The Effect of Identity Preserved Premiums on Elevator Grain Flows

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Abstract:
The effect of identity preserved premiums on a grain elevator's received volumes is modeled using stochastic simulation across the harvest season. A feedback loop simulates competing elevators' bid prices and tracks producer delivery decisions using arbitrage criteria at competing market elevators. Results provide information about the sensitivity of distance thresholds in producer delivery decisions given IP premiums.

Keywords: Identity preserved, market areas, arbitrage

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For any given grain elevator, information flows among producers, end users, and competitor grain elevators. These three categories of market participants generate market-level information that is used internally to maximize the profitability of a particular elevator.

In large part, producer-generated information revolves around total grain volume, as well as the types and quality characteristics of grains produced. Annual production forecasts, based on historical trend, provide elevators with estimates of grains available to be supplied to an elevator. Often greater uncertainty surrounds not the *total volumes produced*, but rather the *distribution of grain types and qualities*. In addition, the elevator is concerned with the producer's transport costs. The combination of three factors, distance to elevator, elevator bid price, and producer transport costs per mile, determine which elevator receives the producer's grain. Or, the possibility exists that the elevator is by-passed altogether in the case of direct producer to end-user shipment. In short, factors influencing arbitrage conditions are critical pieces of producer-generated information used by elevator management.

With respect to end users, the three most likely outlets for corn and soybean usage from the Eastern Corn Belt are food processors (such as crushing mills, wet or dry corn milling, etc.), feed lots, or barge facilities in preparation for export. Historical trends provide reasonable estimates for grain usage by type of user. Food processors and feedlots have exhibited fairly consistent demand patterns over time with greater variation seen in the volumes demanded in export markets.

A commodity-based grain marketing environment invites cost minimization because of high-volume, low-margin product characteristics. Commodity-intensive markets encourage elevator managers to attract the largest grain volumes possible, subject to facility configuration constraints, at the lowest possible per unit cost. Attracting grain flows to an elevator is a function of arbitrage conditions, in turn highlighting the bid price-producer distance relationship. Because commodities do not draw over cash price premia, the producer's shipping cost to an elevator is the determining factor in their delivery decision.

The variable premium structure associated with identity preserved (IP) grains, however, implies a shift in the weight, or value, that bid prices and producer distances carry relative to one another, as producers evaluate their best delivery option. Per bushel IP premiums offered at a mid-range distance elevator could offset the higher transportation cost of delivery compared to those of a closer elevator not offering the same premium. More specifically, IP premiums influence the market boundaries at which elevators compete for producer deliveries. Thus, an elevator's competitive strategy should incorporate information about competitor elevators' bid prices. Assuming competing elevators are angling for the same grain types in a market area, a better understanding of a competitor's bid price distribution might translate into a competitive pricing strategy advantage.

The objective of this paper is to evaluate the effect of competitor bid price offerings on a case study elevator's grain flows during the harvest season. This paper is an effort to better understand the extent to which grain flows are altered with incremental changes and variation in the closest competitors' marketing margin. Particular emphasis is placed on examination of arbitrage conditions in so far as they drive producer delivery decisions.

The intent of this paper is to build on one part of Maltsbarger's IP-opportunity cost argument using stochastic market feedback. In particular, grain volumes lost to competitors is lost revenue, if an elevator could have received, handled, and stored the same grain without compromising operational efficiency. Operational efficiency is further complicated by IP grains through attribute preservation assurance. The results of this study play a role in evaluating the economic impacts of IP grain production at the elevator level. The grain flows examined in this study can be used with cost estimates and blending models to determine the total economic impact on a given elevator's profitability. However, a thorough understanding of the competitive situation and grain flows are a necessary first step to understanding this problem.

The paper is divided into 5 sections. First, previous studies are reviewed for their contribution to this discussion of market area definition, assembly costs, and arbitrage conditions. The second section discusses the methodology. Third, the paper outlines model details including scenario and variable specification, as well as model assumptions. Scenario results are presented in section four. The paper concludes with an interpretation of broader, market consequences implied by the results and suggests future extensions of this research.

Literature Review

Three themes in the literature are reviewed. First, spatial price differentials are examined as a function of micro-market structure. Second, the role of producer assembly costs is addressed as it influences elevator manager's perception of total facility costs. Third, a review of arbitrage conditions follows to the extent that they influence a grain elevator's market definition.

The degree to which micro-market structure explains spatial grain price differentials is motivated by observation that price differentials exist which cannot be attributed to time, space, and form cost variables (Jones; Davis and Hill; McCully). Market variables related to elevator scale and scope, elevator transport options, and proximity to competitors are used to capture market structure effects. The breadth of marketing services offered by an elevator, as well as competitor density emerge as salient factors influencing elevator bid prices (Jones, Davis and Hill; Wenzel et al.).

Wenzel et al. identify three factors contributing to an elevator's ability to offer alternative bid prices: (1) local supply and demand conditions, (2) firm productive efficiency, and (3) operating practices. This research addresses two of these factors. First, local demand and supply conditions are fixed in any given grain marketing year thereby making elevator managers in a given market area compete for a fixed volume in the short run. Second, this research draws attention to the efficiency-volume/type trade-off. Identity preservation likely hinders operational efficiency, relative to the commodity-only scenario. Because an elevator offers higher IP premiums compared to their competitors does not imply they have achieved greater operational efficiency. One of the challenges for elevator managers is to identify how to most effectively adjust bid prices without compromising operational efficiency. This research highlights the inter-relatedness of Wenzel et al.'s second and third market factors, namely operational efficiency and operating practices.

Operational efficiency connotes maximum output at the lowest possible cost, subject to technological/production constraints. Misreading costs can hinder achieving operational efficiency. Araji and Walsh (1969) find that inclusion of previously omitted assembly costs significantly impacts the elevator's cost curves.[1] Previous studies maintained that storage, handling, and loading grains processes provided a complete cost summary. Under this assumption, indirect (marketing) costs are overlooked.

In a commodity only environment, average costs are non-increasing as economies of scale are recognized. The average total costs should also stabilize with larger throughput

[1] Assembly cost factors are defined here as "grain sales density and the costs of hauling grain from farm to elevator" (Araji and Walsh, 36).

volumes. Araji and Walsh argue, however, that exclusion of assembly costs guides managers to expand facility size beyond what is the true profit maximizing capacity. That is, assembly costs, which are a function of grain sales density and producer transport costs, increase with distance. Managers basing their decisions on market area volume need also consider producer-elevator distances in determining which facility receives the grain. Producers traveling greater distances incur greater assembly costs, assuming a constant per mile truck cost. At some distance though, producers will deliver to another facility. In this respect, assembly costs are a type of opportunity cost. Managers who pursue increased storage capacity without considering assembly costs will overestimate their optimal size, by misunderstanding market boundaries.

Inclusion of a feedback mechanism draws attention to arbitrage conditions. Elevators in any given market are assumed to be price takers and thus all confront the same terminal cash market price (Dooley and Wilson). Factors then affecting arbitrage conditions include producers' assembly/transportation costs and elevator pricing strategies (Dooley and Wilson), or

$$(1) \qquad P_j - td_j = P_i - td_i, i \neq j$$

where j = elevator competing with case study elevator i,
P = price paid to producer by elevator i or j
t = linear transportation cost incurred by producer for elevator delivery, and
d = distance, in miles, from farm to elevator i or j.

Equation 1 offers a firm-level approach to examining competitive forces in a grain market, in addition to making allowances for multiple facilities per market (Dooley and Wilson). Using equation 1, producers compare delivery profit margins across all facilities, choosing the one with the highest return for them. Three assumptions parameterize the model. First, it is assumed that producers deliver to the elevator offering the highest price net of transportation costs. Second, it is assumed that producers face uniform linear transport/assembly costs across the market area. Finally, there is no allowance for price discrimination by elevators to producers.

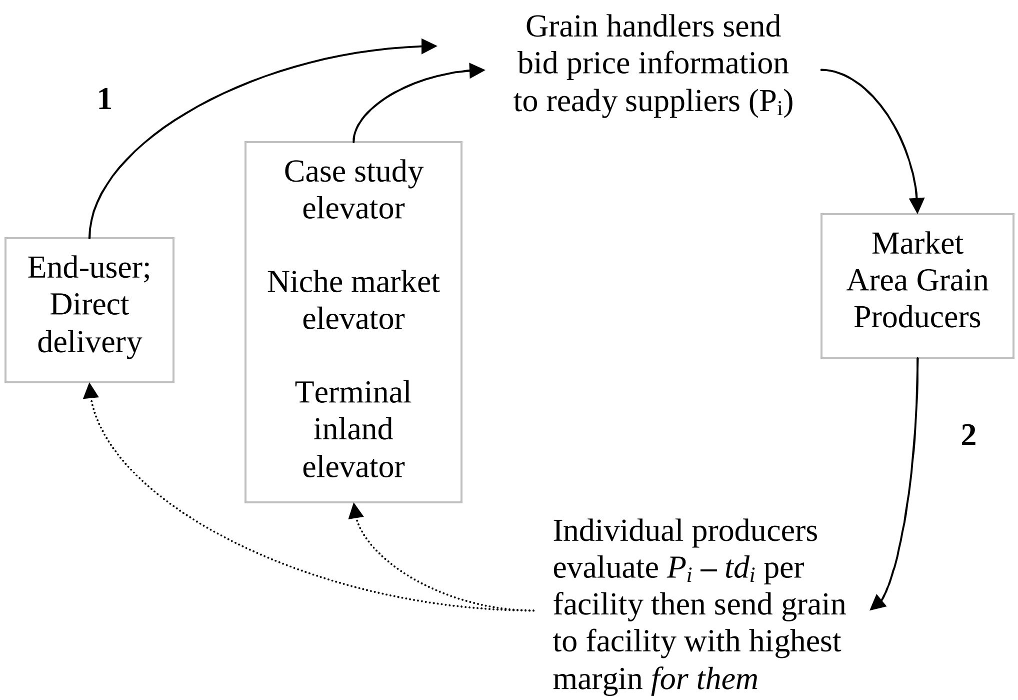
Findings suggest that elevators raise their bid prices to offset competitors' lower margins. For example, if an elevator expands their transport capabilities to include multi-car rail shipments, it effectively lowers their transport costs. These "savings" are then passed along to producers in the form of higher bid prices. The smaller, single-car elevator's (defensive) response is to match the higher bid price so as to retain market share. These findings suggest two points. First, the terminal price by itself is relevant only insofar as it affects elevators' market spreads. For example, if the cash price increases by $0.05 but all elevators change their bid prices by the same amount, the terminal price had no impact on the arbitrage conditions. Second, elevator managers are limited in their ability to use bid prices as a means of market boundary expansion due to the impact of producer transport costs.

Methodology

This analysis focuses on the impacts changes in arbitrage conditions have on a case study elevator's grain flows. Changes in a competitor's marketing margins are viewed as being derived from managerial decisions regarding asset configuration or pricing strategies. Grain flows are directed toward or away from the case study elevator, depending on competitors' bid prices. The premise is that, within a given market, slight changes in elevator bid prices are capable of drawing grain away from one facility to another.

A schematic of the model flow is provided in Figure 1. The model begins assuming that grain producers stand ready to deliver harvest season grain. The first flow in Figure 1 is informational – price signals are sent by elevators, and interpreted by producers (represented by solid lines). Producers then evaluate all market arbitrage opportunities using equation 1 as their guide. Producers will choose to deliver their grain to the facility whose bid price offers the highest margin once transportation expenses have been paid. The second flow is physical product, from producers to the grain facilities, denoted by dashed lines.

Figure 1. Flowchart of Model with Feedback Mechanism



Model Specification

A stochastic simulation model using @RISK® examines the effect of competitor elevators' bid price offerings on grain flows to a case study elevator. These effects are evaluated across an illustrative 12-week production period, September to November. Weekly production volumes are based on the 2002 crop progress schedule and a 5-year yield average for Number 2 corn and Number 1 soybeans in north central Indiana (NASS-IN). The selected grain market is a circular market area 50 miles in diameter, with the case study elevator located at the center. Farms are categorized by size (small, medium, or large) and production is assumed to be distributed evenly across the market area. Three of the 4 competing elevators are located within 15 miles of the case study elevator. The fourth elevator is assumed to be located just inside the market boundary.

Each week, equation 1 allocates available grain flows to all grain elevators in a given market area. Each producer in the market is assumed to deliver to the facility offering the highest return, net of transportation costs.

Changes to asset configuration may lower operational costs that can then be passed on to producers in terms of higher bid prices. It is also possible that changes to asset configuration could raise operational costs. Management's involvement in pricing wars may lead to changes in bid offerings to producers. Again, the priority is the case study elevator's competitive *response* to other market participants, not so much the derivation or impetus of a competitor's move.

Changes in competitor IP premiums are interpreted relative to a baseline scenario absent of price premiums. That is, grain flows are modeled using the market prices for all grain types with no additional premium being offered by competing elevators. Scenario 2-4 adds a $0.02 over price premium to competitors 1, 2, and the case study elevator sequentially. A final scenario evaluates the impact of offered premium variability, as the standard deviation in competitor 2's IP price distribution is reduced. Identity preserved grain price distributions are the same across IP grain types per competitor.

Data

Construction of market area, producer, and grain facility profiles draws largely on data provided by managers at the case study elevator and from Indiana Agricultural Select Indiana counties are the building blocks of the given market area. Producer profiles are based on three pieces of information: (1) producer density in the market area, (2) production volumes by farm size, of acreage harvested, and (3) geographic location. Competitor elevator data, specifically geographic location and bid price offerings, is defined relative to a case study elevator's location and historical cash price series.

The market area is defined as a six county region consisting of the five counties adjacent to the case study elevator, plus the county in which the case study elevator is located. These counties consistently appear in the state's top 10 corn and soybean rankings for total production and yield per acre in Indiana (IN NASS). In the six county market area, small farms (200-499 acres) account for 43 percent, or 610 of the total 1,405 farms (Table 1). Mid-size farms (500-999 acres) and large (1000+ acres) farms, account for 32 percent (454 farms) and 24 percent (341 farms) respectively (IN-NASS).

Table 1. Illustrative Farm Production Profile

Farm Size (Acres)	Average Harvested Acreage per Farm
200-499	326
500-999	701
1000+	1,599

Source United States Department of Agriculture, Indiana Agricultural Statistics Service, http://www.nass.usda.gov/in/

Producer production volume. Similarly, county production volumes are gathered from the Indiana Department of Agriculture. Total production volume from 1997 USDA Census data is divided by the number of producers, per county, and then averaged across the six county area (Table 1). A total of 124 medium and large (size) producers are randomly selected for IP–only production. Small producers are assumed to produce only commodity grains.

Grain types and production yields. The model uses a total of six grain types, three each of corn and soybeans (Table 2). Corn varieties include Number 2, nutritionally dense, and white corn. Bean varieties include Number 1, high protein, and tofu soybeans. A lack of IP yield data existed for Indiana so a yield-rule was created using Illinois data. This rule identifies IP yields as a percent of commodity yields (UIUC, The Value Project); the same commodity-IP yield relationship is applied to Indiana commodity yields to achieve an Indiana-based IP yield (IN-NASS). Per acre commodity yields are based on 5-year averages, 1997-2002 (IN-NASS). All grain type yields are deterministic. A total of 285,200 acres, or approximately 27 % of total market acreage, is allotted to IP production.

Table 2. Grain Type and Production Yields

Grain Type	Yield (Bushels per Acre)
Number 2 corn	139
Nutritionally dense	132
White	118
Number 1 soybeans	44
High protein	41
Tofu	38

Source: University of Illinois, Department of Agricultural and Consumer Economics, "The Value Project: Improving Farm Incomes and Rural Communities through Value-Added Agriculture." http://web.aces.uiuc.edu/value/Default.htm

Producer location. Producers are assumed to be evenly distributed across a circular market (radius 25 miles) area relative to a case study elevator location. The circular market area is characterized by 5-mile radial increments along which it is assumed producers are located. The radial increments are identified *a* through *e*, beginning closest to the facility and working outwards. The circular market area is further divided into quadrants. Thus, producer location is identified by quadrant and radial increment. The number of small, medium and large producers, per quadrant per radial increment, is calculated as a percent of harvested acreage each sector contributes to the quadrant. Each producer has a randomly generated location that is held fixed.

A range of possible distances to the grain facility is identified based on intersecting radials of a particular competitor elevator's and case study elevator's locale. A minimum distance of two miles is established for radial *a*. Each quadrant contains one competitor grain elevator in addition to the market area's centrally located case study elevator.

Transportation. It is assumed that all producers confront the same $ 0.02 per bushel per mile linear transportation cost as per the 2002 Iowa Farm Custom Rate Survey (Iowa State University). A transportation cost is calculated for each of the four competing elevators per producer per week.

Arbitrage Conditions. The distribution of grain flows across facilities is a function of Equation 1. All grain handling facilities are assumed to confront the same cash price distribution. However, factors within the firm may afford the firm more, or less, flexibility in the range of prices they can offer to producers. For example, a facility which can achieve higher efficiency levels may be able to offer higher bid prices to attract larger volumes to their facility because they have lowered their cost structure. The elevator's ability to achieve higher profit levels is conditioned on maintaining a competitive cost advantage. Should other facilities achieve similar efficiency levels, the first mover advantage is compromised and possibly even evaporates. It is also possible that elevator managers are less aggressive with pricing strategies in high production volume years, where competition has eroded a competitive advantage, or the grain market returns to a commodity-only scenario.[2]

Grain facilities are all subject to the same market/cash price and premia per grain type. The terminal cash price series observed at the case study elevator across fifteen years is the foundation for competitors' price series. A weekly, indexed cash price is estimated at the case

[2] For example, currently non-GMO grains are classified as IP grains. In the event that demand for non-GMO grains increases so as to rival standard commodity volumes, the previously considered IP grain would become another commodity grain type.

study elevator using an empirical distribution. Weekly cash prices are indexed to a 15-year marketing average to more effectively capture week and year variability. Competitor price series' use the case study elevator's estimated weekly prices as a base; variability is added through stochastic adjustments to the case study elevator's price mean and standard deviation. Price adjustments are based on a probable pricing strategy employed by the competitor given their type of facility (i.e., small, IP niche market elevator) (Table 3).

Identity preserved premiums are based on 2003 data as provided by the University of Illinois's Value Project. The IP corn premiums are \$0.22 per bushel (nutritionally dense corn) and \$0.10 (white corn). The IP soybean premiums are \$0.90 per bushel (high protein soybeans) and \$1.45 (tofu soybeans).

Competitor Location and Distance. Competitor facilities are incorporated into the market area based on discussions with elevator management. Four types of competitors are identified (Table 3). Competitor one is assumed to specialize in niche, or IP, market grains, located approximately 15 miles northwest of the case study elevator (Figure 2, example). Competitor two is assumed to be a terminal facility of similar storage capacity and bin configuration, relative to the case study elevator, located 15 miles northeast of the case study elevator. Competitor three is assumed to be a processor receiving grain deliveries directly from producers and located approximately 25 miles southeast of the case study elevator. A fourth competitor is a commodity-only facility situated 15 miles southwest of the case study elevator. Competitor four's capacity and configuration closely parallel that of the case study elevator's.

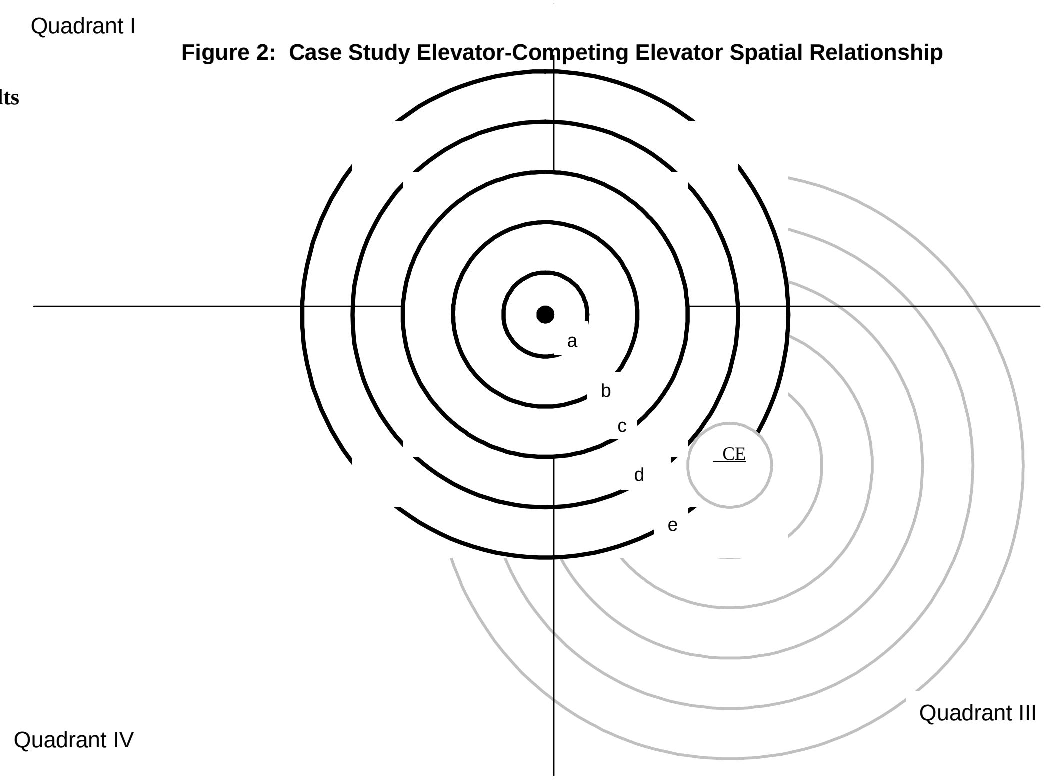
Table 3. Competitor Profiles

Competitor	Distance and Location*	Characteristics*	Likely Variability in Bid Price Distribution
1	15 miles NW	- Niche market elevator - Storage capabilities: more bins of smaller volume - Primarily truck transport from facility	Different mean, different standard deviation
2	15 miles NE	- Large, inland terminal elevator - Similar storage capacity and configuration	Same mean, same standard deviation
3	25 miles SE	- Processing facility utilizing direct delivery from producers - More storage capacity than niche market elevator but less than case study elevator	Same mean, different standard deviation
4	15 miles SW	- Large inland terminal elevator handling commodity grains only - Similar storage capacity and configuration	Same mean, same deviation

* Relative to the case study elevator

Figure 2: Case Study Elevator-Competing Elevator Spatial Relationship

Results



Results

Results from the grain flow model are presented in Tables 4-8. Results are interpreted from the case study elevator's perspective across the premium scenarios. Table 4 presents baseline results which assume no additional premium above the per bushel market value. Results model suggest absent additional premiums, the case study elevator would attract all 6 types of grain. Commodity corn and soybean volumes determined in the model closely resemble actual volumes received. Relative to other competitors also drawing all 6 grain types, the case study elevator attracts the smallest absolute volumes. Competitors 1 and 2 are almost equally competitive for IP soybean grains; competitor 2 is also competes with competitor 4, a commodity-only facility.

Scenario 2 evaluates grain flows when competitor 1 offers an additional $0.02 per bushel premium (Table 5). The case study elevator draws smaller volumes of both types of commodity grains and none of the high protein soybeans. Total volume of tofu soybeans, however, increases almost two fold. Competitor 3's lack of tofu beans suggests that producers could have received higher returns at closer distances, thus distributing tofu volumes among the case study elevator and competitors 1 and 2. When competitor 2 introduces a $0.02 over-price premium, its volumes of nutritionally dense and tofu grains increase by over 800,000 and 50,000 bushels respectively, relative to the baseline scenario (Table 6). Interestingly, this impacts the case study elevator by increasing all IP volumes except high protein soybeans of which the elevator now receives none. Presumably, the case study elevator is picking up IP volumes from quadrant IV of the market area the elevator now receives none.

Table 4. Grain Flows Across Market Area (Baseline Scenario)

	Grain Variety					
	#2 Corn	Nutritionally Dense	White	#1 Soybeans	High Protein	Tofu
	(Bushels)					
Case Study Elevator						
Mean	10,080,699	581,326	641,568	3,083,835	230,087	213,574
Standard Deviation	581,651	245,766	14,274	0	6,495	0
Minimum	9,427,817	41,095	613,888	3,083,835	217,790	213,574
Maximum	11,933,455	1,125,347	673,919	3,083,835	236,118	213,574
Competitor 1						
Mean		1,296,037	1,479,249		504,438	486,515
Standard Deviation		223,386	25,750		9,938	0
Minimum		221,137	1,429,695		496,121	486,515
Maximum		1,474,409	1,578,222		530,069	486,515
Competitor 2						
Mean	18,632,577	1,111,298	1,273,010	5,941,709	445,332	423,082
Standard Deviation	246,767	247,928	12,036	0	3,464	0
Minimum	17,834,318	160,002	1,219,481	5,941,709	434,540	423,082
Maximum	18,921,190	1,334,227	1,290,271	5,941,709	447,607	423,082
Competitor 3						
Mean	10,269,300	1,030,806	890,616	3,274,946	309,470	294,518
Standard Deviation	118,797	631,140	1,803	0	421	0
Minimum	9,839,364	152,438	871,042	3,274,946	306,577	294,518
Maximum	10,369,772	3,353,416	891,107	3,274,946	309,622	294,518
Competitor 4						
Mean	14,837,263			4,735,774		
Standard Deviation	217,101			0		
Minimum	14,212,703			4,735,774		
Maximum	15,101,059			4,735,774		

Table 7 illustrates the impact of the case study elevator's offering a $0.02 over price premium. Relative to the baseline, the elevator only attracts more of the lower-valued IP corn varieties and IP soybean volumes actually fall by approximately half. Even with the higher premium compared to competitors, the case study elevator is still not attracting the higher value IP varieties.

Table 5. Grain Flows Across Market Area (Scenario: Competitor 1 pays $0.02 premium/IP bushel)

	Grain Variety					
	#2 Corn	Nutritionally Dense	White	#1 Soybeans	High Protein	Tofu
	(Bushels)					
Case Study Elevator						
Mean	9,046,997	621,568	749,271	2,744,542	0	421,916
Standard Deviation	578,789	255,090	21,980	2,731	0	12,466
Minimum	8,409,998	60,504	611,042	2,669,853	0	330,224
Maximum	10,915,636	1,086,939	787,615	2,746,210	0	427,148
Competitor 1						
Mean		1,339,616	1,489,026		296,267	488,363
Standard Deviation		173,438	41,695		11,233	12,300
Minimum		235,976	1,197,538		221,552	384,400
Maximum		1,505,378	1,630,653		320,913	509,901
Competitor 2						
Mean	19,327,574	1,137,663	1,299,802	6,168,383	120,160	462,561
Standard Deviation	249,731	220,064	61,387	5,471	24,818	24,073
Minimum	18,487,976	163,877	1,198,941	6,129,329	88,600	435,791
Maximum	19,628,020	1,738,247	1,849,373	6,170,657	397,242	658,215
Competitor 3						
Mean	10,273,568	804,911	615,619	3,277,156	1,026,813	0
Standard Deviation	116,131	568,400	12,833	7,359	17,737	0
Minimum	9,840,215	87,539	495,765	3,273,710	824,447	0
Maximum	10,445,747	3,288,712	622,808	3,462,220	1,053,733	0
Competitor 4						
Mean	15,171,700			4,846,183		
Standard Deviation	215,717			6,562		
Minimum	14,521,210			4,774,863		
Maximum	15,455,446			4,882,871		

The final scenario evaluates the effect on market grain flows as one competitor reduces the variability in their $0.01 over premium price (Table 8). Competitor 2's price distribution and facility configuration are designed to closely mirror those of the case study elevator. The impact on the case study elevator is similar to the effects from a competitor $0.02 premium: commodity volumes fall slightly, the lower-valued IP corn variety volumes increase and higher-valued IP soybean varieties decrease (in the case of high protein, they fall to 0). Ultimately, the magnitude of the premium and change in degree of variability will determine the impact on the case study elevator's grain flows but it appears that the 2 effects cause the same directional changes for the case study elevator relative to baseline results.

Table 6. Grain Flows Across Market Area (Scenario: Competitor 2 pays $0.02 premium/IP bushel)

	Grain Variety					
	#2 Corn	Nutritionally Dense	White	#1 Soybeans	High Protein	Tofu
	(Bushels)					
Case Study Elevator						
Mean	9,046,997	628,250	743,593	2,744,542	0	415,332
Standard Deviation	578,789	253,300	28,356	2,731	0	18,334
Minimum	8,409,998	59,477	609,885	2,669,853	0	291,981
Maximum	10,915,636	1,094,916	791,007	2,746,210	0	427,148
Competitor 1						
Mean		1,300,736	1,443,906		285,513	474,024
Standard Deviation		170,727	49,194		13,924	16,211
Minimum		225,618	1,150,147		209,298	367,586
Maximum		1,462,412	1,577,731		313,165	486,515
Competitor 2						
Mean	19,327,574	1,196,490	1,355,044	6,168,383	148,805	483,482
Standard Deviation	249,731	227,590	83,262	5,471	33,823	34,071
Minimum	18,487,976	173,375	1,251,863	6,129,329	117,988	459,176
Maximum	19,628,020	1,917,235	1,897,921	6,170,657	426,899	703,781
Competitor 3						
Mean	10,273,568	778,722	611,174	3,277,156	1,008,922	0
Standard Deviation	116,131	563,397	18,207	7,359	22,948	0
Minimum	9,840,215	84,807	495,765	3,273,710	807,044	0
Maximum	10,445,747	3,284,827	622,808	3,462,220	1,031,712	0
Competitor 4						
Mean	15,171,700			4,846,183		
Standard Deviation	215,717			6,562		
Minimum	14,521,210			4,774,863		
Maximum	15,455,446			4,882,871		

Table 7. Grain Flows Across Market Area (Scenario: Case study elevator pays $0.02 premium/IP bushel)

	Grain Variety					
	#2 Corn	Nutritionally Dense	White	#1 Soybeans	High Protein	Tofu
	(Bushels)					
Case Study Elevator						
Mean	9,043,687	618,761	551,383	2,743,916	122,352	109,437
Standard Deviation	575,192	435,552	312,596	18,673	107,839	105,290
Minimum	8,409,998	35,384	28,206	2,168,306	8,115	3,238
Maximum	10,915,636	1,805,940	1,308,632	2,744,691	414,611	392,400
Competitor 1						
Mean		1,077,450	1,147,846		229,767	224,355
Standard Deviation		446,862	461,070		203,693	186,428
Minimum		79,817	104,740		0	11,027
Maximum		1,720,803	1,763,797		624,630	584,953
Competitor 2						
Mean	19,329,419	1,382,085	1,738,636	6,167,384	934,509	890,235
Standard Deviation	247,227	602,596	996,291	29,594	415,835	391,257
Minimum	18,460,108	224,351	210,009	5,276,414	116,125	119,575
Maximum	19,628,020	3,043,517	3,917,884	6,170,657	1,420,636	1,347,242
Competitor 3						
Mean	10,274,186	818,644	715,853	3,279,815	156,613	148,812
Standard Deviation	115,214	317,992	238,184	73,174	108,409	102,989
Minimum	9,840,215	139,296	84,898	3,275,229	8,581	8,163
Maximum	10,447,080	1,922,536	957,371	5,513,053	331,680	316,184
Competitor 4						
Mean	15,172,548			4,845,150		
Standard Deviation	215,612			25,896		
Minimum	14,526,479			4,078,492		
Maximum	15,461,020			4,879,473		

Table 8. Grain Flows Across Market Area (Scenario: Competitor 2 reduces IP premium variability)

	Grain Variety					
	#2 Corn	Nutritionally Dense	White	#1 Soybeans	High Protein	Tofu
	(Bushels)					
Case Study Elevator						
Mean	9,046,997	640,521	757,271	2,744,542	0	427,148
Standard Deviation	578,789	259,420	14,601	2,731	0	0
Minimum	8,409,998	63,475	723,157	2,669,853	0	427,148
Maximum	10,915,636	1,096,385	791,007	2,746,210	0	427,148
Competitor 1						
Mean		1,313,676	1,458,515		288,879	478,691
Standard Deviation		167,677	27,517		7,831	2,906
Minimum		232,615	1,400,069		274,524	471,237
Maximum		1,462,207	1,566,882		312,644	485,892
Competitor 2						
Mean	19,327,574	1,162,818	1,318,373	6,168,383	137,394	467,000
Standard Deviation	249,731	209,324	13,870	5,471	5,363	2,906
Minimum	18,487,976	179,707	1,262,712	6,129,329	121,922	459,800
Maximum	19,628,020	1,371,676	1,349,068	6,170,657	151,354	474,455
Competitor 3						
Mean	10,273,568	787,491	619,559	3,277,156	1,016,968	0
Standard Deviation	116,131	566,693	1,252	7,359	6,431	0
Minimum	9,840,215	88,132	600,967	3,273,710	995,173	0
Maximum	10,445,747	3,282,646	622,808	3,462,220	1,031,950	0
Competitor 4						
Mean	15,171,700			4,846,183		
Standard Deviation	215,717			6,562		
Minimum	14,521,210			4,774,863		
Maximum	15,455,446			4,882,871		

Conclusions

This paper has examined grain flow distributions across an illustrative market in north central Indiana from a case study elevator’s perspective. Arbitrage conditions are employed by producers to determine their best delivery option, represented by the highest return net of assembly costs.

In general, near-by competitors offering a $0.02 over price premium result in decreased volumes of higher-valued high protein soybeans but increased volumes of the highest-valued tofu variety by almost twice as much. Smaller premiums associated with IP corn varieties are equally as distance-sensitive; the case study elevator's location makes them an attractive delivery site for producers who receive smaller premiums to offset transport costs. This paper highlights the relationship between linear transportation costs and IP premium structures confronting the producer. Results suggest that the distance threshold for IP grains with smaller premiums is closer than it is for higher premium types. This paper began on the assumption that IP premiums would influence producer delivery decisions. Findings indicate that the elevator manager's need to be aware of the magnitude of variety premiums in assessing changes to their grain flows. Across premium scenarios, commodity volumes changed only nominally. This is expected in that they are only indirectly affected by IP market premiums. The underlying issue however is the cost in operational efficiency as the IP grains are added to an individual elevator's facility. Examination of the costs of incorporating IP grains into a facility's product mix will involve evaluation of the economics costs of adding additional grain types, with attribute preservation requirements to a commodity-system.

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