An Analysis of Consolidation for the Farm Supply Sector

William J. Taylor and Larry L. Vogler

Changing farm numbers and a changing farm supply industry have prompted many regional cooperatives to consider consolidation of local branches as a means of remaining profitable. A behavioral model has been developed that would permit management of regional cooperatives to consider consolidation of product lines or complete branch closures. This model was used in an empirical analysis of a regional cooperative with an overinvestment in capital assets in its local branches. The results indicated that product line consolidation of major products would result in a greater savings than store closure.

The number of agricultural supply cooperatives has fallen since the mid 1950s. The primary causes of this decline have been a decline in farm numbers, the changing nature of the industry, and consolidation of cooperatives (Cropp and Ingalsbe). These dynamic forces in the agricultural supply sector have not diminished the role of the cooperative. The percentage of total farm supplies purchased from cooperatives has increased from 19 percent in 1951 to 26 percent in 1985. This paper presents a model that regional cooperatives can use when considering the consolidation of local branches.

An economic model was developed that simulates the effects of consolidating a local branch of a regional cooperative. The model is predicated on the assumption that patrons will select the least-cost source of agricultural inputs. The model permits the management of a regional cooperative to identify changes in product distribution and profitability associated with various consolidation alternatives. The model does not attempt to quantify the social costs of restructuring. These costs must be compared with the economic savings identified by the model.

Theoretical Framework

Previous studies of consolidation (or optimal distribution networks) have fallen into the categories of optimal size, number, and location models; transportation models; and consumer behavioral models. Stollsteimer developed a model of optimal size, number, and location based on minimizing assembly and processing costs. Those models could be applied to this situation and could minimize the cost to the cooperative of assembly and processing at the various existing facilities (Cobia and Babb). The optimal number of local branches to meet demand and minimize the cost to the

William J. Taylor and Larry L. Vogler are respectively assistant professor and graduate research assistant, Department of Agricultural Economics, Virginia Polytechnic Institute and State University, Blacksburg, Virginia.

This research was partially financed by the Agricultural Cooperative Service, U.S. Department of Agriculture.

regional cooperative could be identified, given existing size and location. These models pay little attention to purchasing behavior of the patron.

Transportation models are similar to the Stollsteimer model and typically have the objective function of minimizing total costs or maximizing total profits to the cooperative. These models will identify the least-cost alternative meeting patron demands within the existing structure of the regional cooperative (Hulslander). These models suffer from the assumption that the patron will continue to frequent existing locations in spite of consolidation.

Behavioral models differ from both the size, number, and location models and the transportation models. The behavioral model simulates the purchasing behavior of the patron. The purchase cost, including acquisition, is minimized to the patron. Product flows are identified without regard to the effects of profitability on the cooperative. Behavioral models are not unique to this analysis. However, typical analyses of consolidation place primary emphasis on the impacts on the cooperative without regard to patron behavior.

Cooperative theory suggests that several economic objectives exist for supply cooperatives. Schmiesing identifies three: maximizing net income as investor-owned firms (IOFs) do, minimizing net price paid by patrons, and operating at break-even. The implicit assumption in the Stollsteimer and basic transportation models is cost minimization to the regional cooperative. The economic objective used by this model is to minimize the price paid by patrons.

In the case of a single cooperative, minimizing cost to the cooperative is equivalent to minimizing the cost to the patron. Any differences between the price paid by the patron and the actual cost to the cooperative constitutes the patronage refund. However, in the situation of a regional cooperative with multiple branches, the minimum cost to the regional cooperative may not be the same as the minimum cost to the patron. Transportation costs for fringe area patrons may increase more than the reduction in product cost. This increased cost may result in fringe area patrons changing their purchasing behavior. The net effect of consolidation may be to increase the net income for the regional cooperative prior to changes in patron behavior. However, after changes in patronage behavior, the results may indicate a reduction in net income for the regional cooperative.

The Data

The data used in this analysis were obtained from a regional cooperative considering consolidation as a means of improving the profitability of the local branches. The regional cooperative has five branches serving a five-county base. The five branches range from seven to thirty-one miles from each other. In the current operating status each branch operates independently.

The local branches sell as many as five product lines. The product lines are: farm supplies, agricultural chemicals, fertilizer, feed, and petroleum. Every site distributes the first four products, but only one site sells petroleum. For each product line, sales volume, fixed costs, and variable costs can be identified.

The operating capacities for each branch were identified through site visits. Capacities were annualized, with attention given to seasonality. None of the local branches were currently using more than half their total potential capacity. Within certain product lines, a site may have operated between 15 and 80 percent of capacity. Overall, feed and fertilizer were the most underutilized product lines among the local branches.

Existing sales data permitted separating the demand area into 13 distinct geographic regions. These regions account for more than 90 percent of the total business volume of the local branches. Historical data permitted a breakdown of sales from each site to each demand region by product line. The sales data were used to estimate regional demands. The model did not consider the existence of competition. The branches provided nearly all the farm supplies purchased in the demand area analyzed.

The Model

The model developed is predicated on consumer behavior. The model minimizes the effective costs to the patron: purchase price plus transportation costs. The cost of the time the patron spends in the acquisition process can be implicitly included in the transportation costs. The model satisfies regional demand subject to production and distribution capacities of the local branches.

The model is restricted to evaluating a total of five distribution sites. The distribution sites may represent the regional cooperative's branches or the competition, depending on the objective of the analysis. Five separate product lines can be carried by each site. Depending on the nature of the analysis, the product lines may be general, such as feed and fertilizer, or very specific, such as liquid nitrogen or anhydrous ammonia. Patron demand is limited to a maximum of 15 regions. The nature of the demand region may be very specific or quite broad. These restrictions are necessary to permit the model to operate on a personal computer with 640K of memory and a hard disk. Previous attempts have resulted in more eloquent models, but these models were very cumbersome and limited to main frame computers (Hulslander).

Each product line is assumed to be either picked up by the patron at the local cooperative or delivered directly to the patron. Each of these costs is modeled as a linear function of the distance between the patron and the local cooperative. If a more distant branch charges a price, including transportation costs, that is less than a price charged by a closer site, the patron will purchase inputs from the more distant branch. However, a local branch that charges slightly higher prices than a more distant site will remain the primary supplier if the cost of transportation from the more distant site makes the effective costs to the patron higher.

The model is constrained to meet capacity and demand constraints. Each local cooperative is limited by processing and storage facilities, delivery capacities, and other factors that limit the throughput volume. Delivery constraints are a function of the delivery capacity for each site. Feed, fertilizer, and petroleum were either delivered or picked up in the model, ag chemicals and farm supplies were only picked up by the patron. If a production capacity is different from a storage capacity, the lower number is used for the constraint. Therefore the stated utilization rates may underestimate actual levels of asset utilization.

The demand constraints are based on historical product flows from the five branches. Actual demand in an area may be significantly greater if other competitors provide products to the patrons. However, in this particular region the cooperative is the primary supplier of agricultural inputs. The demand constraints are based on the amount of product a region demands but are not site-specific.

Results

The Baseline Model

A baseline model was run with the existing data to identify a benchmark by which to judge consolidation alternatives. The baseline model used existing price structures,

Table 1.—Cooperative Restructuring Simulator: Baseline by Product Line and Site

	Total Sales					
	Site A	Site B	Site C	Site D	Site E	All
	Thousand Dollars					
Ag Chemicals	162	90	82	85	91	510
Farm Supplies	474	499	314	332	311	1930
Feed	208	967	495	366	473	2509
Fertilizer	362	237	505	433	443	1979
Petroleum	930	0	0	0	0	930
Total	2136	1793	1396	1216	1318	7859
	Net Income					
	Site A	Site B	Site C	Site D	Site E	All
	Thousand Dollars					
Ag Chemicals	−5.8	−1.6	0.0	−1.9	−1.5	−10.8
Farm Supplies	11.5	19.0	19.9	11.7	12.8	74.9
Feed	−11.4	−54.4	−9.8	−14.9	−16.1	−106.7
Fertilizer	2.1	0.7	22.7	6.2	8.5	40.2
Petroleum	56.9	0.0	0.0	0.0	0.0	56.9
Total	53.3	−36.3	32.8	1.1	3.7	54.5
	Asset Utilization					
	Site A	Site B	Site C	Site D	Site E	All
	Percent					
Ag Chemicals	72.0	37.6	36.5	40.7	60.5	48.6
Farm Supplies	41.1	41.6	72.5	81.3	46.0	49.8
Feed	23.3	66.9	58.4	47.3	26.9	43.9
Fertilizer	15.5	11.6	33.3	37.4	23.0	22.1
Petroleum	45.2	0.0	0.0	0.0	0.0	45.2
Total	32.1	36.4	46.2	47.7	29.2	36.3

capacity constraints, variable costs, and fixed costs. Variable costs were recorded on a product line basis. Fixed costs were allocated to each product line. The remaining fixed costs were allocated to the five product lines according to the observed net margin of each product line. These fixed costs were allocated where they could be absorbed, rather than where the sales volume was based. The sales distribution, net income, and asset utilization for the baseline model are found in table 1.

The results of the baseline model suggest consolidation as a means for increasing the profitability of the regional cooperative. Sales volume for the five sites is fairly similar, if petroleum is disregarded. However, the sales levels of the local cooperatives utilize less than half the potential volume. A further frustrating factor is that feed returns a negative income in every local cooperative. The financial information available indicates that feed is not a profit center for the region analyzed. However, the regional cooperative is also the wholesale supplier to the region and returns may

be generated at that level. It appears that total patronage demand has been falling over the past several years, and this trend is expected to continue.

Store Closure Model

Restructuring alternatives include store closure and product line consolidation. Store closure involves reallocating a particular store's sales volume among the remaining locations. Distances traveled by patrons will increase, resulting in a decreased demand by fringe area customers. Hulslander analyzed this behavior and developed an equation to identify the reduction in demand as distances increase. This technique was employed to identify changes in demand.

Identification of the proper site for closure considered several factors: net income, asset utilization, volume, and regional considerations. Site B is the logical candidate for closure if net income is considered. However, consideration of volume and asset utilization would not have identified the same sites. Site A serves a unique geographic location, thus closure would result in significant loss in sales. Site E was chosen for store closure due to its small volume, low asset utilization, low net income, and geographic location. The store closure model did not reallocate site E's assets to the other sites. Rather the site's assets were sold (fixed costs were eliminated). The assumption was that the fixed assets could be dissipated at book value. This assumption appeared consistent with the expectations of management at that site. Deviations from this assumption can be included in the model by using the appropriate fixed costs. The results of the store closure model are included in table 2.

The store closure resulted in a decrease in volume of about $100,000 for the regional cooperative. Site C absorbed a majority of the patrons who were formerly served by site E. Site B was located farthest from site E and was unaffected by the closure. Net income for the regional cooperative more than doubled with the closure of the site. Net income increased in the remaining sites as break-even volumes were achieved or fixed assets were allocated over a larger sales volume. Asset utilization increased significantly in sites C and D. These sites were located quite close to the demand regions previously served by site E.

Product Consolidation Model

An alternative to complete store closure is a consolidation of certain product lines into a regional service area. Although each local branch could remain active within its respective community, certain products would be handled by only one site. The appropriate product lines to consolidate are feed and fertilizer, where fixed costs are large for each site in operation. Product consolidation permits each local branch to take orders for delivered feed and fertilizer, but the product is delivered from one central site. The patron can pick up the product only at the central site.

Site A was determined to be the optimal site for a regional service area. It was centrally located and had significant capacity for the increased volume. The variable cost for feed and fertilizer was adjusted at site A to equal the average of the five local branches. Fixed costs for feed and fertilizer were removed from the four sites that no longer provided these services. Fixed costs at site A were increased to include two departmental managers, one for each product line. Feed grinding facilities and necessary rolling stock were also brought to site A and resulted in increases in fixed costs.

Table 2.—Cooperative Restructuring Simulator: Store Closure Model Sales by Product Line and Site

	Site A	Site B	Site C	Site D	Site E	All
			Total Sales			
			Thousands Dollars			
Ag Chemicals	162	90	162	93	0	507
Farm Supplies	621	499	435	361	0	1915
Feed	256	967	835	425	0	2482
Fertilizer	362	237	764	557	0	1920
Petroleum	930	0	0	0	0	930
Total	2331	1792	2197	1435	0	7754
			Net Income			
	Site A	Site B	Site C	Site D	Site E	All
			Thousand Dollars			
Ag Chemicals	−5.2	−1.6	2.4	−1.4	0	−5.8
Farm Supplies	18.7	19.0	38.2	17.4	0	93.2
Feed	−13.3	−54.4	−7.0	−14.7	0	−89.4
Fertilizer	4.0	0.7	50.9	14.2	0	69.8
Petroleum	63.3	0.0	0.0	0.0	0	63.3
Total	67.4	−36.3	84.5	15.5	0	131.1
			Asset Utilization			
	Site A	Site B	Site C	Site D	Site E	All
			Percent			
Ag Chemicals	72.0	37.6	71.9	44.2	0	56.3
Farm Supplies	53.8	41.6	100.0	88.5	0	59.9
Feed	28.6	66.9	98.5	54.8	0	62.6
Fertilizer	15.5	11.6	50.4	48.0	0	27.2
Petroleum	45.2	0.0	0.0	0.0	0	45.2
Total	35.0	36.4	72.7	56.3	0	45.2

The demand for delivered feed was determined to be unaffected by the delivery site. The existing purchasing pattern of placing orders at the local branch and receiving delivery at the farm was not changed from the patrons' perspective. However, feed and fertilizer would not be available at the four local branches for pick up. Therefore, sales volumes for feed and fertilizer picked up by patrons were reduced according to estimates based on Hulslander's analysis.

Results of the product consolidation model, shown in table 3, indicate about a $300,000 decline in sales for the region. The lost sales are a result of the increased distances a patron must travel to pick up feed and fertilizer. Sites B, C, D, and E had significant drops in sales volumes as all feed and fertilizer sales were routed through site A. The fixed costs for feed and fertilizer were eliminated in sites B, C, D, and E, resulting in increased net incomes for each site. Asset utilization increased significantly from the baseline model.

Table 3.—Cooperative Restructuring Simulator: Product Consolidation Model Sales by Product Line and Site

	Site A	Site B	Site C	Site D	Site E	All
			Total Sales			
			Thousand Dollars			
Ag Chemicals	162	90	82	85	91	510
Farm Supplies	474	499	314	332	311	1930
Feed	2318	0	0	0	0	2318
Fertilizer	1883	0	0	0	0	1883
Petroleum	930	0	0	0	0	930
Total	5767	589	396	417	402	7571
			Net Income			
	Site A	Site B	Site C	Site D	Site E	All
			Thousand Dollars			
Ag Chemicals	−1.8	−1.6	0.0	−1.9	−1.5	−6.8
Farm Supplies	31.0	19.0	19.9	11.7	12.8	94.4
Feed	−77.4	0.0	0.0	0.0	0.0	−77.4
Fertilizer	79.8	0.0	0.0	0.0	0.0	79.8
Petroleum	102.0	0.0	0.0	0.0	0.0	102.0
Total	133.6	17.4	19.9	9.8	11.3	192.1
			Asset Utilization			
	Site A	Site B	Site C	Site D	Site E	All
			Percent			
Ag Chemicals	72.0	37.6	36.6	40.7	60.5	48.6
Farm Supplies	41.1	41.6	72.2	81.3	46.0	49.8
Feed	52.9	0.0	0.0	0.0	0.0	52.9
Fertilizer	80.8	0.0	0.0	0.0	0.0	80.8
Petroleum	45.2	0.0	0.0	0.0	0.0	45.2
Total	56.7	40.9	60.0	67.5	48.7	55.2

Site A was the primary beneficiary in the product consolidation model. Some feed grinding facilities from the other sites were brought to site A to increase capacity in this area. Sales volume increased nearly threefold and net income increased by a factor of two at site A. The model does not reflect potential increased sales in the other three product lines as pick-up customers may make nonfeed and fertilizer purchases.

Conclusion

Problems of changing farm numbers and a changing farm supply sector have created problems for regional cooperatives. They are faced with the dilemma of maintaining local branches that are no longer profitable or consolidating these existing facilities. A behavioral model was developed that analyzed three alternatives: maintain-

ing existing facilities without change, store closure, and product consolidation. The results indicate that regional cooperative management have alternatives to improve the economic situation of the local branches.

In the store closure model a local branch was closed and its existing patronage was redistributed among the remaining sites. Patronage was adjusted for increased travel to purchase agricultural inputs. The increased distances resulted in about a $100,000 decrease in patronage to the regional cooperative. Net income for the regional cooperative more than doubled. However, one local branch still was not covering its costs. Asset utilization increased significantly for two of the four remaining sites.

The product consolidation model put the processing, direct retailing, and delivery of feed and fertilizer into one central location. This site would serve as the source of all feed and fertilizer sold by the remaining sites. Feed and fertilizer sales fell by nearly $300,000 as patrons who previously had picked up feed and fertilizer purchased product elsewhere. The remaining product lines remained the same as in the baseline case. Net income for the regional cooperative increased more than threefold. The primary source of increased income was in the elimination of underutilized facilities in the feed and fertilizer product lines. Net income of each local branch was positive. Three of the four sites with feed and fertilizer costs increased net income from the baseline case. Asset utilizations increased for all five local cooperatives.

The evidence suggests that product consolidation can provide a successful alternative. Facilities can be maintained to serve their existing constituency. Product lines that are not economically viable for local branches can be placed into a regional service center. The patron must adjust to the fact that feed and fertilizer are no longer available in each local cooperative. Critical items that exhibit high demand could be retained in each local cooperative, but their processing and delivery could be consolidated into one site.

Each local branch would be kept intact as an operating unit of the regional cooperative. Current management and sales staff would be retained except for changes in the feed and fertilizer processing units. Delivery personnel could be retained and could operate from site A. Net income for each site would increase. Specialization of remaining services could result in further improvement of the retailing operations in each of the local branches.

Regional management would accrue a significant improvement in the operation within the region. Sales would be reduced slightly, but net income would increase drastically. Management personnel for the consolidated product lines could be obtained from the existing personnel or hired outside the cooperative. Staffing the consolidated operations would be accomplished by retaining the current operating staff from the other locations.

Behavioral models can provide a realistic simulation for restructuring decisions. Models built on optimal size, location, and number of outlets, or transportation models tend not to pay close attention to the patron's behavior towards restructuring. Models evaluating restructuring alternatives that are insensitive to patron behavior are likely to fail in achieving their purpose.

The results of this research indicate that examination of the alternatives can significantly improve the profitability of the local branches. This analysis suggests that management of regional cooperatives should compare a product consolidation alternative with store closure. Product consolidation is particularly useful if high fixed costs of underutilized product lines ensure losses. Consolidation by product line retains the existing facility and the patronage interface but permits economies of size to accrue.

Although total demand is expected to fall, the resulting net incomes can increase significantly.

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