stitching 2395
19.0304 Automotive and apparel trimmings 2396
19.0305 Schiffli machine embroideries 2397
19.0306 Fabricated textile products, n.e.c. 2399

20+21 Lumber and wood products:

20.0100 Logging 241
20.0200 Sawmills and planing mills, general 2421
20.0300 Hardwood dimension and flooring mills 2426
20.0400 Special product sawmills, n.e.c. 2429
20.0501 Millwork 2431
20.0502 Wood kitchen cabinets 2434
20.0600 Veneer and plywood 2435-6
20.0701 Structural wood members, n.e.c. 2439
20.0702 Prefabricated wood buildings and components 2452
20.0703 Mobile homes 2451
20.0800 Wood preserving 2491
20.0901 Wood pallets and skids 2448
20.0903 Wood products, n.e.c. 2499
20.0904 Reconstituted wood products 2493
21.0000 Wood containers, n.e.c. 2441, 2449

22+23 Furniture and fixtures:

22.0101 Wood household furniture, except upholstered 2511
22.0102 Household furniture, n.e.c. 2519
22.0103 Wood television and radio cabinets 2517
22.0200 Upholstered household furniture 2512
22.0300 Metal household furniture 2514
22.0400 Mattresses and bedsprings 2515
23.0100 Wood office furniture 2521
23.0200 Office furniture, except wood 2522

23.0300 Public building and related furniture 253
23.0400 Wood partitions and fixtures 2541
23.0500 Partitions and fixtures, except wood 2542
23.0600 Drapery hardware and window blinds and shades 2591
23.0700 Furniture and fixtures, n.e.c. 2599

24 Paper and allied products, except containers:

24.0100 Pulp mills 261
24.0400 Envelopes 2677
24.0500 Sanitary paper products 2676
24.0701 Paper coating and glazing 2671-2
24.0702 Bags, except textile 2673-4
24.0703 Die-cut paper and paperboard and cardboard 2675
24.0705 Stationery, tablets, and related products 2678
24.0706 Converted paper products, n.e.c. 2679
24.0800 Paper and paperboard mills 262-3

25 Paperboard containers and boxes:

25.0000 Paperboard containers and boxes 265

26A Newspapers and periodicals:

26.0100 Newspapers 271
26.0200 Periodicals 272

26B Other printing and publishing:

26.0301 Book publishing 2731
26.0302 Book printing 2732
26.0400 Miscellaneous publishing 274
26.0501 Commercial printing 275
26.0601 Manifold business forms 276
26.0602 Blankbooks, looseleaf binders and devices 2782
26.0700 Greeting cards 277
26.0802 Bookbinding and related work 2789
26.0803 Typesetting 2791
26.0806 Platemaking and related services 2796

27A Industrial and other chemicals:

27.0100 Industrial inorganic and organic chemicals 281, 2865, 2869
27.0401 Gum and wood chemicals 2861
27.0402 Adhesives and sealants 2891

27.0403 Explosives 2892
27.0404 Printing ink 2893
27.0405 Carbon black 2895
27.0406 Chemicals and chemical preparations, n.e.c. 2899

27B Agricultural fertilizers and chemicals:

27.0201 Nitrogenous and phosphatic fertilizers 2873-4
27.0202 Fertilizers, mixing only 2875
27.0300 Pesticides and agricultural chemicals, n.e.c. 2879

28 Plastics and synthetic materials:

28.0100 Plastics materials and resins 2821
28.0200 Synthetic rubber 2822
28.0300 Cellulosic manmade fibers 2823
28.0400 Manmade organic fibers, except cellulosic 2824

29A Drugs:

29.0100 Drugs 283

29B Cleaning and toilet preparations:

29.0201 Soap and other detergents 2841
29.0202 Polishes and sanitation goods 2842
29.0203 Surface active agents 2843
29.0300 Toilet preparations 2844

30 Paints and allied products:

30.0000 Paints and allied products 285

31 Petroleum refining and related products:

31.0101 Petroleum refining 291
31.0102 Lubricating oils and greases 2992
31.0103 Products of petroleum and coal, n.e.c. 2999
31.0200 Asphalt paving mixtures and blocks 2951
31.0300 Asphalt felts and coatings 2952

32 Rubber and miscellaneous plastics products:

32.0100 Tires and inner tubes 301

32.0200 Rubber and plastics footwear 302
32.0300 Fabricated rubber products, n.e.c. 306
32.0400 Miscellaneous plastics products, n.e.c. 308
32.0500 Rubber and plastics hose and belting 3052
32.0600 Gaskets, packing, and sealing devices 3053

33+34 Footwear, leather, and leather products:

33.0001 Leather tanning and finishing 311
34.0100 Boot and shoe cut stock and findings 313
34.0201 Shoes, except rubber 3143-4, 3149
34.0202 House slippers 3142
34.0301 Leather gloves and mittens 315
34.0302 Luggage 316
34.0303 Women's handbags and purses 3171
34.0304 Personal leather goods, n.e.c. 3172
34.0305 Leather goods, n.e.c. 319

35 Glass and glass products:

35.0100 Glass and glass products, except containers 321, 3229, 323
35.0200 Glass containers 3221

36 Stone and clay products:

36.0100 Cement, hydraulic 324
36.0200 Brick and structural clay tile 3251
36.0300 Ceramic wall and floor tile 3253
36.0400 Clay refractories 3255
36.0500 Structural clay products, n.e.c. 3259
36.0600 Vitreous china plumbing fixtures 3261
36.0701 Vitreous china table and kitchenware 3262
36.0702 Fine earthenware table and kitchenware 3263
36.0800 Porcelain electrical supplies 3264
36.0900 Pottery products, n.e.c. 3269
36.1000 Concrete block and brick 3271
36.1100 Concrete products, except block and brick 3272
36.1200 Ready-mixed concrete 3273
36.1300 Lime 3274
36.1400 Gypsum products 3275
36.1500 Cut stone and stone products 328
36.1600 Abrasive products 3291
36.1700 Asbestos products 3292
36.1900 Minerals, ground or treated 3295
36.2000 Mineral wool 3296

36.2100 Nonclay refractories 3297
36.2200 Nonmetallic mineral products, n.e.c. 3299

37 Primary iron and steel manufacturing:

37.0101 Blast furnaces and steel mills 3312
37.0102 Electrometallurgical products, except steel 3313
37.0103 Steel wiredrawing and steel nails and spikes 3315
37.0104 Cold-rolled steel sheet, strip, and bars 3316
37.0105 Steel pipe and tubes 3317
37.0200 Iron and steel foundries 332
37.0300 Iron and steel forgings 3462
37.0401 Metal heat treating 3398
37.0402 Primary metal products, n.e.c. 3399

38 Primary nonferrous metals manufacturing:

38.0100 Primary smelting and refining of copper 3331
38.0400 Primary aluminum 3334
38.0501 Primary nonferrous metals, n.e.c. 3339
38.0600 Secondary nonferrous metals 334
38.0700 Rolling, drawing, and extruding of copper 3351
38.0800 Aluminum rolling and drawing 3353-5
38.0900 Nonferrous rolling and drawing, n.e.c. 3356
38.1000 Nonferrous wiredrawing and insulating 3357
38.1100 Aluminum castings 3363, 3365
38.1200 Copper foundries 3366
38.1300 Nonferrous castings, n.e.c. 3364, 3369
38.1400 Nonferrous forgings 3463

39 Metal containers:

39.0100 Metal cans 3411
39.0200 Metal shipping barrels, drums, kegs, and pails 3412

40 Heating, plumbing, and fabricated structural metal products:

40.0100 Enameled iron and metal sanitary ware 3431
40.0200 Plumbing fixture fittings and trim 3432
40.0300 Heating equipment, except electric and warm air furnaces 3433
40.0400 Fabricated structural metal 3441
40.0500 Metal doors, sash, frames, molding, and trim 3442
40.0600 Fabricated plate work (boiler shops) 3443
40.0700 Sheet metal work 3444
40.0800 Architectural and ornamental metal work 3446

40.0901 Prefabricated metal buildings and components 3448
40.0902 Miscellaneous structural metal work 3449

41 Screw machine products and stampings:

41.0100 Screw machine products, bolts, etc. 345
41.0201 Automotive stampings 3465
41.0202 Crowns and closures 3466
41.0203 Metal stampings, n.e.c. 3469

42 Other fabricated metal products:

42.0100 Cutlery 3421
42.0201 Hand and edge tools, except machine tools and handsaws 3423
42.0202 Saw blades and handsaws 3425
42.0300 Hardware, n.e.c. 3429
42.0401 Plating and polishing 3471
42.0402 Coating, engraving, and allied services, n.e.c. 3479
42.0500 Miscellaneous fabricated wire products 3495-6
42.0700 Steel springs, except wire 3493
42.0800 Pipe, valves, and pipe fittings 3491-2, 3494, 3498
42.1000 Metal foil and leaf 3497
42.1100 Fabricated metal products, n.e.c. 3499

43 Engines and turbines:

43.0100 Turbines and turbine generator sets 3511
43.0200 Internal combustion engines, n.e.c. 3519

44+45 Farm, construction, and mining machinery:

44.0001 Farm machinery and equipment 3523
44.0002 Lawn and garden equipment 3524
45.0100 Construction machinery and equipment 3531
45.0200 Mining machinery, except oil field 3532
45.0300 Oil and gas field machinery and equipment 3533

46 Materials handling machinery and equipment:

46.0100 Elevators and moving stairways 3534
46.0200 Conveyors and conveying equipment 3535
46.0300 Hoists, cranes, and monorails 3536
46.0400 Industrial trucks and tractors 3537

47 Metalworking machinery and equipment:

47.0100 Machine tools, metal cutting types 3541
47.0200 Machine tools, metal forming types 3542
47.0300 Special dies and tools and machine tool accessories 3544-5
47.0401 Power-driven handtools 3546
47.0402 Rolling mill machinery and equipment 3547
47.0404 Electric and gas welding and soldering equipment 3548
47.0405 Industrial patterns 3543
47.0500 Metalworking machinery, n.e.c. 3549

48 Special industry machinery and equipment:

48.0100 Food products machinery 3556
48.0200 Textile machinery 3552
48.0300 Woodworking machinery 3553
48.0400 Paper industries machinery 3554
48.0500 Printing trades machinery and equipment 3555
48.0600 Special industry machinery, n.e.c. 3559

49 General industrial machinery and equipment:

49.0100 Pumps and compressors 3561, 3563
49.0200 Ball and roller bearings 3562
49.0300 Blowers and fans 3564
49.0500 Mechanical power transmission equipment 3566, 3568
49.0600 Industrial process furnaces and ovens 3567
49.0700 General industrial machinery and equipment, n.e.c. 3569
49.0800 Packaging machinery 3565

50 Miscellaneous machinery, except electrical:

50.0100 Carburetors, pistons, rings, and valves 3592
50.0200 Fluid power equipment 3593-4
50.0300 Scales and balances, except laboratory 3596
50.0400 Industrial and commercial machinery and equipment, n.e.c. 3599

51 Computer and office equipment:

51.0102 Calculating and accounting machines 3578
51.0103 Electronic computers 3571
51.0104 Computer peripheral equipment 3572, 3575, 3577
51.0400 Office machines, n.e.c. 3579

52 Service industry machinery:

52.0100 Automatic vending machines 3581
52.0200 Commercial laundry equipment 3582
52.0300 Refrigeration and heating equipment 3585
52.0400 Measuring and dispensing pumps 3586
52.0500 Service industry machinery, n.e.c. 3589

53 Electrical industrial equipment and apparatus:

53.0200 Power, distribution, and specialty transformers 3612
53.0300 Switchgear and switchboard apparatus 3613
53.0400 Motors and generators 3621
53.0500 Relays and industrial controls 3625
53.0700 Carbon and graphite products 3624
53.0800 Electrical industrial apparatus, n.e.c. 3629

54 Household appliances:

54.0100 Household cooking equipment 3631
54.0200 Household refrigerators and freezers 3632
54.0300 Household laundry equipment 3633
54.0400 Electric housewares and fans 3634
54.0500 Household vacuum cleaners 3635
54.0700 Household appliances, n.e.c. 3639

55 Electric lighting and wiring equipment:

55.0100 Electric lamp bulbs and tubes 3641
55.0200 Lighting fixtures and equipment 3645-8
55.0300 Wiring devices 3643-4

56 Audio, video, and communication equipment:

56.0100 Household audio and video equipment 3651
56.0200 Prerecorded records and tapes 3652
56.0300 Telephone and telegraph apparatus 3661
56.0500 Communication equipment 3663, 3669

57 Electronic components and accessories:

57.0100 Electron tubes 3671
57.0200 Semiconductors and related devices 3674
57.0300 Other electronic components 3672, 3675-9

58 Miscellaneous electrical machinery and supplies:

58.0100 Storage batteries 3691
58.0200 Primary batteries, dry and wet 3692
58.0400 Electrical equipment for internal combustion engines 3694
58.0600 Magnetic and optical recording media 3695
58.0700 Electrical machinery, equipment, and supplies, n.e.c. 3699

59A Motor vehicles (passenger cars and trucks):

59.0301 Motor vehicles and passenger car bodies 3711

59B Truck and bus bodies, trailers, and motor vehicles parts:

59.0100 Truck and bus bodies 3713
59.0200 Truck trailers 3715
59.0302 Motor vehicle parts and accessories 3714

60 Aircraft and parts:

60.0100 Aircraft 3721
60.0200 Aircraft and missile engines and engine parts 3724, 3764
60.0400 Aircraft and missile equipment, n.e.c. 3728, 3769

61 Other transportation equipment:

61.0100 Ship building and repairing 3731
61.0200 Boat building and repairing 3732
61.0300 Railroad equipment 374
61.0500 Motorcycles, bicycles, and parts 375
61.0601 Travel trailers and campers 3792
61.0603 Motor homes 3716
61.0700 Transportation equipment, n.e.c. 3799

62 Scientific and controlling instruments:

62.0101 Search and navigation equipment 381
62.0102 Laboratory apparatus and furniture 3821
62.0200 Mechanical measuring devices 3823-4, 3829
62.0300 Environmental controls 3822
62.0400 Surgical and medical instruments and apparatus 3841
62.0500 Surgical appliances and supplies 3842
62.0600 Dental equipment and supplies 3843
62.0700 Watches, clocks, watchcases, and parts 387
62.0800 X-ray apparatus and tubes 3844

62.0900 Electromedical and electro-therapeutic apparatus 3845
62.1000 Laboratory and optical instruments 3826-7
62.1100 Instruments to measure electricity 3825

63 Ophthalmic and photographic equipment:

63.0200 Ophthalmic goods 385
63.0300 Photographic equipment and supplies 386

64 Miscellaneous manufacturing:

64.0101 Jewelry, precious metal 3911
64.0102 Jewelers' materials and lapidary work 3915
64.0104 Silverware and plated ware 3914
64.0105 Costume jewelry 3961
64.0200 Musical instruments 393
64.0301 Games, toys, and children's vehicles 3944
64.0302 Dolls and stuffed toys 3942
64.0400 Sporting and athletic goods, n.e.c. 3949
64.0501 Pens, mechanical pencils, and parts 3951
64.0502 Lead pencils and art goods 3952
64.0503 Marking devices 3953
64.0504 Carbon paper and inked ribbons 3955
64.0700 Fasteners, buttons, needles, and pins 3965
64.0800 Brooms and brushes 3991
64.0900 Hard surface floor coverings, n.e.c. 3996
64.1000 Burial caskets 3995
64.1100 Signs and advertising specialties 3993
64.1200 Manufacturing industries, n.e.c. 3999

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65.0100 Railroads and related services 40, 474
65.0200 Local and suburban transit and interurban highway passenger transportation 41

65B Motor freight transportation and warehousing:

65.0301 Trucking and courier services, except air 421, 423
65.0302 Warehousing and storage 422

65C Water transportation:

65.0400 Water transportation 44

65D Air transportation:

65.0500 Air transportation 45

65E Pipelines, freight forwarders, and related services:

65.0600 Pipelines, except natural gas 46
65.0701 Freight forwarders and other transportation services 473, 478
65.0702 Arrangement of passenger transportation 472

66 Communications, except radio and TV:

66.0100 Telephone and telegraph communications, and commun-ications services, n.e.c. 481-2, 489
66.0200 Cable and other pay television services 484

67 Radio and TV broadcasting:

67.0000 Radio and TV broadcasting 483

68A Electric services (utilities):

68.0100 Electric services (utilities) 491, 4931

68B Gas production and distribution (utilities):

68.0201 Natural gas transportation 4922, *4923
68.0202 Natural gas distribution *4923, 4924, 4925, 4932, 4939

68C Water and sanitary services:

68.0301 Water supply and sewerage systems 494, 4952
68.0302 Sanitary services, steam supply, and Irrigation systems 4953, 4959, 496-7

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69A Wholesale trade:

69.0100 Wholesale trade 50, 51

69B Retail trade:

69.0200 Retail trade, except eating and drinking 52-7, 59

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70A Finance:

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70.0200 Credit agencies other than banks 61, 67 (excl. 6732)
70.0300 Security and commodity brokers 62

70B Insurance:

70.0400 Insurance carriers 63
70.0500 Insurance agents, brokers, and services 64

71A Owner-occupied dwellings:

71.0100 Owner-occupied dwellings --

71B Real estate and royalties:

71.0201 Real estate agents, managers, operators, and lessors 65 (excl. 6552)
71.0202 Royalties --

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72.0102 Other lodging places 702-4

72B Personal and repair services (except auto):

72.0201 Laundry, cleaning, garment services, and shoe repair 721, 725
72.0202 Funeral service and crematories 726
72.0203 Portrait photographic studios, and other miscell-aneous personal services 722, 729
72.0204 Electrical repair shops 762
72.0205 Watch, clock, jewelry, and furniture repair 763-4
72.0300 Beauty and barber shops 723-4

73A Computer and data processing services:

73.0104 Computer and data processing services 737

73B Legal, engineering, accounting, and related services:

73.0301 Legal services 81

73.0302 Engineering, architectural, and surveying services 871
73.0303 Accounting, auditing and book-keeping, and miscellaneous services, n.e.c. 872, 89

73C Other business and professional services, except medical:

73.0101 Miscellaneous repair shops 769
73.0102 Services to dwellings and other buildings 734
73.0103 Personnel supply services 736
73.0106 Detective and protective services 7381-2
73.0107 Miscellaneous equipment rental and leasing 735
73.0108 Photofinishing labs and commercial photography 7335-6, 7384
73.0109 Other business services 732, 7331, 7334, 7338, 7383, 7389
73.0111 Management and consulting services 874
73.0112 Testing and research labs 8731-2, 8734

73D Advertising:

73.0200 Advertising 731

74 Eating and drinking places:

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75 Automotive repair and services:

75.0001 Automotive rental and leasing, without drivers 751
75.0002 Automotive repair shops and services 753, 7549
75.0003 Automobile parking and car washes 752, 7542

76 Amusements:

76.0101 Motion picture services and theaters 781-3
76.0102 Video tape rental 784
76.0201 Theatrical producers (except motion picture), bands, orchestras and entertainers 792
76.0202 Bowling centers 793
76.0203 Professional sports clubs and promoters 7941
76.0204 Racing, including track operation 7948
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77A Health services:

77.0100 Doctors and dentists 801-3, 8041
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77.0303 Home health care services 808
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77B Educational and social services, and membership organizations:

77.0401 Elementary and secondary schools 821
77.0402 Colleges, universities, and professional schools 822
77.0403 Private libraries, vocational schools, and educational services, n.e.c. 823-4, 829
77.0501 Business associations and professional membership organizations 861-2
77.0502 Labor organizations, civic, social, and fraternal associations 863-4
77.0503 Religious organizations 866
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77.0700 Child day care services 835
77.0800 Residential care 836
77.0900 Social services, n.e.c. 832, 839

Appendix 3 to Chapter II: Identification of the System Presented in § 2.9

The purpose of Appendix C is to determine whether the following system is identified:

$$\begin{cases} 4CR = \alpha_1 * \dfrac{\pi}{S} + \alpha_2 * \dfrac{Adv}{S} + \sum_i \alpha_i * Time_i \\ \dfrac{\pi}{S} = \beta_1 * 4CR + \beta_2 * \Delta 4CR + \sum_i \beta_i * Time_i \\ \dfrac{Adv}{S} = \gamma_1 * 4CR + \gamma_2 * \Delta \dfrac{\pi}{S} + \sum_i \gamma_i * Time_i \end{cases} \qquad (1)$$

To determine the identification of each equation in the system above, we do not consider the variable present in each equation of the system, i.e., the dummy variable, since they do not affect the identifiability of the system. This will simplify our calculations.

Every general linear simultaneous equation can be rewritten as:

$$\mathbf{B}\, y_t + \mathbf{C}\, x_t = u_t \qquad t = 1, \ldots, n \qquad (2)$$

Where **B** is a G X G matrix of coefficients of current endogenous variables, **C** is a G X K matrix of coefficients of predetermined variables, and $\mathbf{y_t}$, $\mathbf{x_t}$, and $\mathbf{u_t}$ are column vectors of G, K, and G elements, respectively:

$$\begin{array}{llll} 4CR & -\dfrac{\pi}{S} & -\dfrac{Adv}{S} & = u_{1t} \\ -4CR & \dfrac{\pi}{S} & -\Delta 4CR & = u_{2t} \\ -4CR & \dfrac{Adv}{S} & -\Delta \dfrac{\pi}{S} & = u_{3t} \end{array} \qquad (3)$$

with

$$B = \begin{bmatrix} \beta_{11} & \beta_{12} & \beta_{13} \\ \beta_{21} & \beta_{22} & 0 \\ \beta_{31} & 0 & \beta_{33} \end{bmatrix} \qquad C = \begin{bmatrix} 0 & 0 \\ \gamma_{21} & 0 \\ 0 & \gamma_{32} \end{bmatrix}$$

$$y_t = \begin{bmatrix} 4CR \\ \dfrac{\pi}{S} \\ \dfrac{Adv}{S} \end{bmatrix} \qquad x_t = \begin{bmatrix} \Delta 4CR \\ \Delta \dfrac{\pi}{S} \end{bmatrix} \qquad u_t = \begin{bmatrix} u_{1t} \\ u_{2t} \\ u_{3t} \end{bmatrix}$$

In our case, G is equal to three and K to two. The system of equations presented in (2) can also be expressed as

$$A z_t = [B \quad C]\begin{bmatrix} y_t \\ x_t \end{bmatrix} = u_t \tag{4}$$

where A is the G X (G + K) matrix of all structural coefficients and z_t is the (G + K)X 1 vector of observations on all variables at time t. Each equation of the system can be written as

$$\alpha_i z_t = u_{it} \tag{5}$$

where i represents the number of the equation selected from the system, or the i^{th} row of A. The restrictions on each equation can then be written as:

$$\alpha_i \Phi = 0 \tag{6}$$

The Φ matrix has G + K rows and a column for each a priori restriction on the first equation. In addition to the restrictions from (6) there will also be restrictions on α_i arising from the relationship between structural and reduced form coefficients.

In order to determine if the system of equation is identified, we express (2) in its reduced form:

$$y_t = \Pi x_t + v_t \tag{7}$$

where $\Pi = -B^{-1}C \qquad v_t = B^{-1}u_t$ (8)

from (5) we can rewrite $B\Pi + C = 0$

or $AW = 0$

where $W = \begin{bmatrix} \Pi \\ I_2 \end{bmatrix}$ (9)

each equation of the system can be obtained from (9) as

$$\alpha_i W = 0 \tag{10}$$

Combining (6) and (10) we have:

$$\alpha_i [\Phi \quad W] = 0 \tag{11}$$

which represents the complete set of restrictions. There are G + K unknown in α_i. The matrix [W Φ] is of order (G + K) X (K + R), where R is the number of columns in Φ. On the assumption that Π is known, all the elements in [W Φ] are known. Thus, equation (11)

constitutes a set of K + R equations in G + K unknowns. Identification of the first equation requires that the rank of [W Φ] be G + K −1, so that all the solutions to (11) will lie on a single ray through the origin. To summarize, identification of equation i of the system of simultaneous equations requires

$$\rho\,[W\ \Phi] = G + K - 1 \tag{12}$$

By applying this methodology to our system of equations we have:

$$\Phi_1 = \begin{bmatrix} 0 & 0 \\ 0 & 0 \\ 0 & 0 \\ 1 & 0 \\ 0 & 1 \end{bmatrix} \quad \Phi_2 = \begin{bmatrix} 0 & 0 \\ 0 & 0 \\ 1 & 0 \\ 0 & 0 \\ 0 & 1 \end{bmatrix} \quad \Phi_3 = \begin{bmatrix} 0 & 0 \\ 1 & 0 \\ 0 & 0 \\ 0 & 1 \\ 0 & 0 \end{bmatrix} \tag{13}$$

To compute B^{-1}, let's call the determinant of the matrix B as D_B. Therefore

$$B^{-1} = \frac{1}{D_B}\begin{bmatrix} \beta_{22}\beta_{33} & -\beta_{21}\beta_{33} & -\beta_{31}\beta_{22} \\ -\beta_{12}\beta_{33} & \beta_{11}\beta_{33} - \beta_{31}\beta_{13} & \beta_{31}\beta_{12} \\ -\beta_{22}\beta_{13} & \beta_{21}\beta_{13} & \beta_{11}\beta_{22} - \beta_{21}\beta_{12} \end{bmatrix} \tag{14}$$

and Π is obtained from equation (8) and simplified as follows:

$$\Pi = -B^{-1}C = -\frac{1}{D_B}\begin{bmatrix} -\beta_{21}\beta_{33}\gamma_{21} & -\beta_{31}\beta_{22}\gamma_{32} \\ (\beta_{11}\beta_{33} - \beta_{31}\beta_{13})\gamma_{21} & \beta_{31}\beta_{12}\gamma_{32} \\ \beta_{21}\beta_{13}\gamma_{21} & (\beta_{11}\beta_{22} - \beta_{21}\beta_{13})\gamma_{32} \end{bmatrix} \tag{15}$$

To verify the identification of each equation of the system, we obtain W by vertically concatenating Π with an identity matrix and we concatenate horizontally W with each of the matrices in (13) and we determine the rank of the resulting matrix. It is straightforward to show that for each equation the rank is equal to seven. Thus, each of the equations of the system is exactly identified.

Appendix 4 to Chapter II: Identification of the System Presented in § 2.10

Following the methodology of Appendix C, we show that the following system is exactly identified:

$$\begin{cases} 4CR = \alpha_0 + \alpha_1 * \frac{\pi}{S} + \alpha_2 * Lag(\frac{\pi}{S}) \\ \frac{\pi}{S} = \beta_0 + \beta_1 * 4CR + \beta_2 * \Delta 4CR \end{cases} \quad (1)$$

which can be rewritten as:

$$\begin{array}{rrrrcl} 4CR & -\frac{\pi}{S} & Lag(\frac{\pi}{S}) & 0 & = & u_{1t} \\ -4CR & \frac{\pi}{S} & 0 & \Delta 4CR & = & u_{2t} \end{array} \quad (2)$$

In this case G and K are equal to two.

$$y_t = \begin{bmatrix} 4CR \\ \frac{\pi}{S} \end{bmatrix}, \quad x_t = \begin{bmatrix} D_t \\ \Delta 4CR \end{bmatrix}, \Phi_1 = \begin{bmatrix} 0 \\ 0 \\ 0 \\ 1 \end{bmatrix}, \Phi_2 = \begin{bmatrix} 0 \\ 0 \\ 1 \\ 0 \end{bmatrix}$$

$$B = \begin{bmatrix} \beta_{11} & \beta_{12} \\ \beta_{21} & \beta_{22} \end{bmatrix}, \text{ and } C = \begin{bmatrix} \gamma_{12} & 0 \\ 0 & \gamma_{22} \end{bmatrix}.$$

In this case, Π is immediately calculated from the inverse of B and from C:

$$\Pi = -\frac{1}{D_B} \begin{bmatrix} \gamma_{12}\beta_{22} & -\beta_{12}\gamma_{22} \\ -\beta_{21}\gamma_{12} & \beta_{22}\gamma_{22} \end{bmatrix}$$

To verify the identification of each equation of the system, we obtain W by vertically concatenating Π with an identity matrix (2X2) and we concatenate horizontally W with Φ_1 or with Φ_2 and we determine the rank of the resulting matrix. As in appendix C, it is straightforward to show that for each equation the rank is equal to three. Thus, each of the two equations of the system are exactly identified.

Appendix 1 to Chapter III: Complete Estimation Results for the Equations of this Chapter

Table 15: OLS Estimation for the Automotive and Pharma Sector
Automotive Industry

The REG Procedure
Model: m1
Dependent Variable: share
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	11	48.22288	4.38390	1.31	0.2275
Error	119	398.44290	3.34826		
Corrected Total	130	446.66578			

Root MSE	1.82983	R-Square	0.1080
Dependent Mean	0.31725	Adj R-Sq	0.0255
Coeff Var	576.77662		

Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	Intercept	1	-0.21514	0.52989	-0.41	0.6855
advsal	VAR40	1	-0.18935	0.17267	-1.10	0.2750
ebtda	VAR2	1	-0.04932	0.06486	-0.76	0.4484
time82		1	1.72044	0.91590	1.88	0.0628
time84		1	1.75225	0.74494	2.35	0.0203
time86		1	1.43289	0.75504	1.90	0.0602
time88		1	0.33157	0.72026	0.46	0.6461
time90		1	0.25596	0.75463	0.34	0.7351
time92		1	0.11476	0.72490	0.16	0.8745
time94		1	0.37456	0.76424	0.49	0.6250
time96		1	0.25573	0.70144	0.36	0.7161
time98		1	0.06941	0.66294	0.10	0.9168

Table 15: OLS Estimation for the Automotive and Pharma Sector
Automotive Industry

The REG Procedure
Model: m2
Dependent Variable: advsal VAR40

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	11	10.95529	0.99594	0.99	0.4621
Error	119	120.06361	1.00894		
Corrected Total	130	131.01891			

Root MSE	1.00446	R-Square	0.0836
Dependent Mean	-0.03906	Adj R-Sq	-0.0011
Coeff Var	-2571.86304		

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	Intercept	1	-0.25151	0.29021	-0.87	0.3879
share		1	-0.03343	0.05236	-0.64	0.5244
dif2con		1	0.06145	0.07470	0.82	0.4123
time82		1	0.37779	0.51415	0.73	0.4639
time84		1	0.76793	0.41168	1.87	0.0646
time86		1	0.51828	0.41624	1.25	0.2155
time88		1	0.10557	0.39811	0.27	0.7913
time90		1	0.62178	0.41030	1.52	0.1323
time92		1	-0.01904	0.39532	-0.05	0.9617
time94		1	-0.13823	0.41995	-0.33	0.7426
time96		1	0.03625	0.38373	0.09	0.9249
time98		1	0.17205	0.36371	0.47	0.6370

Table 15: OLS Estimation for the Automotive and Pharma Sector

Automotive Industry

The REG Procedure

Model: m3

Dependent Variable: ebtda VAR2

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	11	63.53765	5.77615	0.80	0.6410
Error	119	860.49701	7.23107		
Corrected Total	130	924.03466			

Root MSE	2.68906	R-Square	0.0688
Dependent Mean	0.07919	Adj R-Sq	-0.0173
Coeff Var	3395.50833		

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	Intercept	1	0.11047	0.77670	0.14	0.8871
dif1con		1	0.12191	0.38311	0.32	0.7509
dif2con		1	0.02477	0.22182	0.11	0.9113
time82		1	0.05638	1.38019	0.04	0.9675
time84		1	0.40043	1.07783	0.37	0.7109
time86		1	1.03478	1.11137	0.93	0.3537
time88		1	0.06301	1.06465	0.06	0.9529
time90		1	-0.90562	1.09852	-0.82	0.4114
time92		1	-1.30774	1.05800	-1.24	0.2189
time94		1	-0.03635	1.12445	-0.03	0.9743
time96		1	0.92321	1.02704	0.90	0.3705
time98		1	-0.32068	0.97363	-0.33	0.7425

Table 15: OLS Estimation for the Automotive and Pharma Sector

Automotive Industry

The REG Procedure

Model: m4

Dependent Variable: ebtda VAR2

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	11	65.07834	5.91621	0.82	0.6206
Error	119	858.95631	7.21812		
Corrected Total	130	924.03466			

Root MSE	2.68666	R-Square	0.0704
Dependent Mean	0.07919	Adj R-Sq	-0.0155
Coeff Var	3392.46719		

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	Intercept	1	0.09935	0.77635	0.13	0.8984
share		1	-0.06360	0.13380	-0.48	0.6354
dif1con		1	0.14423	0.32969	0.44	0.6626
time82		1	0.12811	1.36227	0.09	0.9252
time84		1	0.50262	1.09771	0.46	0.6479
time86		1	1.11257	1.12304	0.99	0.3239
time88		1	0.09567	1.05771	0.09	0.9281
time90		1	-0.89427	1.09780	-0.81	0.4169
time92		1	-1.29585	1.05733	-1.23	0.2228
time94		1	-0.01303	1.12455	-0.01	0.9908
time96		1	0.93715	1.02646	0.91	0.3631
time98		1	-0.31395	0.97227	-0.32	0.7473

Table 16: Granger Causality Test
Automotive Industry

The REG Procedure
Model: m1
Dependent Variable: advsal VAR40

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	12	18.45429	1.53786	1.62	0.0956
Error	109	103.30288	0.94773		
Corrected Total	121	121.75717			

Root MSE	0.97352	R-Square	0.1516
Dependent Mean	-0.02135	Adj R-Sq	0.0582
Coeff Var	-4559.04410		

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	Intercept	1	-0.26186	0.29362	-0.89	0.3744
lagad		1	0.27157	0.09770	2.78	0.0064
lagshare		1	-0.01756	0.04535	-0.39	0.6993
lagebtda		1	0.00411	0.01353	0.30	0.7620
time82		1	0.31014	0.47563	0.65	0.5157
time84		1	0.71529	0.40527	1.76	0.0804
time86		1	0.32100	0.42149	0.76	0.4480
time88		1	0.09477	0.39729	0.24	0.8119
time90		1	0.55369	0.40766	1.36	0.1772
time92		1	-0.07052	0.41516	-0.17	0.8654
time94		1	-0.13485	0.42691	-0.32	0.7527
time96		1	0.27772	0.39991	0.69	0.4889
time98		1	0.20586	0.36888	0.56	0.5779

Table 16: Granger Causality Test
Automotive Industry

The REG Procedure
Model: m2
Dependent Variable: share

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	12	389.16075	32.43006	64.61	<.0001
Error	109	54.71156	0.50194		
Corrected Total	121	443.87231			

Root MSE	0.70848	R-Square	0.8767
Dependent Mean	0.34697	Adj R-Sq	0.8632
Coeff Var	204.19183		

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	Intercept	1	-0.10121	0.21368	-0.47	0.6367
lagshare		1	0.85923	0.03300	26.04	<.0001
lagad		1	-0.04517	0.07110	-0.64	0.5266
lagebtda		1	-0.00122	0.00984	-0.12	0.9017
time82		1	0.29331	0.34614	0.85	0.3986
time84		1	0.37942	0.29493	1.29	0.2010
time86		1	-0.21389	0.30674	-0.70	0.4871
time88		1	0.07040	0.28913	0.24	0.8081
time90		1	0.15058	0.29667	0.51	0.6128
time92		1	0.08167	0.30214	0.27	0.7874
time94		1	0.23059	0.31068	0.74	0.4596
time96		1	-0.03879	0.29103	-0.13	0.8942
time98		1	0.10207	0.26845	0.38	0.7045

Table 16: Granger Causality Test
Automotive Industry

The REG Procedure
Model: m3
Dependent Variable: ebtda VAR2

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	12	116.34556	9.69546	1.44	0.1577
Error	109	732.46998	6.71991		
Corrected Total	121	848.81555			

Root MSE	2.59228	R-Square	0.1371
Dependent Mean	-0.00409	Adj R-Sq	0.0421
Coeff Var	-63370		

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	Intercept	1	0.11489	0.78184	0.15	0.8834
lagebtda		1	0.10255	0.03602	2.85	0.0053
lagshare		1	-0.06664	0.12074	-0.55	0.5821
lagad		1	0.11126	0.26015	0.43	0.6697
time82		1	0.25095	1.26651	0.20	0.8433
time84		1	0.45635	1.07914	0.42	0.6732
time86		1	0.89868	1.12234	0.80	0.4250
time88		1	0.55676	1.05790	0.53	0.5998
time90		1	-0.87921	1.08551	-0.81	0.4197
time92		1	-1.67617	1.10550	-1.52	0.1324
time94		1	0.18763	1.13676	0.17	0.8692
time96		1	0.27660	1.06487	0.26	0.7955
time98		1	-0.35054	0.98225	-0.36	0.7219

Table 17: Simultaneous Equations Estimation
Automotive Industry

The SYSLIN Procedure
Full-Information Maximum Likelihood Estimation

NOTE: Convergence criterion met at iteration 6.

Model	CONCENT
Dependent Variable	share
Label	

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variable Label
Intercept	1	-0.23188	1.778351	-0.13	0.8965	Intercept
advsal	1	-0.23532	7.145356	-0.03	0.9738	VAR40
ebtda	1	0.003489	0.883618	0.00	0.9969	VAR2
time82	1	1.495577	2.470337	0.61	0.5460	
time84	1	1.763189	5.592102	0.32	0.7531	
time86	1	1.402302	3.990559	0.35	0.7259	
time88	1	0.333376	1.207465	0.28	0.7829	
time90	1	0.331465	3.757109	0.09	0.9298	
time92	1	0.182438	1.471429	0.12	0.9015	
time94	1	0.368389	1.285379	0.29	0.7749	
time96	1	0.208609	1.213908	0.17	0.8638	
time98	1	0.094299	1.200484	0.08	0.9375	

Table 17: Simultaneous Equations Estimation
Automotive Industry

The SYSLIN Procedure
Full-Information Maximum Likelihood Estimation

Model	PROFIT
Dependent Variable	ebtda
Label	VAR2

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variable Label
Intercept	1	5.736171	45.17796	0.13	0.8992	Intercept
share	1	32.76785	244.6277	0.13	0.8937	
difcon	1	-0.23426	7.613641	-0.03	0.9755	
time82	1	-46.4761	348.0740	-0.13	0.8940	
time84	1	-51.7675	390.1496	-0.13	0.8947	
time86	1	-41.8730	321.1701	-0.13	0.8965	
time88	1	-9.85278	77.51548	-0.13	0.8991	
time90	1	-6.82597	50.07581	-0.14	0.8918	
time92	1	-7.28684	50.06710	-0.15	0.8845	
time94	1	-13.1674	100.9308	-0.13	0.8964	
time96	1	-5.80889	54.87246	-0.11	0.9159	
time98	1	-1.97599	24.25425	-0.08	0.9352	

Table 17: Simultaneous Equations Estimation
Automotive Industry

The SYSLIN Procedure
Full-Information Maximum Likelihood Estimation

Model	ADVERT
Dependent Variable	advsal
Label	VAR40

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variable Label
Intercept	1	-0.95323	13.53063	-0.07	0.9440	Intercept
share	1	-4.07196	77.53992	-0.05	0.9582	
lagebtda	1	0.000927	0.251139	0.00	0.9971	
time82	1	6.105371	110.5441	0.06	0.9560	
time84	1	7.215746	123.5632	0.06	0.9535	
time86	1	5.740966	100.8871	0.06	0.9547	
time88	1	1.368589	24.82604	0.06	0.9561	
time90	1	1.363589	14.53895	0.09	0.9254	
time92	1	0.723417	14.44709	0.05	0.9601	
time94	1	1.495074	31.70708	0.05	0.9625	
time96	1	0.862637	15.85828	0.05	0.9567	
time98	1	0.386969	4.694910	0.08	0.9344	

Obs	_MODEL_	_DEPVAR_	_SIGMA_	Intercept	difIcon	lagebtda	time82	time84
1	CONCENT	share	1.8345	-0.23188	.	.	1.4956	1.7632
2	PROFIT	ebtda	60.4408	5.73617	-0.23426	.	-46.4761	-51.7675
3	ADVERT	advsal	7.4687	-0.95323	.	.000927036	6.1054	7.2157

time86	time88	time90	time92	time94	time96	time98	share	ebtda	advsal
1.4023	0.33338	0.33147	0.18244	0.3684	0.20861	0.09430	-1.0000	0.00349	-0.23532
-41.8730	-9.85278	-6.82597	-7.28684	-13.1674	-5.80889	-1.97599	32.7679	-1.00000	.
5.7410	1.36859	1.36359	0.72342	1.4951	0.86264	0.38697	-4.0720	.	-1.00000

Table 18: OLS Estimation of the Advertising Equation
Automotive Industry

The REG Procedure
Model: m1
Dependent Variable: advsal VAR40

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	11	11.44174	1.04016	1.04	0.4192
Error	110	110.31542	1.00287		
Corrected Total	121	121.75717			

Root MSE	1.00143	R-Square	0.0940
Dependent Mean	-0.02135	Adj R-Sq	0.0034
Coeff Var	-4689.78144		

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	Intercept	1	-0.28250	0.30209	-0.94	0.3517
share		1	-0.04721	0.04979	-0.95	0.3450
lagebtda		1	-0.01059	0.01280	-0.83	0.4097
time82		1	0.39483	0.49002	0.81	0.4221
time84		1	0.82713	0.41801	1.98	0.0503
time86		1	0.52940	0.42330	1.25	0.2137
time88		1	0.11500	0.40873	0.28	0.7790
time90		1	0.64799	0.41820	1.55	0.1241
time92		1	-0.06086	0.42714	-0.14	0.8870
time94		1	-0.20219	0.43858	-0.46	0.6457
time96		1	0.21222	0.41059	0.52	0.6063
time98		1	0.19511	0.37945	0.51	0.6082

Table 19: Simultaneous Equations Estimation
Automotive Industry

The SYSLIN Procedure
Full-Information Maximum Likelihood Estimation

NOTE: Convergence criterion met at iteration 0.

Model	CONCENT
Dependent Variable	share
Label	

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variable Label
Intercept	1	-0.18107	0.538757	-0.34	0.7374	Intercept
ebtda	1	0.083455	1.613472	0.05	0.9588	VAR2
lagebtda	1	-0.00522	0.160858	-0.03	0.9742	
time82	1	1.408654	0.902231	1.56	0.1211	
time84	1	1.559908	0.957791	1.63	0.1060	
time86	1	1.228644	1.568059	0.78	0.4349	
time88	1	0.270908	1.154001	0.23	0.8148	
time90	1	0.253334	1.528745	0.17	0.8687	
time92	1	0.292015	2.224337	0.13	0.8958	
time94	1	0.396489	0.769591	0.52	0.6074	
time96	1	0.134370	1.464193	0.09	0.9270	
time98	1	0.077466	0.825977	0.09	0.9254	

Table 19: Simultaneous Equations Estimation
Automotive Industry

The SYSLIN Procedure
Full-Information Maximum Likelihood Estimation

Model	PROFIT
Dependent Variable	ebtda
Label	VAR2

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variable Label
Intercept	1	5.736175	45.17796	0.13	0.8992	Intercept
share	1	32.76783	244.6274	0.13	0.8937	
difIcon	1	-0.23419	7.613443	-0.03	0.9755	
time82	1	-46.4761	348.0736	-0.13	0.8940	
time84	1	-51.7675	390.1492	-0.13	0.8947	
time86	1	-41.8729	321.1694	-0.13	0.8965	
time88	1	-9.85278	77.51540	-0.13	0.8991	
time90	1	-6.82598	50.07583	-0.14	0.8918	
time92	1	-7.28685	50.06708	-0.15	0.8845	
time94	1	-13.1674	100.9308	-0.13	0.8964	
time96	1	-5.80889	54.87239	-0.11	0.9159	
time98	1	-1.97599	24.25425	-0.08	0.9352	

Table 19: Simultaneous Equations Estimation
Automotive Industry

Obs	_MODEL_	_DEPVAR_	_SIGMA_	Intercept	difIcon	lagebtda	time82	time84
1	CONCENT	share	1.8619	-0.18107	.	-.005218056	1.4087	1.5599
2	PROFIT	ebtda	60.4408	5.73618	-0.23419	.	-46.4761	-51.7675

time86	time88	time90	time92	time94	time96	time98	share	ebtda
1.2286	0.27091	0.25333	0.29201	0.3965	0.13437	0.07747	-1.0000	0.08345
-41.8729	-9.85278	-6.82598	-7.28685	-13.1674	-5.80889	-1.97599	32.7678	-1.00000

Table 20: Simultaneous Equation Estimation of the Relationship between Advertising and Profits
Automotive Industry

The SYSLIN Procedure
Full-Information Maximum Likelihood Estimation

NOTE: Convergence criterion met at iteration 0.

Model	ADVERTIS
Dependent Variable	advsal
Label	VAR40

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variable Label
Intercept	1	-0.51809	1.712969	-0.30	0.7629	Intercept
ebtda	1	2.103749	4.116576	0.51	0.6103	VAR2
lagebtda	1	-0.21341	0.402667	-0.53	0.5972	
time82	1	-0.04758	2.740381	-0.02	0.9862	
time84	1	-0.05947	2.740688	-0.02	0.9827	
time86	1	-1.32248	4.177937	-0.32	0.7522	
time88	1	-1.03733	3.145740	-0.33	0.7422	
time90	1	2.424191	4.170744	0.58	0.5623	
time92	1	3.473722	7.315043	0.47	0.6358	
time94	1	-0.51212	2.452034	-0.21	0.8349	
time96	1	-0.28024	2.427220	-0.12	0.9083	
time98	1	0.942498	2.538047	0.37	0.7111	

Table 20: Simultaneous Equation Estimation of the Relationship between Advertising and Profits
Automotive Industry

The SYSLIN Procedure
Full-Information Maximum Likelihood Estimation

Model	EBTDA
Dependent Variable	ebtda
Label	VAR2

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variable Label
Intercept	1	6.288817	19.90916	0.32	0.7527	Intercept
advsal	1	23.73593	71.81517	0.33	0.7416	VAR40
lagad	1	-6.44185	19.12547	-0.34	0.7369	
time82	1	-6.62422	22.93706	-0.29	0.7733	
time84	1	-15.9925	50.58457	-0.32	0.7525	
time86	1	-6.01462	23.36015	-0.26	0.7973	
time88	1	-1.58066	10.45659	-0.15	0.8801	
time90	1	-13.9621	40.78916	-0.34	0.7328	
time92	1	0.049168	10.94740	0.00	0.9964	
time94	1	3.438189	14.44667	0.24	0.8123	
time96	1	-6.24707	21.80619	-0.29	0.7750	
time98	1	-5.23913	17.05851	-0.31	0.7593	

Table 20: Simultaneous Equation Estimation of the Relationship between Advertising and Profits
Automotive Industry

Obs	_MODEL_	_DEPVAR_	_SIGMA_	Intercept	lagad	lagebtda	time82	time84
1	ADVERTIS	advsal	5.7451	-0.51809	.	-0.21341	-0.04758	-0.0595
2	EBTDA	ebtda	23.7668	6.28882	-6.44185	.	-6.62422	-15.9925

time86	time88	time90	time92	time94	time96	time98	advsal	ebtda
-1.32248	-1.03733	2.4242	3.47372	-0.51212	-0.28024	0.94250	-1.0000	2.10375
-6.01462	-1.58066	-13.9621	0.04917	3.43819	-6.24707	-5.23913	23.7359	-1.00000

Table 15: OLS Estimation for the Automotive and Pharma Sector Pharmaceutical Industry

The REG Procedure
Model: m1
Dependent Variable: share

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	11	70.21798	6.38345	9.36	<.0001
Error	1521	1037.31860	0.68200		
Corrected Total	1532	1107.53658			

Root MSE	0.82583	R-Square	0.0634
Dependent Mean	0.02596	Adj R-Sq	0.0566
Coeff Var	3180.88570		

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	Intercept	1	-0.14106	0.07195	-1.96	0.0501
advsal	VAR40	1	0.00036977	0.00564	0.07	0.9478
ebtda	VAR2	1	0.00173	0.00207	0.84	0.4037
time82		1	0.78988	0.13448	5.87	<.0001
time84		1	0.56368	0.10291	5.48	<.0001
time86		1	0.31593	0.09625	3.28	0.0011
time88		1	0.26469	0.09347	2.83	0.0047
time90		1	0.19850	0.09191	2.16	0.0309
time92		1	0.07013	0.09148	0.77	0.4434
time94		1	-0.02904	0.11146	-0.26	0.7945
time96		1	-0.03658	0.09893	-0.37	0.7116
time98		1	-0.04751	0.09291	-0.51	0.6092

Table 15: OLS Estimation for the Automotive and Pharma Sector
Pharmaceutical Industry

The REG Procedure
Model: m2
Dependent Variable: advsal VAR40

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	11	143.71098	13.06463	0.91	0.5294
Error	1521	21827	14.35010		
Corrected Total	1532	21970			

Root MSE	3.78815	R-Square	0.0065
Dependent Mean	-0.00302	Adj R-Sq	-0.0006
Coeff Var	-125332		

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	Intercept	1	0.49218	0.33025	1.49	0.1363
share		1	0.00779	0.12184	0.06	0.9490
dif2con		1	0.06526	0.15059	0.43	0.6648
time82		1	-0.23163	0.62771	-0.37	0.7122
time84		1	-0.17600	0.47671	-0.37	0.7120
time86		1	-0.32719	0.44291	-0.74	0.4602
time88		1	-0.65449	0.42962	-1.52	0.1279
time90		1	-0.72088	0.42184	-1.71	0.0877
time92		1	-0.69887	0.41933	-1.67	0.0958
time94		1	-0.16602	0.51135	-0.32	0.7455
time96		1	-1.06439	0.45281	-2.35	0.0189
time98		1	-0.33619	0.42615	-0.79	0.4303

Table 15: OLS Estimation for the Automotive and Pharma Sector
Pharmaceutical Industry

The REG Procedure
Model: m3
Dependent Variable: ebtda VAR2

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	11	1604.91204	145.90109	1.36	0.1848
Error	1521	162960	107.14026		
Corrected Total	1532	164565			

Root MSE	10.35086	R-Square	0.0098
Dependent Mean	0.23416	Adj R-Sq	0.0026
Coeff Var	4420.49966		

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	Intercept	1	0.59264	0.90115	0.66	0.5109
dif1con		1	0.27465	0.93966	0.29	0.7701
dif2con		1	-0.11343	0.44245	-0.26	0.7977
time82		1	-3.33509	1.70592	-1.96	0.0508
time84		1	-1.44086	1.29266	-1.11	0.2652
time86		1	-1.41162	1.20671	-1.17	0.2423
time88		1	-0.82743	1.17066	-0.71	0.4798
time90		1	-0.15632	1.15148	-0.14	0.8920
time92		1	0.21257	1.14845	0.19	0.8532
time94		1	0.05202	1.39858	0.04	0.9703
time96		1	1.74481	1.23858	1.41	0.1591
time98		1	-0.32598	1.16524	-0.28	0.7797

Table 15: OLS Estimation for the Automotive and Pharma Sector
Pharmaceutical Industry

The REG Procedure
Model: m4
Dependent Variable: ebtda VAR2

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	11	1670.87762	151.89797	1.42	0.1579
Error	1521	162894	107.09689		
Corrected Total	1532	164565			

Root MSE	10.34876	R-Square	0.0102
Dependent Mean	0.23416	Adj R-Sq	0.0030
Coeff Var	4419.60487		

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	Intercept	1	0.63474	0.90194	0.70	0.4817
share		1	0.26553	0.32160	0.83	0.4091
difcon		1	0.13542	0.84419	0.16	0.8726
time82		1	-3.47679	1.70341	-2.04	0.0414
time84		1	-1.60349	1.30488	-1.23	0.2193
time86		1	-1.50450	1.21045	-1.24	0.2141
time88		1	-0.90338	1.17334	-0.77	0.4415
time90		1	-0.21434	1.15300	-0.19	0.8526
time92		1	0.18286	1.14808	0.16	0.8735
time94		1	0.04457	1.39733	0.03	0.9746
time96		1	1.74441	1.23801	1.41	0.1590
time98		1	-0.32304	1.16461	-0.28	0.7815

Table 16: Granger Causality Test
Pharmaceutical Industry

The REG Procedure
Model: m1
Dependent Variable: advsal VAR40

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	12	1808.52444	150.71037	11.67	<.0001
Error	1369	17680	12.91472		
Corrected Total	1381	19489			

Root MSE	3.59371	R-Square	0.0928
Dependent Mean	0.06823	Adj R-Sq	0.0848
Coeff Var	5267.34633		

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	Intercept	1	0.74962	0.34643	2.16	0.0307
lagad		1	0.31129	0.02739	11.37	<.0001
lagshare		1	-0.00670	0.10662	-0.06	0.9499
lagebtda		1	0.01337	0.00911	1.47	0.1421
time82		1	-0.60056	0.61868	-0.97	0.3319
time84		1	-0.43584	0.48208	-0.90	0.3661
time86		1	-0.65848	0.45309	-1.45	0.1464
time88		1	-0.83861	0.44027	-1.90	0.0570
time90		1	-0.88049	0.43027	-2.05	0.0409
time92		1	-0.94187	0.42763	-2.20	0.0278
time94		1	-0.68676	0.53063	-1.29	0.1958
time96		1	-1.00279	0.47991	-2.09	0.0368
time98		1	-0.43808	0.44429	-0.99	0.3243

Table 16: Granger Causality Test
Pharmaceutical Industry

The REG Procedure
Model: m2
Dependent Variable: share

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	12	972.25648	81.02137	910.54	<.0001
Error	1369	121.81539	0.08898		
Corrected Total	1381	1094.07187			

Root MSE	0.29830	R-Square	0.8887
Dependent Mean	0.02786	Adj R-Sq	0.8877
Coeff Var	1070.58720		

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	Intercept	1	-0.03795	0.02876	-1.32	0.1871
lagshare		1	0.88707	0.00885	100.24	<.0001
lagad		1	0.00190	0.00227	0.84	0.4026
lagebtda		1	0.00024508	0.00075577	0.32	0.7458
time82		1	0.05116	0.05135	1.00	0.3194
time84		1	0.00321	0.04002	0.08	0.9360
time86		1	0.01793	0.03761	0.48	0.6336
time88		1	0.04406	0.03654	1.21	0.2282
time90		1	0.01660	0.03571	0.46	0.6422
time92		1	-0.04268	0.03550	-1.20	0.2294
time94		1	-0.02763	0.04405	-0.63	0.5306
time96		1	-0.03797	0.03984	-0.95	0.3407
time98		1	-0.02243	0.03688	-0.61	0.5432

Table 16: Granger Causality Test
Pharmaceutical Industry

The REG Procedure
Model: m3
Dependent Variable: ebtda VAR2

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	12	15469	1289.09306	14.37	<.0001
Error	1369	122836	89.72713		
Corrected Total	1381	138306			

Root MSE	9.47244	R-Square	0.1118
Dependent Mean	0.15603	Adj R-Sq	0.1041
Coeff Var	6070.77856		

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	Intercept	1	-0.38941	0.91315	-0.43	0.6698
lagebtda		1	0.30384	0.02400	12.66	<.0001
lagshare		1	0.07907	0.28102	0.28	0.7785
lagad		1	0.22470	0.07219	3.11	0.0019
time82		1	-0.65109	1.63076	-0.40	0.6898
time84		1	-0.15368	1.27070	-0.12	0.9038
time86		1	0.10495	1.19426	0.09	0.9300
time88		1	0.56600	1.16048	0.49	0.6258
time90		1	0.58902	1.13413	0.52	0.6036
time92		1	1.32766	1.12716	1.18	0.2390
time94		1	0.86870	1.39866	0.62	0.5346
time96		1	1.85396	1.26497	1.47	0.1430
time98		1	0.06249	1.17109	0.05	0.9575

Table 17: Simultaneous Equations Estimation
Pharmaceutical Industry

The SYSLIN Procedure
Full-Information Maximum Likelihood Estimation

NOTE: Convergence criterion met at iteration 4.

Model	CONCENT
Dependent Variable	share
Label	

Parameter Estimates

Parameter Variable	DF	Estimate	Standard Error	t Value	Pr > |t|	Variable Label
Intercept	1	-0.40892	0.438187	-0.93	0.3509	Intercept
advsal	1	0.549740	0.806797	0.68	0.4957	VAR40
ebtda	1	0.000311	0.022507	0.01	0.9890	VAR2
time82	1	0.933603	0.423914	2.20	0.0278	
time84	1	0.656061	0.310178	2.12	0.0346	
time86	1	0.491577	0.366198	1.34	0.1797	
time88	1	0.620922	0.580090	1.07	0.2846	
time90	1	0.593644	0.630934	0.94	0.3469	
time92	1	0.454452	0.616363	0.74	0.4610	
time94	1	0.059765	0.328296	0.18	0.8556	
time96	1	0.550376	0.905491	0.61	0.5434	
time98	1	0.135564	0.367592	0.37	0.7123	

The SYSLIN Procedure

Full-Information Maximum Likelihood Estimation

Model	PROFIT
Dependent Variable	ebtda
Label	VAR2

Parameter Variable	DF	Estimate	Standard Error	t Value	Pr > |t|	Variable Label
Intercept	1	60.06694	207.2369	0.29	0.7720	Intercept
share	1	421.1328	1451.957	0.29	0.7718	
dif1con	1	-52.2047	182.7582	-0.29	0.7752	
time82	1	-337.591	1154.041	-0.29	0.7699	
time84	1	-243.071	834.1616	-0.29	0.7708	
time86	1	-136.137	466.2184	-0.29	0.7703	
time88	1	-112.676	387.5864	-0.29	0.7713	
time90	1	-85.8091	297.7930	-0.29	0.7733	
time92	1	-34.0118	124.0552	-0.27	0.7840	
time94	1	9.627602	57.23751	0.17	0.8664	
time96	1	12.95110	56.64287	0.23	0.8192	
time98	1	17.86900	73.85978	0.24	0.8089	

Table 17: Simultaneous Equations Estimation
Pharmaceutical Industry

The SYSLIN Procedure
Full-Information Maximum Likelihood Estimation

Model	ADVERT
Dependent Variable	advsal
Label	VAR40

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variable Label
Intercept	1	0.743575	0.514862	1.44	0.1489	Intercept
share	1	1.818404	2.662317	0.68	0.4947	
lagebtda	1	-0.00012	0.008456	-0.01	0.9890	
time82	1	-1.69616	2.192343	-0.77	0.4392	
time84	1	-1.19226	1.577562	-0.76	0.4499	
time86	1	-0.89343	0.961521	-0.93	0.3529	
time88	1	-1.12917	0.840852	-1.34	0.1795	
time90	1	-1.07977	0.695107	-1.55	0.1205	
time92	1	-0.82693	0.487856	-1.70	0.0903	
time94	1	-0.10897	0.553394	-0.20	0.8439	
time96	1	-1.00204	0.494084	-2.03	0.0427	
time98	1	-0.24651	0.474292	-0.52	0.6033	

Obs	_MODEL_	_DEPVAR_	_SIGMA_	Intercept	difIcon	lagebtda	time82	time84
1	CONCENT	share	2.241	-0.4089	.	.	0.934	0.656
2	PROFIT	ebtda	347.409	60.0669	-52.2047	.	-337.591	-243.071
3	ADVERT	advsal	4.077	0.7436	.	-.000116383	-1.696	-1.192

time86	time88	time90	time92	time94	time96	time98	share	ebtda	advsal
0.492	0.621	0.5936	0.4545	0.05977	0.5504	0.1356	-1.000	0.00031	0.54974
-136.137	-112.676	-85.8091	-34.0118	9.62760	12.9511	17.8690	421.133	-1.00000	.
-0.893	-1.129	-1.0798	-0.8269	-0.10897	-1.0020	-0.2465	1.818	.	-1.00000

Table 18: OLS Estimation of the Advertising Equation
Pharmaceutical Industry

The REG Procedure
Model: m3
Dependent Variable: advsal VAR40

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	11	139.77969	12.70724	0.90	0.5400
Error	1370	19349	14.12336		
Corrected Total	1381	19489			

Root MSE	3.75811	R-Square	0.0072
Dependent Mean	0.06823	Adj R-Sq	-0.0008
Coeff Var	5508.30920		

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	Intercept	1	0.79027	0.36246	2.18	0.0294
share		1	0.01634	0.11791	0.14	0.8898
lagebtda		1	-0.00281	0.00941	-0.30	0.7651
time82		1	-0.58093	0.64693	-0.90	0.3694
time84		1	-0.44119	0.50344	-0.88	0.3810
time86		1	-0.60745	0.47370	-1.28	0.1999
time88		1	-0.91635	0.46061	-1.99	0.0469
time90		1	-1.02471	0.44979	-2.28	0.0229
time92		1	-1.01153	0.44691	-2.26	0.0238
time94		1	-0.53507	0.55471	-0.96	0.3349
time96		1	-1.06193	0.50186	-2.12	0.0345
time98		1	-0.46979	0.46463	-1.01	0.3121

Table 19: Simultaneous Equations Estimation
Pharmaceutical Industry

The SYSLIN Procedure
Full-Information Maximum Likelihood Estimation

NOTE: Convergence criterion met at iteration 0.

Model	SHARE
Dependent Variable	share
Label	

Parameter Variable	DF	Estimate	Standard Error	t Value	Pr > |t|	Label
Intercept	1	-0.41740	1.790568	-0.23	0.8157	Intercept
ebtda	1	0.888563	5.181083	0.17	0.8639	VAR2
lagebtda	1	-0.18288	1.069400	-0.17	0.8642	
time82	1	3.306529	14.77259	0.22	0.8229	
time84	1	1.798650	7.299568	0.25	0.8054	
time86	1	1.205678	5.299437	0.23	0.8201	
time88	1	0.486433	1.640093	0.30	0.7668	
time90	1	0.150982	1.027217	0.15	0.8832	
time92	1	-0.40933	2.969215	-0.14	0.8904	
time94	1	-0.39541	2.455408	-0.16	0.8721	
time96	1	-1.39658	8.013171	-0.17	0.8617	
time98	1	0.136104	1.467069	0.09	0.9261	

Table 19: Simultaneous Equations Estimation
Pharmaceutical Industry

The SYSLIN Procedure
Full-Information Maximum Likelihood Estimation

Model	EBTDA
Dependent Variable	ebtda
Label	VAR2

Parameter Variable	DF	Standard Estimate	Error	t Value	Pr > |t|	Variable Label
Intercept	1	60.06716	207.2381	0.29	0.7720	Intercept
share	1	421.1339	1451.965	0.29	0.7718	
difIcon	1	-52.2109	182.7790	-0.29	0.7752	
time82	1	-337.592	1154.049	-0.29	0.7699	
time84	1	-243.072	834.1679	-0.29	0.7708	
time86	1	-136.138	466.2218	-0.29	0.7703	
time88	1	-112.676	387.5888	-0.29	0.7713	
time90	1	-85.8096	297.7954	-0.29	0.7733	
time92	1	-34.0125	124.0575	-0.27	0.7840	
time94	1	9.627321	57.23712	0.17	0.8664	
time96	1	12.95077	56.64227	0.23	0.8192	
time98	1	17.86881	73.85942	0.24	0.8089	

Obs	_SIGMA_	Intercept	difIcon	lagebtda	time82	time84
1	8.930	-0.4174	.	-0.18288	3.307	1.799
2	347.410	60.0672	-52.2109	.	-337.592	-243.072

time86	time88	time90	time92	time94	time96	time98	share	ebtda
1.206	0.486	0.1510	-0.4093	-0.39541	-1.3966	0.1361	-1.000	0.88856
-136.138	-112.676	-85.8096	-34.0125	9.62732	12.9508	17.8688	421.134	-1.00000

Table 20: Simultaneous Equation Estimation of the Relationship between Advertising and Profits Pharmaceutical Industry

The SYSLIN Procedure
Full-Information Maximum Likelihood Estimation

NOTE: Convergence criterion met at iteration 0.

Model	ADVERTIS
Dependent Variable	advsal
Label	VAR40

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variable Label
Intercept	1	1.310010	1.378796	0.95	0.3422	Intercept
ebtda	1	1.386987	0.482069	2.88	0.0041	VAR2
lagebtda	1	-0.40824	0.145332	-2.81	0.0050	
time82	1	0.195765	2.428227	0.08	0.9358	
time84	1	-0.30563	1.881444	-0.16	0.8710	
time86	1	-0.85268	1.783533	-0.48	0.6327	
time88	1	-1.66100	1.753592	-0.95	0.3437	
time90	1	-1.72846	1.713411	-1.01	0.3133	
time92	1	-2.80464	1.799307	-1.56	0.1193	
time94	1	-1.89642	2.148591	-0.88	0.3776	
time96	1	-3.57382	2.087307	-1.71	0.0871	
time98	1	-0.52271	1.755491	-0.30	0.7659	

Table 20: Simultaneous Equation Estimation of the Relationship between Advertising and Profits Pharmaceutical Industry

The SYSLIN Procedure
Full-Information Maximum Likelihood Estimation

Model	EBTDA
Dependent Variable	ebtda
Label	VAR2

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variable Label
Intercept	1	-17.4831	14.55786	-1.20	0.2300	Intercept
advsal	1	22.74927	15.86387	1.43	0.1518	VAR40
lagad	1	-6.85761	4.879909	-1.41	0.1602	
time82	1	13.22360	17.41956	0.76	0.4479	
time84	1	9.926321	13.31891	0.75	0.4562	
time86	1	15.18170	15.13896	1.00	0.3161	
time88	1	19.71808	17.22071	1.15	0.2524	
time90	1	20.68127	17.32764	1.19	0.2329	
time92	1	22.79687	18.23560	1.25	0.2115	
time94	1	16.50158	16.72831	0.99	0.3241	
time96	1	24.66586	19.11450	1.29	0.1971	
time98	1	10.02437	12.43806	0.81	0.4204	

Table 20: Simultaneous Equation Estimation of the Relationship between Advertising and Profits Pharmaceutical Industry

Obs	_MODEL_	_DEPVAR_	_SIGMA_	Intercept	lagad	lagebtda	time82	time84
1	ADVERTIS	advsal	14.2611	1.3100	.	-0.40824	0.1958	-0.30563
2	EBTDA	ebtda	84.0444	-17.4831	-6.85761	.	13.2236	9.92632

time86	time88	time90	time92	time94	time96	time98	advsal	ebtda
-0.8527	-1.6610	-1.7285	-2.8046	-1.8964	-3.5738	-0.5227	-1.0000	1.38699
15.1817	19.7181	20.6813	22.7969	16.5016	24.6659	10.0244	22.7493	-1.00000

Appendix 2 to Chapter III: Identification of the System Presented in § 3.7

The purpose of Appendix A is to determine whether the following system is identified:

$$\begin{cases} Share = \alpha_0 + \alpha_1 * \dfrac{\pi}{S} + \alpha_2 * \dfrac{Adv}{S} \\ \dfrac{\pi}{S} = \beta_0 + \beta_1 * Share + \beta_2 * \Delta Share \\ \dfrac{Adv}{S} = \gamma_0 + \gamma_1 * Share + \gamma_2 * \Delta\dfrac{\pi}{S} \end{cases} \qquad (1)$$

Every general linear simultaneous equation can be rewritten as

$$\mathbf{B}\, y_t + \mathbf{C}\, x_t = u_t \qquad t = 1, \ldots, n \qquad (2)$$

Where **B** is a G X G matrix of coefficients of current endogenous variables, **C** is a G X K matrix of coefficients of predetermined variables, and $\mathbf{y_t}$, $\mathbf{x_t}$, and $\mathbf{u_t}$ are column vectors of G, K, and G elements, respectively:

$$\begin{array}{lllll} Share & -\dfrac{\pi}{S} & -\dfrac{Adv}{S} & -SS & = u_{1t} \\ -Share & \dfrac{\pi}{S} & & -SS \quad -\Delta Share & = u_{2t} \\ -Share & & \dfrac{Adv}{S} & -SS \quad -\Delta\dfrac{\pi}{S} & = u_{3t} \end{array} \qquad (3)$$

with

$$B = \begin{bmatrix} \beta_{11} & \beta_{12} & \beta_{13} \\ \beta_{21} & \beta_{22} & 0 \\ \beta_{31} & 0 & \beta_{33} \end{bmatrix} \qquad C = \begin{bmatrix} 0 & 0 \\ \gamma_{21} & 0 \\ 0 & \gamma_{32} \end{bmatrix}$$

$$y_t = \begin{bmatrix} Share \\ \dfrac{\pi}{S} \\ \dfrac{Adv}{S} \end{bmatrix} \qquad x_t = \begin{bmatrix} \Delta Share \\ \Delta\dfrac{\pi}{S} \end{bmatrix} \qquad u_t = \begin{bmatrix} u_{1t} \\ u_{2t} \\ u_{3t} \end{bmatrix}$$

In our case, G is equal to three and K to two. The system of equations presented in (2) can also be expressed as

$$Az_t = \begin{bmatrix} B & C \end{bmatrix} \begin{bmatrix} y_t \\ x_t \end{bmatrix} = u_t \qquad (4)$$

where A is the G X (G + K) matrix of all structural coefficients and z_t is the (G + K)X 1 vector of observations on all variables at time t. Each equation of the system can be written as

$$\alpha_i z_t = u_{it} \qquad (5)$$

where i represents the number of the equation selected from the system, or the i^{th} row of A. The restrictions on each equation can then be written as:

$$\alpha_i \Phi = 0 \qquad (6)$$

The Φ matrix has G + K rows and a column for each a priori restriction on the first equation. In addition to the restrictions from (6) there will also be restrictions on α_i arising from the relationship between structural and reduced form coefficients.

In order to determine if the system of equation is identified, we express (2) in its reduced form:

$$y_t = \prod x_t + v_t \qquad (7)$$

where $\prod = -B^{-1}C \qquad v_t = B^{-1}u_t \qquad (8)$

from (5) we can rewrite $B\prod + C = 0$

or $AW = 0$

where $W = \begin{bmatrix} \Pi \\ I_5 \end{bmatrix} \qquad (9)$

each equation of the system can be obtained from (9) as

$$\alpha_i W = 0 \qquad (10)$$

Combining (6) and (10) we have:

$$\alpha_i \begin{bmatrix} \Phi & W \end{bmatrix} = 0 \qquad (11)$$

which represents the complete set of restrictions. There are G + K unknown in α_i. The matrix [W Φ] is of order (G + K) X (K + R), where R is the number of columns in Φ. On the assumption that Π is known, all the elements in [W Φ] are known. Thus, equation (11) constitutes a set of K + R equations in G + K unknowns. Identification of the first equation requires that the rank of [W Φ] be G + K −1, so that all the solutions to (11) will lie on a single ray through the origin To summarize, identification of equation i of the system of simultaneous equations requires

$$\rho\,[W\ \Phi] = G + K - 1 \tag{12}$$

By applying this methodology to our system of equations we have:

$$\Phi_1 = \begin{bmatrix} 0 & 0 \\ 0 & 0 \\ 0 & 0 \\ 1 & 0 \\ 0 & 1 \end{bmatrix} \quad \Phi_2 = \begin{bmatrix} 0 & 0 \\ 0 & 0 \\ 1 & 0 \\ 0 & 0 \\ 0 & 1 \end{bmatrix} \quad \Phi_3 = \begin{bmatrix} 0 & 0 \\ 1 & 0 \\ 0 & 0 \\ 0 & 1 \\ 0 & 0 \end{bmatrix} \tag{13}$$

To compute B^{-1}, let's call the determinant of the matrix B as D_B. Therefore

$$B^{-1} = \frac{1}{D_B}\begin{bmatrix} \beta_{22}\beta_{33} & -\beta_{21}\beta_{33} & -\beta_{31}\beta_{22} \\ -\beta_{12}\beta_{33} & \beta_{11}\beta_{33} - \beta_{31}\beta_{13} & \beta_{31}\beta_{12} \\ -\beta_{22}\beta_{13} & \beta_{21}\beta_{13} & \beta_{11}\beta_{22} - \beta_{21}\beta_{12} \end{bmatrix} \tag{14}$$

and Π is obtained from equation (8) and simplified as follows:

$$\Pi = -B^{-1}C = -\frac{1}{D_B}\begin{bmatrix} -\gamma_{22}\beta_{21}\beta_{33} & -\beta_{31}\beta_{22}\gamma_{33} \\ \gamma_{22}(\beta_{11}\beta_{33} - \beta_{31}\beta_{13}) & \beta_{31}\beta_{12}\gamma_{33} \\ \beta_{21}\beta_{13}\gamma_{31} & \gamma_{33}(\beta_{11}\beta_{21} - \beta_{21}\beta_{12}) \end{bmatrix} \tag{15}$$

To verify the identification of each equation of the system, we obtain W by vertically concatenating Π with an identity matrix and we concatenate horizontally W with each of the matrices in (13) and we determine the rank of the resulting matrix.

Identification of the first equation of (1):

$$[W \quad \Phi_1] = \begin{bmatrix} -\gamma_{22}\beta_{21}\beta_{33} & -\beta_{31}\beta_{22}\gamma_{33} & 0 & 0 \\ \gamma_{22}(\beta_{11}\beta_{33} - \beta_{31}\beta_{13}) & \gamma_{32}\beta_{31}\beta_{12} & 0 & 0 \\ \gamma_{21}\beta_{21}\beta_{13} & \gamma_{33}(\beta_{11}\beta_{21} - \beta_{21}\beta_{12}) & 0 & 0 \\ 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \end{bmatrix} \tag{16}$$

The matrix in (16) has rank 4, which corresponds to (G+K-1) and therefore the first equation of (1) is exactly identified.

Identification of the second equation of (1):

$$[W \quad \Phi_2] = \begin{bmatrix} -\gamma_{22}\beta_{21}\beta_{33} & -\beta_{31}\beta_{22}\gamma_{33} & 0 & 0 \\ \gamma_{22}(\beta_{11}\beta_{33} - \beta_{31}\beta_{13}) & \gamma_{32}\beta_{31}\beta_{12} & 0 & 0 \\ \gamma_{21}\beta_{21}\beta_{13} & \gamma_{33}(\beta_{11}\beta_{21} - \beta_{21}\beta_{12}) & 1 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 \end{bmatrix} \qquad (17)$$

The matrix in (17) has rank 4, which corresponds to (G+K-1) and therefore the first equation of (1) is exactly identified.

Identification of the third equation of (1):

$$[W \quad \Phi_3] = \begin{bmatrix} -\gamma_{22}\beta_{21}\beta_{33} & -\beta_{31}\beta_{22}\gamma_{33} & 0 & 0 \\ \gamma_{22}(\beta_{11}\beta_{33} - \beta_{31}\beta_{13}) & \gamma_{32}\beta_{31}\beta_{12} & 1 & 0 \\ \gamma_{21}\beta_{21}\beta_{13} & \gamma_{33}(\beta_{11}\beta_{21} - \beta_{21}\beta_{12}) & 0 & 0 \\ 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 \end{bmatrix} \qquad (18)$$

The matrix in (18) has rank 4, which corresponds to (G+K-1) and therefore the first equation of (1) is exactly identified.

ABSTRACT

The majority of studies presented in the literature have been performed across all industries. Few studies focused on the cereal or sugar industries are too specific to produce general results. Based on the existing research there is a wide range of studies for which the results cannot be applied to specific industries; or there are very specific industry studies that are initiated to explain a characteristic of an industry, and that cannot be generalized. In addition, studies generally focus on one year or, at most, on the change between two years. This does not take into consideration the fact that industries evolve over time and that the interaction between advertising, concentration and profitability requires time lags to show its effects. The characteristics of these studies and of the data employed affect our ability to extend the results obtained in these studies to other industries or over time.

This dissertation investigates the relationship between advertising, concentration and profitability in the U.S. manufacturing industry. The analysis focuses on the U.S. manufacturing industry at the two-digit SIC code level over the period 1963-1997. The same analysis is performed using public companies operating in the automotive and pharmaceutical sectors over the period 1980-2000 focusing on the automotive and the pharmaceutical sectors.

The results from the estimation and the indications from the Granger causality test confirm the existence of a rich pattern of relationship between the three variables in levels, first differences or lags. Advertising appears to be determined by the interaction of profitability and concentration, whether these two variables interact and influence each other simultaneously. The analysis performed at the single industry level indicates that there is not sufficient variability to clearly identify the direction of causality between advertising, concentration and profitability.

VITA

Luca Bonardi, son of Silvia and Valerio Bonardi, was born on August 30, 1972 in Iseo (BS), Italy. In 1996 he obtained a graduate degree in Economics from University of Brescia, in Italy, where he presented the thesis "Econometric Models for the Terms Structure of Interest Rates." In 1997 he entered the Ph.D. program at Fordham University and in February 1998 he received a Master of Arts in Economics.

From October 1998 he worked for Arthur Andersen, Economic Analysis Group. His experience ranges from the performance of compliance studies for major industrial multinationals to projects aimed at identifying the optimal allocation of intangible assets.