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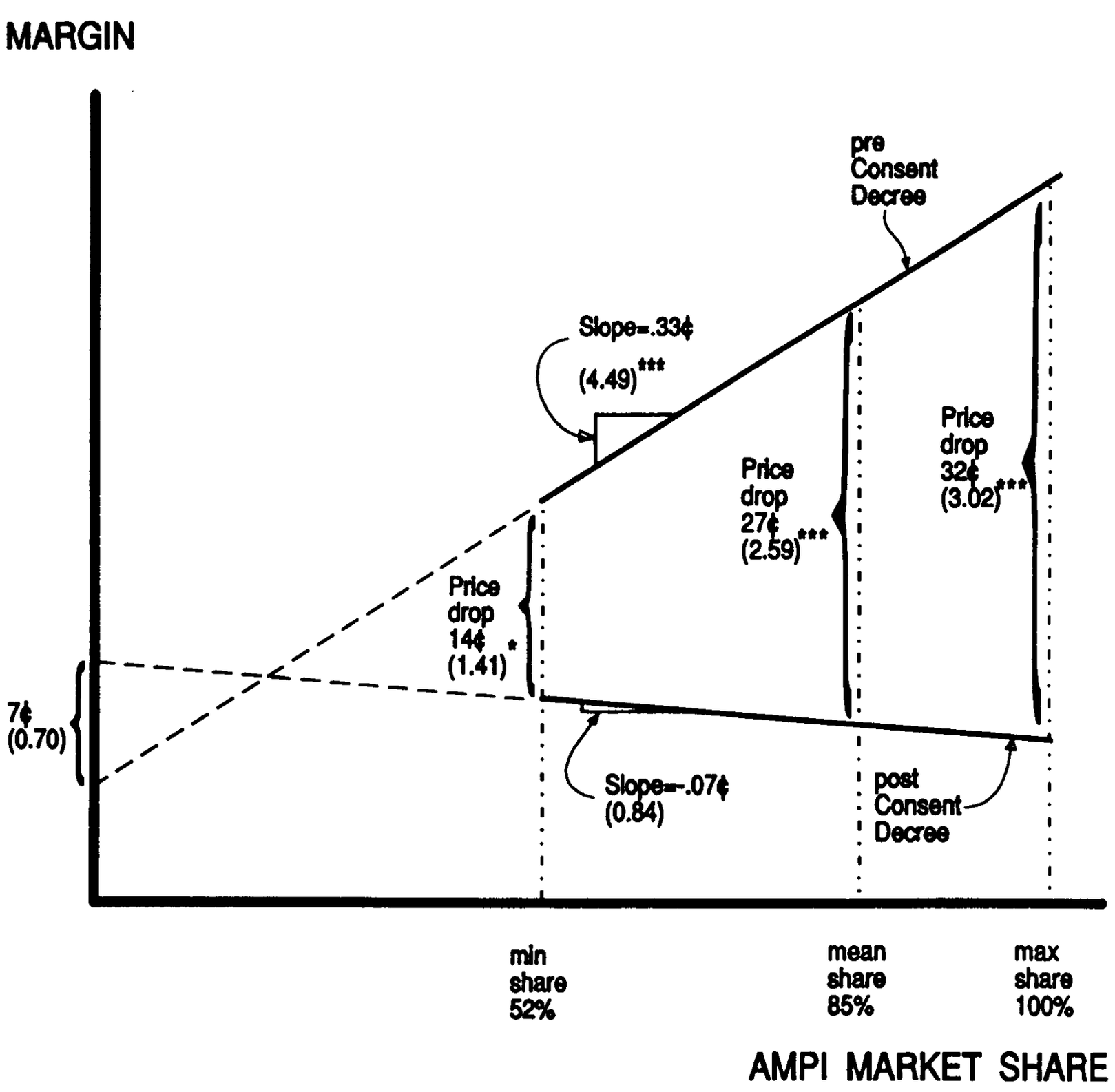
FIGURE 1.—AMPI MARGINS



Note: *t*-values in ( )'s, * = 10%; *** = 1%.

COOPERATION FOR MONOPOLIZATION? AN EMPIRICAL ANALYSIS OF CARTELIZATION

Ananth N. Madhavan, Robert T. Masson, and William H. Lesser*

Abstract—This paper examines the ability of a large numbers cartel to raise price–cost margins. The cartel in question is a dairy cooperative, Associated Milk Producers, Inc. (AMPI), with more than 30,000 members. We develop a model of spatial limit pricing that we test using the method of Seemingly Unrelated Regressions, adjusting for serial correlation. Our results suggest that the cartel successfully obtained and used market power and that its power was proportional to its market share. In contrast, after an antitrust consent decree, margins fell significiantly and were no longer related to market shares. These results are robust under both pooled and market fixed effects analysis.

I. Introduction

SOME economists find it unlikely that large numbers of sellers could unite to effectively raise prices. Stigler (1966) states: "In general, the cartel becomes feasible only if the number of firms is not very large, and (what is then usually the case) a few firms are so large relative to the industry that they cannot individually abstain from the cartel or it will not be formed." Recent theoretical analysis, however, suggests this intuition may fail. In the later models, firms consider the possibility that cheating may destabilize price agreements or lead to retaliation. Green (1980) finds cooperation when the number of firms increases without bound while Harrington (1989) finds a similar result when entry is "almost" free.[1]

This paper examines empirically the price-setting behavior of a large numbers cartel, Associated Milk Producers, Inc. (AMPI), a cooperative with more than 30,000 members.[2] AMPI consolidated power during the 1960s through numerous mergers; it allegedly gained power through predation and exclusion, inviting both private and U.S. Department of Justice (DOJ) antitrust suits.[3] The DOJ case was settled in 1975 by a consent decree under which AMPI agreed to desist from specific "predatory and exclusionary" practices and to provide other remedial relief, such as temporarily altering farmer contract terms (e.g., membership termination provisions). AMPI also lost that part of the major private case charging *conspiracy to monopolize*.

The AMPI case provides a unique opportunity to examine whether a large numbers cartel can possess and exercise market power. In particular, certain special characteristics of the industry allow us to create an economically relevant measure of price–cost margins for milk. Furthermore, it is easy to define economically relevant geographic markets. Finally, because the consent decree took effect during our sample period, we can analyze whether a behavioral agreement can successfully reduce a cartel's market power.

We develop a model of spatial limit pricing to exploit the unique nature of our data and test for market power in 14 AMPI markets during the period 1972–1980.[4] We find that in the period before the consent decree (1972–April 1975), our measure of the effective price–cost margin (which we explain in detail below) averaged 33¢, whereas after the decree (May 1975–1980) it averaged only 4¢.[5] From the formation of AMPI until the effective date of the consent decree, it appears that market power kept margins well above competitive levels in most markets.[6] Of particular interest is the observation that the extent of AMPI's substantial and sustained departures from

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[1] Harrington models "punishment" of defectors whereas Green models non-cooperative behavior following defection. These models do not require enforceable cartel contracts.

[2] Individual markets in which AMPI operated were atomistic at the farmer level. For example, in October, 1968 AMPI had 1,264 members in Oklahoma competing with 174 independent rivals (non-members of any cooperative). Note that each individual farmer is presumed to have decreasing returns to scale in the range of current output.

[3] Cooperatives, including AMPI, play[ed] numerous positive roles as well.

[4] These are all of the AMPI southern region "markets" for which a complete data series can be constructed. The markets were all Federal Milk Marketing Order markets, which will be explained later.

[5] Excluding the last half of 1975, post-consent decree margins averaged −1¢.

[6] The exceptions are three non-price control months and slightly over a year under price controls.

competitive pricing was directly related to its share across markets and through time. Following the consent decree, margins fell more than 85% on average and market share no longer explained margins across markets. Our results are unaffected when we extend the analysis by estimating a fixed effects model to allow for market-specific factors.

The paper goes from a brief summary of the relevant institutional details in section II, to a spatial limit pricing model in section III. Our primary results are presented in section IV. Section V considers supplementary statistical evidence, and section VI concludes.

II. The Historical Background

Certain institutional features of the milk industry are important to understanding our data and methodology. The Capper-Volstead Act grants agricultural cooperatives an antitrust exemption.[7] The act permits farmers to cartelize but does not allow "predation or exclusion."[8] Milk cooperatives do not dictate member output but may exercise market power. Farmer monopoly rents may be achieved by restricting the supply of milk for fluid use, called "Class I use," while directing the remainder to manufacturing, "Class II" use (butter, cheese, and ice cream).[9] Because the demand for fluid milk is inelastic and the demand for manufacturing products is elastic, this type of diversion can raise the average revenue obtained for a given supply. Unless supply is perfectly elastic, this strategy can increase the rents of members (see, e.g., Ippolito and Masson, 1978), providing a strong incentive for forming a cartel.

AMPI's beginning dates to August 1967, when six cooperatives merged to form Milk Producers, Inc. (MPI). By the end of the year, following other mergers, MPI had become what was soon to be AMPI's Southern Region. (AMPI's Southern Region covered part of Tennessee, Arkansas, Kansas, Oklahoma and Texas; individual market areas are named in the tables that present empirical results.[10]) AMPI itself was formed in October 1969, when MPI merged with PMA, a cooperative located in Wisconsin, Illinois and Indiana. Also in the late 1960s, two other giant milk cooperatives, Mid-America Dairymen (Mid-Am) and Dairyman, Inc. (DI), were formed through several mergers of smaller cooperatives. Mid-Am controlled much of the milk to the north of AMPI's Southern region in Minnesota, Iowa, Kansas and Missouri, and DI controlled much of the milk to its east, in Kentucky, Tennessee, Mississippi and Georgia. In many markets one of these cooperatives controlled more than 90% of the sales of raw milk.[11] In 1982, well after the litigation, AMPI, Mid-Am and DI had *Fortune 500* sales ranks of 151, 255 and 266, respectively.[12] A stated purpose of the mergers that formed these cooperatives was the attainment of market power.

These three cooperatives, along with other cooperatives in the Midwest and South, had mutual agreements not to compete that were complemented by a side-payment agreement known as the "Standby Pool."[13] Under this latter arrangement, farmers in milk surplus areas in upper Minnesota and Wisconsin were paid by farmers in the allied cooperatives not to ship milk into

[7] Without such an exemption, farmers shipping product in a single tanker might be guilty of "price fixing" if they agreed upon the price at which to sell their product. The exemption authorizes cooperative sales. Caves and Petersen (1986) find that cooperatives hold larger shares in processing those crops or products for which free-riding is easiest to control.

[8] Jacquemin and de Jong (1977) state: "Cartels, according to a classic definition by Liefmann, represent 'the contractual cooperation of independent companies in similar activities with the goal to influence the market in a monopolistic way.'" Fellner (1949) defines them as explicit agreements (more effective if contractual), citing the U.S. agricultural antitrust exemption as permitting cartels.

[9] Models of milk cooperative pricing power are reviewed in Gardner et al. (1986). Countervailing "bargaining power" was a goal of the Capper-Volstead Act, but there were limits implied (Baumer, Masson and Masson 1986).

[10] Mergers also created AMPI's more northerly divisions in Illinois and Wisconsin.

[11] By markets we mean Federal Milk Order Markets. Milk processors in a federally defined milk order market face regulatory barriers when buying milk from other markets. One form of barrier works by buyers paying a fee for "other source" milk which is refunded, prorata, to the local producers. If the producers are members of a cooperative, the refund goes to the cooperative. Since the refund is proportional to market share, a dominant cooperative, when importing, receives almost all of the fee back. Hence, if a market is defined by where *buyers* can turn to obtain supplies *other than* those of the dominant cooperative, federal order markets are close approximations of economic markets.

[12] AMPI and DI were on the services list; these are their equivalent 500 sales ranks (*Fortune* May 2 and June 13, 1983).

[13] Standby Pool member cooperatives had options on milk in the North and exclusive sales areas for the optioned milk elsewhere. The exclusive agreements were said to effectuate the efficient use of the optioned reserve supply. Eisenstat, Masson and Roddy (1974) and Cook (1970) discuss these option contracts in the context of being a mechanism to attain greater bargaining power.

their markets unless asked to do so by a member. By 1972, there were 17 Standby Pool member cooperatives, covering a good deal of the milk production within a region that extended from the Dakota's through Michigan, Ohio, western Pennsylvania, Virginia, the Carolinas, Florida, Mississippi, Texas, New Mexico, Kansas, and Nebraska. The markets covered by these intercooperative agreements were "Standby Pool member" markets.

The Standby Pool was initially implemented on September 1, 1967, immediately following the formation of MPI. Cook (1970), an architect of the Standby Pool, refers to it as a "strategic bargaining device" and attributes its formation and the creation of MPI to the desire for market power.

It is possible to create an economically sensible metric of the market power resulting from these mergers and intercooperative agreements by using certain industry-specific features of milk pricing. Before the formation of MPI, farmers received a single federally regulated "blend" price (i.e., a weighted average of federally regulated *minimum* Class I and Class II prices for all raw milk) regardless whether the milk was destined for fluid consumption or for manufacturing. In September 1967, the newly created MPI demanded a premium of 50¢ per cwt. (cwt. represents a hundred pounds, or approximately 11.5 gallons) above the federally regulated minimum Class I price for milk designated for fluid use. MPI settled for the regulated minimum Class II price, however, for milk destined for nonfluid products (e.g., ice cream, cheese) even if it was commingled in the same tanker load with milk destined for fluid use. Under this new MPI pricing schedule the net price to the farmer was the regulated blend price plus 50¢ for Class I milk and simply the blend price for Class II milk. For milk commingled on a single tanker, the farmers received different prices depending upon its post delivery use, as chosen by the buyer. The blend price represents the opportunity cost of milk for the farmer. Thus, the difference between the fluid milk price and the blend price can be used to construct a price–cost margin for milk for each of the 14 geographic markets in our sample over the relevant time horizon.

MPI's attempt to raise price–cost margins proved highly successful. On September 1, 1967 MPI's price–cost margin (measured by the elevation of the farmers' net price for fluid sales above that for manufacturing sales) went from 0¢ in all 12 of the 14 study markets for which data exist to a mean of 44.5¢ and standard deviation of 4.14¢. The U.S. Department of Agriculture's Capper-Volstead Committee (1976) puts the regional margins at 1¢ in calendar year 1966, 20¢ in 1967, and 50¢, 50¢, and 49¢ for the years 1968–1970, respectively.

DOJ policy was that cooperative mergers, agreements, and prices achieved by voluntary action were exempt from antitrust actions. However, the DOJ challenged AMPI's (as well as Mid-Am's and DI's) treatment of nonmember and defector farmers, alleging predatory pricing, price squeezes, and foreclosure of nonmembers from customers through contracts and mergers with nonfarmer milk processors. The evidence the DOJ amassed about AMPI's power is summarized in Eisenstat, Masson and Roddy (1974) (EM & R)[14] and discussed in Fones, Hall and Masson (1977). (The hypothesis that milk cooperatives could have any market power has been questioned.[15] Our results rebut the no-power hypothesis.[16]) The DOJ sued these three large cooperatives in 1972 and signed consent decrees with AMPI (1975) and Mid-Am (1977). The suit against DI went to trial in 1976 and was resolved, partially in the DOJ's favor, in 1985.

[14] A summary of DOJ's evidence with an economic narrative [EM & R] was released "...at this Court's request...[it] is literally three inches thick and was made available to anyone... [and] has fully acquainted the Court with the government's economic rationale." [*U.S. v. Associated Milk Producers, Inc.* 394 F. Supp. 29 (W.D. Mo. 1975), *aff'd*, 534 F.2d 113 (8th Cir.), *cert. denied*, 429 U.S. 940 (1976).] AMPI maintains EM & R mischaracterized the evidence.

[15] Gardner et al. (1986) review the theory and cite to a refutation of the power hypothesis (attributed to Ippolito-Masson) using data from the same time period, but wider in geographic scope and unavailable to us. The empirical refutation mischaracterizes our hypothesis, testing *Class I premium levels* rather than a *Law of One Price* hypothesis (detailed below) based upon the *additional* net to farmer premium received for Class I relative to tanker load commingled Class II milk. The General Accounting Office (1990) [hereinafter GAO], rely upon Gardner et al. and reviewed additional tests (also using only Class I premium levels) critical of our hypothesis.

[16] Finding some market power does not imply that the cartel had what would legally be deemed to be "monopoly power," and AMPI was not found to have monopoly power in the private antitrust suit.

This paper is not about antitrust allegations[17] nor about whether prices were in any sense "too high."[18] Rather, we use statistical evidence to infer that a large numbers cartel succeeded in effectively elevating prices. Our data are drawn from the 14 geographic markets in AMPI's southern region for the period 1972–1980.[19] These data are of particular interest for two reasons: (1) AMPI had a near monopoly in this area (AMPI's mean market share in the area was 91% in 1971), and (2) the data cover the period around the time the consent decree took effect. We go on by developing a model of spatial limit pricing which exploits the structure of regulated milk pricing. We then use the model to assess the ability of AMPI to elevate price–cost margins and analyze the main determinants of market power, both across markets and over time. Finally, the model provides a way to examine the effect of the consent decree on price–cost margins. We turn now to the model.

III. A Model of Cartel Prices

The intuition for the model is drawn from *The Law of One Price* (hereinafter the Law), which states that for units of an "... identical good, ... [one price] is indeed a logical consequence of economic rationality and competitive markets." (Caves, Frankel and Jones, 1990). The Law implies that with competition, a farmer must receive only one price regardless of final use. Our tests are based upon prices farmers received for milk "commingled" in a single tanker load that was sorted into use class after delivery. With these prices, we can define a price–cost margin based on the recognition that the price received for Class II sales serves as an opportunity cost for a Class I sale. This metric for market power may be affected by other variables as well. The next subsection presents some theory to help understand this margin and "control variables," other than market power and litigation variables, which may affect this margin across time and space.

A. *Some Theoretical Relationships*

Our model is based on spatial limit pricing where prices are set to avoid losing sales to imports from other markets.[20] We first distinguish the average revenue or "blend price" the farmer receives from the price the buyer pays. Clearly if farmers are competitive, they will receive but one price. Minimum prices for Class I and Class II milk are set by the federal government. Let PI_i and PII_i denote the Class I and Class II prices, respectively, for market i. In addition, farmers may receive premiums above these prices. The regulated minimum prices are set such that $PI_i > PII_i$ for area i. The Class II price, PII_i, is approximately equal across markets, because manufactured products can be easily shipped between markets and the government price support system stands ready to buy butter, milk powder, and cheese at fixed prices.

In each market the regulated Class I and Class II revenues are "pooled"[21] and each farmer (or cooperative) receives a regulated "blend price." The blend price, denoted by PB_i, is the average price prevailing in market i, and is given by the formula

$$PB_i = PII_i + (PI_i - PII_i) * UTILIZATION_i,$$

where $UTILIZATION_i$ represents the Class I utilization, i.e., the amount of fluid milk as a percentage of total production. Formally, we define $UTILIZATION_i \equiv QI_i/(QI_i + QII_i)$, where QI_i and QII_i are, respectively, the quantities of

[17] In *Alexander v. Nat'l Farmers Organization*, 687 F.2d 1173 the 8th circuit finds AMPI (and Mid-Am) to have entered into a conspiracy to monopolize: "... the defendants do not seriously dispute, nor could they on this record, that they acted in concert with the intent to eliminate competition and gain sufficient control of milk to enable them to set higher prices... [and the record] reveals straightforward admission of predatory motive by various AMPI officials and former officials." But AMPI was not found to have monopolized—having attained sufficient unilateral monopoly power.

[18] Pre consent decree margins were a little over 5% of price, not high by absolute standards. Post-consent Decree margins are close to zero. Such changes are not considered negligible in antitrust merger analysis (cf., Department of Justice Merger Guidelines), but may not rise to some legal standard of "monopoly power."

[19] Two of AMPI's Southern Region markets were excluded because of incomplete data. Individual market names and shares are reported in table 5.

[20] For example, in designing the Standby Pool, C. Farr (in 1965) simulated a southern market's "improved bargaining position," a cooperative's potential Class I price increase as a function of [payments supplementing] prices in Minnesota and Wisconsin (EM & R provides the specific documentary cites to Farr and discusses spatial factors more thoroughly).

[21] "Pools" were common before the Sherman Act (Stevens 1913). Pooling revenues by one rule, distributing by another, alters non-cooperative equilibria, enhancing profits without the necessity of dictating prices or quantities.

Class I and Class II milk in market i. Premiums above the regulated prices, ΔI_i or ΔII_i, are paid directly to the seller and are not pooled with regulated revenues. As a result, if the Class II premium is zero (i.e., $\Delta II_i = 0$), then ΔI_i represents the price–cost margin on Class I milk for any producer selling positive quantities of Class II product.

Intuitively, directing production to Class II sales nets the farmer the blend price, PB_i, whereas selling to Class I nets the blend price plus the Class I premium, i.e., $PB_i + \Delta I_i$.[22] Thus, the opportunity cost of a Class I sale is a Class II sale, so that ΔI_i represents the markup on Class I sales. If $\Delta II_i > 0$, then the margin is $M_i = \Delta I_i - \Delta II_i$. With perfect competition between farmers, $M_i = 0$ because the farmer must receive only one price regardless of final use (i.e., $PB + \Delta I = PB + \Delta II$).

A cooperative in market i may face outside competition from market j (often the closest northern market). Geographic limit pricing reflects industry characteristics.[23] Inelastic Class I demand means that without import possibilities, the monopoly price would be higher. Transport costs and regulatory barriers separate markets, but sufficiently large price differentials can induce buyers to import milk from other markets. We assume that price supports and national competition for Class II products equate Class II prices, so intermarket effects should set ΔII_i's by:

$$PII_i + \Delta II_i = PII_j + \Delta II_j. \tag{1}$$

A monopoly cooperative's objective function calls for it to maximize member returns in market i[24] by maximizing the price of Class I milk (given inelastic demand) subject to an import constraint of the price in market j plus the intermarket transfer cost, T_{ij}:

$$\text{Max}(PI_i + \Delta I_i) = PI_j + \Delta I_j + T_{ij}. \tag{2}$$

Using the definition of M_i, and equations (1) and (2):

$$\text{Max } M_i = (PI_j - PI_i) + T_{ij} + (\Delta I_j - \Delta II_j) - (PII_j - PII_i). \tag{3}$$

The empirical model follows from (3).

B. *Empirical Implementation*

We hypothesize that, before the consent decree and in markets which AMPI had a 100% market share, AMPI should function as in equation (3); after the decree, or where shares were lower, competition would dictate that AMPI would have lower margins.[25]

To carry out the tests we define a "margin" measuring the degree of violation of The Law of One Price: $M_i = \Delta I_i - \Delta II_i$. We examine how the margin is affected by market share, the consent decree, import prices, and other factors.

Equation (3) describes a general tendency rather than a continuous equilibrium. In practice, (3) is not a precise relationship but one that suggests how intermarket factors influence pricing. Looking at equation (3) in more detail, the PI_i's over our sample period were equal to a time variant number plus a time invariant market specific differential, so $PI_j - PI_i$ is time invariant and captured in the intercept or fixed effect. Transport costs T_{ij} are time variant, so a transportation cost index is in the model. Also noted in (3) is the difference in Class II prices across orders. This relationship changed once during the sample period. After the early 1970s, $PII_i = PII_j$ for all i, j. For the early part of that decade, 10 sample markets had PII's that deviated from a national norm for PII. For these markets and times we include the difference between the market's Class II price and the national norm. The influence of the margin in market j, $\Delta I_j - \Delta II_j$ in equation (3), is handled by our econometric treatment of the error structure.

To control for market conditions we also look at other factors. We include a measure of regional supplies relative to demand, the Class I utilization rate: $UTILIZATION \equiv QI/(QI + QII)$. Low utilization has uncertain effects on

[22] Additionally, since a farmer is a price-taker on Class II sales, in perfect competition, if $QII > 0$ and $\Delta II = 0$, the marginal cost of the farmer would be PB.

[23] This is more complex in practice than it is modeled here. The cost of intermarket transfers depends upon whether a supermarket is importing packaged product, or whether a fluid processor is purchasing directly from distant farmers or purchasing raw milk from a distant processor. This is discussed in Fones, Hall and Masson (1977) and in greater detail in EM & R. See also above, note 20, which discusses southern prices being set relative to northern prices.

[24] Cooperative incentives to free-ride rival markets are ignored. See EM & R for analysis of this issue.

[25] In section V we address whether AMPI lost some of its power earlier, when the antitrust investigation commenced.

M_i.[26] For example, low utilization can encourage free-riding. To see this, suppose that AMPI had a 100% share and $\Delta II_i = 0$. Then the price received as an AMPI member[27] would be $PB_i + (\Delta I_i * UTILIZATION_i)$. A defector could offer milk to a Class I buyer at $\Delta I_i - \epsilon$. With a 100% Class I milk purchaser, a defector would realize a price of $PB_t + (\Delta I_t - \epsilon)$. The gains from free-riding decrease with higher utilization. On the other hand, excess Class II milk is analogous to excess capacity. Excess capacity *may* stabilize cartel agreements, because the consequences of no agreement are more grim (cf., Brock and Scheinkman (1985) or Rotemberg and Saloner (1986)). We measure Class I utilization for the region, because AMPI, as a dominant cooperative, had wide discretion over where to manufacture its milk.[28]

Higher feed costs may influence markups, so a feed index is added.[29] The period of the analysis included the time during which agricultural products were under price controls, thus a dummy variable is added. The level of the regulated minimum price may affect demand elasticity or cartel power, so the regulated minimum Class I price level is another variable.

One function of adding several of these variables is to control for a "competitive" hypothesis; that is, unusually high premiums in 1974 and 1975 were caused by escalating feed costs, higher fuel/transport costs, low milk supplies and an "inadequate" regulated price.[30] Feed costs, transport costs, utilization rate, and the regulated Class I price may control for these alternatives. Under the perfectly competitive hypothesis, cost and other factors that may raise the level of premiums must raise both premiums, ΔI and ΔII, maintaining a zero margin.

Equation (3) suggests links between markets' prices, the margin in market i being influenced by that in market j, $\Delta I_j - \Delta II_j$. Further, shocks may influence regional price structures simultaneously, but not necessarily identically. Consequently we use Zellner's method of Seemingly Unrelated Regressions (SUR), which allows for the possibility that the error terms (which may reflect the effect of excluded variables) are correlated across markets. The model to be tested is:

$$\begin{aligned} M_{it} = {} & \{\delta_0 \text{ or } \alpha_{0i}\} + \delta_1 SHARE_{i\tau} \\ & + \delta_2 CONSENT_t \\ & + \delta_3 (CONSENT_t * SHARE_{i\tau}) \\ & + \sum_k \alpha_{ki} X_{kit} + \epsilon_{it} \end{aligned} \tag{4}$$

where

M_{it} = the difference between Class I and Class II premiums,

$SHARE_{i\tau}$ = the cooperative's percent market share at time τ, where $\tau < t$,

$CONSENT_t$ = a dummy that is 1 after the consent decree,

ϵ_{it} = a market and time-specific stochastic disturbance term.

The X_{kit}'s are the controls:

—the Class I percent utilization rate for time t in the west-south-central region,
—feed costs: the price index for 16% protein dairy feeds,
—transport costs: a seasonally adjusted price index for general freight common carriers,
—a dummy variable equal to 1 during agricultural product price controls,
—the federal milk order Class I price level in cents (at a base market),
—the difference between order i's PII_{it} and the Midwest Class II price in cents.

[26] Utilization endogeneity is low. Class I demand elasticity was about 0.2 (cf., Ippolito and Masson 1978), implying a price influence on utilization that is small relative to observed variation. Also, the utilization measure we use is regional, not market specific.

[27] Actually a member's returns should be net of membership costs and cooperatives are permitted to "reblend" revenues across markets. Both issues were important for the antitrust analysis (see EM & R), but are not addressed herein.

[28] AMPI, as a dominant cooperative, enjoyed regulatory advantages that permitted it to market Class II milk in one physical location, yet have its revenues pooled with another location. During the alleged predation in Oklahoma, milk that physically remained in Iowa, Minnesota and Wisconsin was counted *as if* in Oklahoma, lowering the Oklahoma *PB*. In June 1971 and January 1972, USDA altered regulations to make pooling of *distant* milk more costly to AMPI, to help protect non-members. However wide discretion remained *within* the region.

[29] With monopoly, higher costs generally mean lower margins. But higher margins can surface from behavioral models, utility maximization with plausible imperfections in credit or farm employment markets, or when higher costs raise prices in competitive alternative supply areas. In more concrete terms, well publicized "milk dumping" often occurs when net farmer income falls, just as labor union "militancy" is sometimes triggered by adverse macro economic conditions.

[30] Low minimum prices may lead to large competitive levels of ΔI, but with competition, $M = 0$. We test whether unusual conditions in these years influenced results in section V.

All variables vary over time, but several are the same for each market and time. The only cross market variations are in M_{it}, market $SHARE_{i\tau}$, the interaction $(CONSENT_t * SHARE_{i\tau})$, the Class II price differences, and the error term. We impose little structure on the estimation and permit region-wide variables, such as feed costs, to have different impacts across markets.[31] This is reflected in the notation, δ and α. The δ_k's are constrained to be the same across markets and the α_{ki}'s are market-specific. The model is estimated both with a common intercept and with market fixed effects. Our Generalized Least Squares estimation uses Parks' (1967) method to account for first order serial correlation within each market. Thus, our approach permits $\text{corr}\{\epsilon_{it}, \epsilon_{jt}\} \neq 0$ and $\text{corr}\{\epsilon_{it}, \epsilon_{it-1}\} \neq 0$.

The primary focus of our tests is on the constrained coefficients, δ_1, δ_2 and δ_3. The α_{ki}'s control for other factors that may affect margins. The coefficient on $SHARE_{i\tau}$, δ_1, measures the effect of increasing AMPI's market share on margins before the date of the consent decree. The coefficient on $CONSENT_t$, δ_2, measures the predicted effect of the consent decree at a market share of zero (outside the sample range). The sum $\delta_1 + \delta_3$ represents the marginal effect of increasing AMPI's share on margins after the consent decree. The share used for estimating δ_3 is the share in the December preceding the year the consent decree was signed (1975), as endogenous structural change could have been one procompetitive effect of the consent decree.[32] Finally, the interaction term $\delta_2 + \delta_3 * SHARE^0$ measures the effect of the consent decree on a market with share equal to $SHARE^0$ at $t = 0$, the time immediately preceding the consent decree (e.g., a market with a pre-consent decree share of 85% would have a price effect of $\delta_1 + \delta_3 * 85$). Each parameter is estimated twice, once without market fixed effects (i.e., an intercept of δ_0) and once with market fixed effects (where the intercept is a vector of α_{0i}'s). The former model estimates the effect of *SHARE* from both across market and across time information. The latter fixed effects model estimates only the effects of *SHARE* as it varies over time "within" a market.

TABLE 1.—CLASS I PRICE MARKUPS: MARKET POWER AND THE CONSENT DECREE

	Pooled Model	Fixed-Effect Model
INTERCEPT	48.30[c] (1.29)	(see table 2)
AMPI SHARE	0.327[a] (4.49)	0.379[a] (4.91)
CONSENT DECREE Dummy	7.006 (0.70)	9.783 (0.98)
*CONSENT * SHARE Interaction*	−0.402[a] (5.98)	−0.419[a] (6.02)
Effect of *SHARE* after *CONSENT DECREE*	−0.075 (0.84)	−0.040[c] (0.42)
Effect of *CONSENT DECREE* at Min SHARE = 52%	−13.898[c] (1.41)	−12.005 (1.24)
Effect of *CONSENT DECREE* at Mean *SHARE* = 85%	−27.164[a] (2.59)	−25.832[a] (2.53)
Effect of *CONSENT DECREE* at Max *SHARE* = 100%	−33.194[a] (3.04)	−32.117[a] (3.02)

[a] Significant at 1%.
[b] Significant at 5%.
[c] Significant at 10%.

IV. Data and Results

Our measure of the margin, M_{it}, is drawn from AMPI price announcements and USDA premium data. Market structure can be treated as a predetermined variable in a recursively identified model of the structure performance link (see Masson and Shaanan (1982), or Jeong and Masson (1990) for tests of recursive identification in structure performance modeling). For 1972–1973, $SHARE_{i\tau}$ is AMPI's 1971 year total share. For 1974, $SHARE_{i\tau}$ is AMPI's December 1973 share. For 1975 on, it is the December 1974 share.[33]

[31] Model consistency would suggest similar, albeit not identical, effects for most of these regressors for different markets. The transport variable might be expected to have differing effects across markets because the regressor only captures intertemporal variation in costs, not each individual market's distance from alternative supplies.

[32] That is, the *SHARE * CONSENT* interaction, when *CONSENT* = 1, uses *SHARE* for December 1974. Also, as expected, the decree had little effect on AMPI's shares.

[33] Less disjointed share data are not available to us. Were more share data available, we could simultaneously estimate share and margin and determine the dynamics of structural and behavioral changes. Given the available data, we use recursive identification.

TABLE 2.—CLASS I PRICE MARKUPS: CONTROL VARIABLES

Market	Fixed Effect	Utilization Rate	Feed Costs	Transport Costs	Price Control Dummy	Class I Price Level	Class II Price Difference	ρ
Central Arkansas	44.57[c] (1.25)	−0.25 (0.58)	0.55[a] (2.70)	0.32[b] (1.60)	−31.07[b] (2.43)	−0.11[a] (4.37)	n.a.	0.49
Lubbock-Plainview	64.23[b] (1.75)	−0.37 (0.84)	0.46[b] (2.25)	−0.14 (0.69)	−21.40[b] (1.62)	−0.02 (0.83)	−0.58[a] (8.70)	0.46
North Texas	114.81[a] (3.48)	−0.52[c] (1.35)	0.56[a] (3.13)	−0.10 (0.56)	−19.97[b] (1.70)	−0.11[a] (6.21)	−0.39[a] (8.62)	0.50
Central West-Texas	103.19[a] (2.81)	−0.68[b] (1.62)	0.57[a] (2.90)	−0.09 (0.44)	−18.75[b] (1.43)	−0.08[a] (3.78)	−0.49[a] (8.69)	0.54
Austin-Waco	94.37[a] (2.52)	−0.53[c] (1.25)	0.64[a] (3.19)	−0.14 (0.70)	−21.10[b] (1.59)	−0.09[a] (3.97)	−0.32[a] (5.67)	0.56
Corpus Christi	87.14[a] (2.58)	−0.60[c] (1.46)	0.25 (1.43)	-0.11 (0.60)	−17.50[b] (1.44)	−0.03[b] (1.93)	−0.26[a] (3.85)	0.43
South Texas	93.03 (2.48)	−0.62[c] (1.43)	0.63[a] (3.05)	−0.11 (0.54)	−16.68[c] (1.25)	−0.09[a] (3.72)	−0.35[a] (4.48)	0.54
San Antonio	125.71[a] (3.73)	−0.62[b] (1.57)	0.56[a] (3.07)	−0.06 (0.34)	−21.91[b] (1.82)	−0.12[a] (6.05)	−0.47[a] (9.50)	0.50
Texas Panhandle	54.20[c] (1.32)	−0.10 (0.21)	0.45[b] (1.91)	−0.23 (1.00)	−20.32[b] (1.37)	−0.01 (0.32)	−0.65[a] (6.56)	0.49
Wichita	19.19 (0.55)	−0.29 (0.68)	0.03 (0.17)	0.15 (0.75)	−21.59[a] (1.70)	0.02 (0.87)	−0.67[a] (4.93)	0.40
Fort-Smith	25.92 (0.75)	−0.23 (0.56)	0.35[b] (1.76)	0.40[b] (2.10)	−31.38[a] (2.51)	−0.08[a] (3.01)	n.a.	0.51
Memphis	33.62 (0.96)	−0.33 (0.81)	0.36[b] (1.79)	0.42[b] (2.15)	−28.64[b] (2.27)	−0.08[a] (3.08)	n.a.	0.54
Oklahoma-Metropolitan	30.37 (0.95)	−0.15 (0.41)	0.45[b] (2.49)	0.06 (0.32)	−22.58[b] (1.97)	−0.04[b] (1.92)	n.a.	0.46
Red River Valley	60.33[b] (1.95)	−0.23 (0.63)	0.37[b] (2.08)	0.31[b] (1.79)	−23.65[b] (2.12)	−0.12[a] (5.08)	−0.34[a] (2.98)	0.49

[a] Significant at 1%.
[b] Significant at 5%.
[c] Significant at 10%.

Each market has 108 monthly observations for 1972–1980. The major variables of interest, the effects of *SHARE*, *CONSENT* and their interaction (coefficients δ_1, δ_2 and δ_3) are presented in table 1. Table 2 reports the coefficients on the control variables and the fixed effect estimation.

A. Market Share, the Consent Decree and Margins

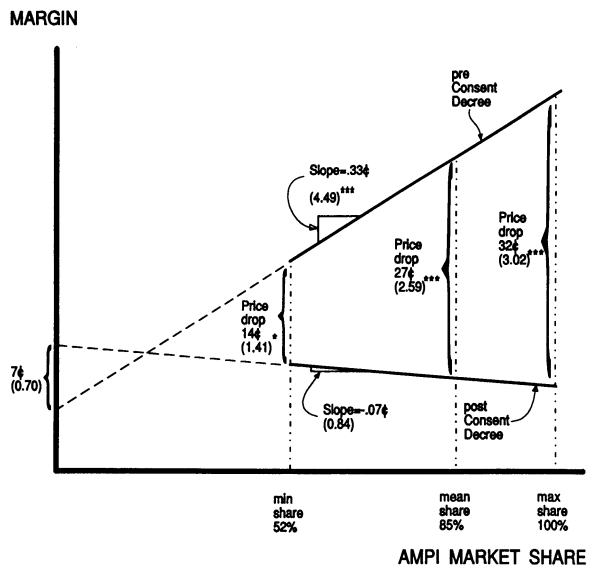
The results support the major hypotheses: (1) market share has a statistically significant effect on margins before the consent decree; (2) share is not significant after the consent decree; (3) the fall in margins following the consent decree is statistically significant.

Margins are in cents per hundred weight. Near the beginning of the sample period, regulated prices were in the zone of $6.00 and almost doubled during the period. Thus, in assessing the magnitudes of changes in margins, a decline of, say, thirty cents is a price decline of less than 5%.[34]

The results without fixed effects, called the *pooled model*, are reported in the first column of table 1, with the important elements of these

[34] A decline of 30¢ in 1975 may mean an inflation adjusted decline of 50¢ in 1980. If so, the decline would be about 5%. Importantly, as noted above, the antitrust case was not based so much upon the impact on consumers as on retaliation against rivals.

FIGURE 1.—AMPI MARGINS



Note: t-values in ( )'s, * = 10%; *** = 1%.

results illustrated in figure 1. Before the consent decree the effect of *SHARE* is positive and significant: $\delta_1 = .33$ ($t = 4.49$). The consent decree dummy is not significant and even positive, $\delta_2 = 7.0¢$ ($t = 0.70$), but the net effect of the consent decree will be shown to be negative and significant due to the interaction term, which is significant: $\delta_3 = -.04$ ($t = 5.98$).

The second and third vertical partitions of the table are derived from regression parameters, rather than simple reports of regression parameters. The t-values in these partitions are calculated from the covariance matrix of the estimated coefficients. In the second partition we report the effect of the *SHARE* variable after the consent decree took effect. This term is negative, but not significant; our estimates yield $\delta_1 + \delta_3 = -0.075$ ($t = 0.84$). Thus, after the consent decree was signed, market share was no longer a determinant of price–cost margins, which is consistent with competitive markets.

The table also includes estimates of the effect of the consent decree, measured by the term $\delta_1 + \delta_3 * SHARE^0$, at each of three $SHARE^0$'s, {52%, 85%, 100%}, representing the sample minimum, mean, and maximum, respectively, in the December preceding the consent decree. The share-weighted t-values are computed from the variance-covariance matrix of the estimated coefficients, and represent the significance of the "price drop" due to the consent decree at selected market share values. At the minimum observed market share of 52%, the total effect of the consent decree is $-14¢$ ($t = 1.41$), which is significant at only the 10% level. But the effect is significant at the 1% level at both the sample mean and at its maximum. At the mean of 85% the estimated impact is $-27¢$, at the maximum of 100% it is $-33¢$. If we accept the estimated effect of power at a share of 100% to be $\delta_1 * 100$, or 32.7¢, and that the effect of the consent decree was to *drop* margins by 33.2¢ at a share of 100%, then the consent decree appears to have offset the full effects of market power.[35].

The panel nature of our data suggests a natural way to evaluate the robustness of the model by estimating a fixed effects model that allows for market-specific influences. This model is reported in the second column of table 1. The results are very similar to the pooled model in both point estimates and t-values, so we do not discuss them separately. What the test indicates is that we can eliminate one alternative possible interpretation of our results. This eliminates the possibility that some market specific underlying factor causes both high shares and high margins, as in Demsetz (1973).[36]

The results seem strongly supportive of the cartel market power hypothesis. We address some alternate interpretations in section V. However, one alternative can be nested in this model and addressed here, namely, were these changes due to market trends or were they discontinuous changes following the consent decree?

It is possible that the apparent significance of the consent decree is due to trends in market structure that were not induced by the decree. For example, there has been increased buyer concentration and increased vertical integration

[35] The average margin, from January 1972 through to the consent decree was 33¢, falling to $-5¢$ in 1976. The margin averaged 4¢ after the consent decree through 1980, and $-1¢$ for 1976–1980.

[36] The Demsetz (1973) hypothesis would say that in markets in which AMPI's competitive superiority over competitors was greater AMPI would have both higher market shares and margins. Unless changes in AMPI's shares and margins over time were explained by changes in AMPI's relative superiority within markets over time, the fixed effect model permits us to eliminate this interpretation of the *SHARE*-Margin results.

of supermarkets into milk processing.[37] To test for these trends (a time series on buyers' concentration was unavailable), we included a post-consent decree time trend variable, the product of the number of months post-consent decree, and the consent decree dummy.

The results, not presented here, are similar to those in table 1. The time trend is insignificant and both δ_1 and δ_3 continue to be statistically significant, as are effects of the consent decree at high levels of *SHARE*. This suggests a discontinuous effect on margins contemporaneous with the consent decree, not a trend.[38] These results are not surprising given the data; the margin series looks discontinuous. For example, calendar year mean margins suggest a discontinuity. For 1970–1974, the mean margins were, respectively, 49¢, 43¢, 14¢, 33¢, and 43¢ (agricultural product price controls were in effect for much of 1972 and half of 1973). The mean margin for 1975, the year of the consent decree, was 45¢. Post-consent decree, calendar year mean margins never reached even the lowest margin noted above. For 1976–1980, the mean margins were, respectively, −5¢, −9¢, 6¢, 11¢, and −4¢.[39]

B. The Control Variables

The coefficients for the control variables from the fixed effect regression are shown in table 2. The final column reports the first order serial correlation, ρ. Estimates were similar for the pooled model.

As implied by equation (3), misaligned Class II prices are important. Transport costs are mixed in sign, however. Also, as expected, price controls lower the margin. Although no strong a priori predictions apply, feed costs raise margins, and both higher Class I prices and *UTILIZATION* lower the margins (although *UTILIZATION* is generally insignificant).

V. Related Hypotheses

A reviewer has suggested that our results may be due to an abnormal test period, with the delayed effects of the price freeze, high domestic wheat prices, and the sudden increase in fuel prices. Nationally, Class I premiums rose sharply in 1974, and dropped by 31 cents in 1976. The reviewer suggested that our consent decree dummy might be capturing the national effects of these exogenous factors, rather than the effects of the consent decree itself.[40] The reviewer also hypothesized that if AMPI had attained any market power, it would have lost its power earlier as "... it is well known that firms quickly clean up their act as soon as the government goes after them." These two additional hypotheses unfortunately cannot be nested within those in table 1 with the data available to us, so we must use supplementary tests (rather than adding variables to earlier regressions) to examine these alternatives.

A. The AMPI Consent Decree or National Trends?

Our original goal was to look at cooperative market shares, cooperative mergers, intercooperative agreements, antitrust litigation, and their effects on margins in a simultaneous share-margin framework for the nation more generally. Unfortunately, the USDA national data required for this ambitious undertaking were not available.[41] For our regional AMPI sample we could control for temporal effects by using feed costs, transport

[37] Even if the consent decree were not the reason for the structural change, the change from $M_i > 0$ and related to *SHARE* to $M_i \approx 0$ and unrelated to *SHARE*, has the same power interpretation, only a different explanation for the loss of power. (We can rule out monopoly pricing with lessened third degree price discrimination, because monopoly rents are created from discrimination when member quantities cannot be directly controlled.)

[38] There is some hint that the drop in margins was instantaneous in low *SHARE* markets, and slightly lagged in high *SHARE* markets.

[39] A distribution of positives and negatives may be explained by institutional details (as well as possible measurement error). PI_t is equal to PII_{t-2} (later PII_{t-1}) plus a market specific fixed differential. The USDA announces *PI* before the month of shipment and *PII* after the month of shipment. The cooperative announces ΔI before shipment. It often announces $PII + \Delta II$ preshipment, before it knows *PII*.

[40] The reviewer correctly characterizes these substantial Class I premium shifts. We believe these would bias tests based upon Class I premium levels (cf., studies relied upon in Gardner et al. (1986) and GAO (1990)), because the market clearing Class II premium also went up at the same time. Our annual average margin estimates are 43 & 45¢ for 1974 & 75 and 43 to 50¢ for the pre-price control period of 1968–1971. The violations of The Law do not appear unusual over 1974 and 1975.

[41] Tests with the full USDA data set have used Class I premiums, not the One Price test we use herein. They have also not controlled for litigation (or tested its effects), Class II price differences, and some other factors such as intercooperative agreements. These studies are reviewed in GAO (1990).

costs and total supply relative to the Class I market (utilization). We can present some national data tests using a different data set. With these national data we cannot control for all the factors we used in our regional sample, but we can present evidence about our sample relative to national pricing patterns.

The source of these national data comes from regressions reported in the Capper-Volstead Committee Report (1976). The Committee's research staff ran cross-section regressions explaining ΔI (annual average Class I premiums) for 1974, 1975 and July 1975–June 1976 separately, using coopertive market share and geographic interorder "price alignment" regressors, and reported the residuals by market. These residuals can be used to examine how our markets and how Standby Pool member markets differ from other markets.[42] The USDA tests are of the form:

$$\Delta I_{i\tau} = \beta_{0\tau} + \beta_{1\tau} X_{i\tau} + \epsilon_{i\tau} \qquad (5)$$

estimated as separate cross-sections for each time period. If we assume that time period τ follows the consent decree and time period $(\tau - 1)$ precedes it, and otherwise accept the USDA model with its data,[43] we could structure an ideal test of the effects of the consent decree on Class I premium as

$$\begin{aligned}(\Delta I_{i\tau} - \Delta I_{i,\tau-1}) = {} & (\beta_{0\tau} - \beta_{0,\tau-1}) \\ & + \beta_{1\tau} X_{i\tau} - \beta_{1,\tau-1} X_{i,\tau-1} \\ & + \beta_2(\text{Market Dummy})_i \\ & + (\epsilon_{i\tau} - \epsilon_{i,\tau-1}) \qquad (6)\end{aligned}$$

where $(\text{Market Dummy})_i = 1$ for "AMPI consent decree markets" and 0 otherwise. An inefficient (t-values biased down) but unbiased estimator of β_2, the difference between test markets and the other national markets, can be derived from the residuals of equation (5) for each of two time periods. Call these residuals $\hat{\epsilon}_{i\tau}$'s. The estimator is

$$\begin{aligned}(\hat{\epsilon}_{i\tau} - \hat{\epsilon}_{i,\tau-1}) = {} & \gamma_0 + \gamma_1(\text{Market Dummy})_i \\ & + \eta_i \qquad (7)\end{aligned}$$

where γ_1 is an estimate of β_2.[44]

We estimated the model in (7) using two types of market dummies. One was a Standby Pool market dummy, a second was a dummy for being one of our AMPI test markets. The USDA data had 53 observations for calendar years 1974 and 1975, and 47 observations for July 1975–June 1976. Thirteen of our test markets are included in the 1974 and 1975 data and seven of our test markets are in the July 1975–June 1976 data.[45]

We ran two tests, one in which the post-consent decree period is assumed to be 1975 (it unavoidably pools some pre-consent decree months with the post-consent decree data) and another in which it is assumed to be July 1975–June 1976. The latter test corresponds more closely to the post-consent decree period (which took effect in May 1975), but can only be estimated at the cost of eliminating some test market observations. The results are presented in table 3.

One goal of the AMPI consent decree was to eliminate the anticompetitive aspects of the Standby Pool. Compared with the base markets,

[42] Recall that AMPI, Mid Am, DI, and others were members of this alleged anti-competitive (but possibly antitrust exempt) agreement. Standby Pool member markets are markets of cooperatives which were signatories of this agreement. One goal of the AMPI consent decree was to undermine this agreement, and hence impact not only AMPI, but other signatories to this allegedly anticompetitive agreement (see Baumer, Masson and Masson 1986).

[43] We mentioned some overlooked factors in these studies above. Additionally, the inclusion of their "price alignment" regressors is questionable. They imply that if price in i is less than in the Upper Mid West plus transport that the market is "competitive," even if both Δ_i and M_i are substantial. Our initial project contemplated estimating each market's lowest import price from the set of alternatives and fitting a modified spline at that import price. This would require the national data used by the Capper-Volstead Committee (1976) and by the studies cited by the GAO (1990). We would expect the biases in the USDA cross section estimation to have a little effect on the "before and after" estimation of (7) below, but do not have the national data to verify this.

[44] The γ_0 must capture not only the intercepts from (6), but also the influences of the terms involving the X_{it}'s. If these are not constant across markets, some inefficiency in estimation is introduced. The rest of the inefficiency of the estimator comes from suppressing the covariances between the β's.

A non-stochastic example of (7) may help. Suppose in time $t = 0$, $\Delta I_0 = \alpha + \beta * \text{AMPI}$; AMPI = 1 if an AMPI market, zero otherwise. In $t = 1$, $\Delta I_1 = \alpha$. (Note: β is the analogue of $-\beta_2$ in (6).) To simplify, assume AMPI = 1 for half of all markets. Then estimation of (5), (no dummy) leads to $\epsilon_0 = \beta/2$ if AMPI = 1, $\epsilon_0 = -\beta/2$ otherwise. Since $\epsilon_1 = 0$, (7) implies $-\epsilon_0 = \beta/2 = \gamma_0$ for AMPI = 0. Hence, for AMPI = 1, $-\epsilon_0 = -\beta/2 = (\beta/2) - \gamma_1$ which implies $\gamma_1 = \beta$. Measurement via (7) is perfect if the only stochasticity in USDA's regressions (5) is due to an excluded dummy variable for AMPI.

[45] Several Texas Orders merged, and were no longer reported in disaggregated fashion. AMPI continued to set its premiums based upon the premeger market areas. Our tests in section IV were based upon the AMPI price by area, not the USDA weighted average price for the merged marketing order.

TABLE 3.—NATIONAL DATA CLASS I PREMIUM RESIDUALS. THE STANDBY POOL, AMPI, AND THE CONSENT DECREE

	Post-consent Period Used for Estimation	
	1975	7/1975–6/1976
INTERCEPT	23.78[a]	30.56[a]
	(2.40)	(3.25)
STANDBY POOL Dummy	−21.99[b]	−31.32[a]
	(2.08)	(3.11)
AMPI TEST MARKET Dummy	−17.18[b]	−21.95[a]
	(2.39)	(2.52)

[a] Significant at 1%.
[b] Significant at 5%.
[c] Significant at 10%.

TABLE 4.—CLASS I PRICE MARKUPS: MARKET POWER AND LITIGATION VARIABLES

	Pooled Model	Fixed-Effect Model
INTERCEPT	76.630[a]	n.a.
	(2.842)	
INVESTIGATION Dummy	−39.180[a]	−40.457[a]
	(3.134)	(3.305)
FILING Dummy	0.991	3.709
	(0.073)	(0.278)
AMPI SHARE	0.249[b]	0.254[b]
	(2.537)	(2.605)
CONSENT DECREE Dummy	6.276	8.398
	(0.643)	(0.853)
*INVESTIGATION * SHARE* Interaction	0.129[c]	0.130[c]
	(1.190)	(1.213)
*FILING * SHARE* Interaction	−0.172[b]	−0.154[c]
	(1.999)	(1.799)
*CONSENT * SHARE* Interaction	−0.349[a]	−0.362[a]
	(4.401)	(4.372)
Effect of *SHARE* after *INVESTIGATION*	0.378[a]	0.384[a]
	(3.086)	(3.245)
Effect of *SHARE* after *FILING*	0.206[b]	0.230[b]
	(1.535)	(1.764)
Effect of *SHARE* after *CONSENT DECREE*	−0.143	−0.132
	(0.940)	(0.866)
Effect of *INVESTIGATION* at Mean Share = 91%	−27.441[b]	−28.627[b]
	(1.909)	(2.019)
Effect of *CASE FILING* at Mean Share = 91%	−14.661	−10.305
	(1.070)	(0.766)
Effect of *CONSENT DECREE* at Mean Share = 85%	−23.389[b]	−22.372[b]
	(2.310)	(2.170)

[a] Significant at 1%.
[b] Significant at 5%.
[c] Significant at 10%.

Class I premiums in Standby Pool markets, including the AMPI test markets, decreased by 22¢ ($t = 2.08$) using the 1975 data as "post-consent decree" observations, or 31¢ ($t = 3.11$) using the July 1975–June 1976 data. Given that most of the national markets were Standby Pool members' markets, part of the national decline may have been due to the effect of the AMPI consent decree on the Standby Pool (as was DOJ's intention).[46] Further, prices in our AMPI test markets fell by more than those in the other Standby Pool member markets. Compared with the other Standby Pool markets, they fell by an additional 17¢ ($t = 2.39$) using the 1975 data and 22¢ ($t = 2.52$) using the July 1975–June 1976 data.[47]

We cannot form a direct test of our margins-share hypotheses (e.g., based on ΔI–ΔII) without more comprehensive national data. But clearly the market ΔI's of Standby Pool members fell significantly relative to base markets following a decree significantly limiting the Standby Pool. Similarly, our test markets fell significantly relative to the other Standby Pool markets. Further, the point estimates of the degree of relative ΔI decline for AMPI markets are similar to our estimates of the effect of the consent decree on margins. These observations strengthen our conclusion that the consent decree had an effect on these markets.

B. *Did AMPI Lose Market Power Earlier?*

A reasonable hypothesis is that AMPI may have already lost some of its market power once the antitrust investigation commenced. That AMPI had remaining market power when the decree was entered follows from *The Law of One Price* and $\Delta I > \Delta II$.[48] We added a dummy for

[46] Another part was related to the factors causing a general decline in ΔII.

[47] E.g., relative to the national trend of non-Standby Pool markets, AMPI's ΔI fell by 40¢–50¢. Note that above we report AMPI's annual margins after the consent decree. Its margin in 1976 was less than its average annual margin post-consent decree by 9¢, suggesting a total effect for 1976 of about 40¢.

[48] After the antitrust investigation started AMPI would have to be more circumspect in its dealings. There were dominant firms formed by mergers near the turn of the century, and

TABLE 5.—CLASS I PRICE MARKUPS: CONTROL VARIABLES: 1970–1980

Market (1971 share)	Utilization Rate	Feed Costs	Transport Costs	Price Control Dummy	Class I Price Level	Class II Price Difference	ρ
Central Arkansas (90%)	−0.46 (1.05)	0.44[b] (2.18)	0.18 (0.87)	−36.13[a] (2.76)	−0.11[a] (3.99)	n.a.	0.49
Lubbock-Plainview (94%)	−0.61[c] (1.34)	0.42[b] (2.04)	−0.21 (0.99)	−23.42[c] (1.72)	−0.02 (0.67)	−0.65[a] (9.28)	0.47
North Texas (61%)	−0.25 (0.61)	0.55[a] (3.10)	−0.08 (0.40)	−21.05[b] (1.75)	−0.12[a] (5.83)	−0.47[a] (10.22)	0.5
Central West-Texas (97%)	−0.47 (1.07)	0.53[a] (2.64)	−0.08 (0.40)	−20.42[c] (1.50)	−0.09[a] (3.63)	−0.60[a] (10.52)	0.55
Austin-Waco (98%)	−0.38 (0.86)	0.59[a] (2.86)	−0.16 (0.76)	−23.06[c] (1.67)	−0.09[a] (3.75)	−0.42[a] (7.28)	0.56
Corpus Christi (75%)	−0.61[c] (1.42)	0.26[c] (1.53)	−0.17 (0.85)	−20.25[c] (1.64)	−0.02[b] (1.77)	−0.34[a] (4.87)	0.44
South Texas (81%)	−0.49 (1.14)	0.56[a] (2.87)	−0.11 (0.57)	−21.42[c] (1.62)	−0.08[a] (3.83)	−0.47[a] (7.79)	0.55
San Antonio (98%)	−0.19 (0.45)	0.52[a] (2.76)	−0.01 (0.03)	−23.66[b] (1.87)	−0.13[a] (5.66)	−0.55[a] (9.94)	0.52
Texas Panhandle (100%)	−0.33 (0.67)	0.39[c] (1.64)	−0.34[c] (1.44)	−23.36[c] (1.53)	−0.01 (0.28)	−0.73[a] (6.87)	0.49
Wichita (97%)	−1.06 (2.35)	0.02 (0.08)	0.001 (0.005)	−25.55[b] (1.92)	0.03 (1.02)	−0.75[a] (5.05)	0.43
Fort Smith (100%)	−0.64 (1.48)	0.24 (1.19)	0.23 (1.13)	−36.10[a] (2.78)	−0.07[a] (2.60)	n.a.	0.52
Memphis (98%)	−0.70[c] (1.63)	0.26 (1.24)	0.26 (1.27)	−33.07[a] (2.50)	−0.08[a] (2.55)	n.a.	0.56
Oklahoma-Metropolitan (90%)	−0.59[c] (1.42)	0.37[b] (2.05)	−0.11 (0.62)	−26.89[b] (2.30)	−0.04[c] (1.52)	n.a.	0.47
Red River Valley (91%)	−0.39 (0.99)	0.31[b] (1.82)	0.19 (1.11)	−27.54[b] (2.49)	−0.11[a] (4.70)	−0.35[a] (2.95)	0.48

[a] Significant at 1%.
[b] Significant at 5%.
[c] Significant at 10%.

they did not lose dominance immediately after exercising pricing power (cf., Caves et al. (1984)). AMPI, too, was formed by mergers, but the glue holding it together was not ownership, but membership contracts. After the investigation commenced, AMPI continued to have membership contracts with restrictive loss of equity provisions tied to non-compete agreements. It continued to have [semi-] exclusive contracts with buyers and it continued to have its contractual relationships with other cooperatives through the Standby Pool. The consent decree significantly restricted all three types of AMPI's contractual relationships.

The consent decree limited the penalties from the non-competition agreements and required AMPI to market former members' milk while they searched for a buyer. The decree removed AMPI's ability to discriminate against partial supply buyers. Importantly, the decree focused on the Standby Pool. (While AMPI and Mid-Am were found to have violated the law in *Alexander v. NFO*, the Standby Pool was not.) AMPI could be restrained from belonging to organizations with specified rules, such as not freeing up "optioned milk" if the option was not to be exercised. The decree required optional milk to be released if not called for by 24 hours in advance.

Further, DOJ alleged that the "bad acts" continued. In August 1974, an AMPI official, McKinney, showed in deposition how AMPI was continuing to lose about $30,000/month in the South Texas market, in at least some months, through June 1974, and that to avoid the loss would only involve changing an AMPI computer program. (The program allocated sales of one AMPI plant to South Texas Class II sales rather than North Texas Class II, driving down the South Texas *PB*, while raising the North Texas *PB*.) This is a subtle exercise of power. Rivals may not know if they are facing below cost sales. This and other episodes described in EM & R were described in Masson and Eisenstat (1975), cited by Ordover and Saloner (1989) as an early discussion of how "asymmetric information may provide for predation in order to signal costs are low." It hypothesizes, and Easley, Masson and Reynolds (1985) proves, that predation may work if rivals cannot distinguish low returns caused by predation from those caused by competition.

the beginning of the AMPI investigation and a dummy starting after the case was filed. Both dummies interacted with the share variable. To accommodate these dates we needed to add 1970–1971 data. Since 1969 or 1970 share data were not available to us, the 1971 (annual) share is attributed to the 1970–1971 observations. This model is not recursively identified, as the 1971 share is not predetermined in 1970–1971.[49]

These results are presented in table 4. The results from section IV are robust. Share is significant until the consent decree, but not after, and the decree decreases the margin. One of the reviewer's hypotheses, if less starkly framed, is also (somewhat to our surprise) supported. Margins appear to have decreased in a statistically significant fashion once AMPI knew it was under investigation. The point estimates suggest an insignificant additional decline after filing. Interestingly, the effects of share became stronger after the investigation began. This is contrary to the pattern following the consent decree, but seems perfectly natural. When the investigation started, it appears that AMPI lost some pricing power in markets where its share approached 100% and lost even more power where its membership comprised a lower share of the market. If AMPI's most overt forms of retaliation were needed only where rivals' share was largest, these results are consistent with AMPI having reduced its most overt forms of retaliation once the investigation began.

VI. Conclusions

Recent theoretical analyses suggest that, contrary to popular belief, a large numbers cartel may be able to raise and maintain price–cost margins in excess of competitive levels. We test this hypothesis using data drawn from a large dairy cooperative, Associated Milk Producers, Inc., with more than 30,000 members. Unique features of the milk industry allow us to construct an economically meaningful measure of the price–cost margin for well-defined markets.

We developed a model of spatial limit pricing to analyze these data. We tested the model using the method of Seemingly Unrelated Regressions, adjusting for serial correlation. Our results provide strong statistical evidence for the hypothesis that in the period before the consent decree, the cartel successfully obtained and used market power. Further, its market power, measured by the price–cost margin, was proportional to its market share. In contrast, margins fell significantly after the consent decree and these margins were no longer related to market share. Our results are robust to several alternate interpretations. We estimated a fixed effects version of the model and obtained the same results. We rejected the hypothesis that the result came from industry trends. Using a different data sample we can show that the result is unique to AMPI markets; the cooperative's prices fell relative to other prices at the same point in time.

In summary, our results show that a large numbers cartel facing virtually free entry can be formed and can maintain its market power over several years. We also find strong statistical support for the proposition that the cartel's market power was sharply reduced after a behavioral consent decree went into effect.

[49] Initially we applied price data to contemporaneous share, as is common in concentration-profits studies. Queries about endogeneity led to recursive identification in the primary tests above. Results for 1970–71 may be biased if endogenous intra-market changes in shares are significant relative to inter-market exogenous differences in shares. Membership shares are potentially volatile. Data on AMPI sales for several of our markets for 1968–72 and market histories are reported in EM & R These lead us to believe the 1970–71 results are robust. (1971 share is reported in the first column of table 5.)

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