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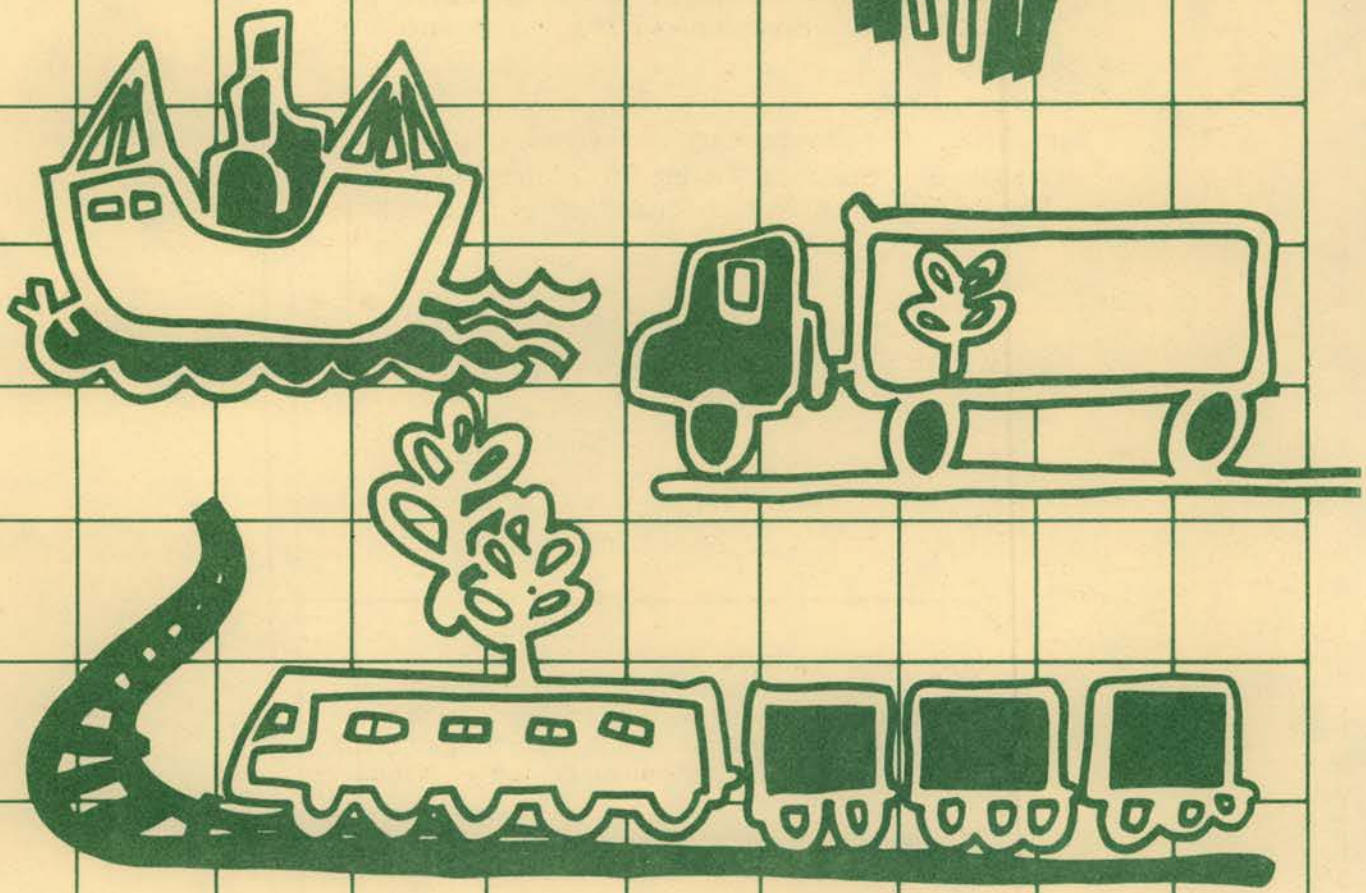
Adoption of New Marketing Methods By Idaho Grain Producers

Brian L. Calkins and Neil L. Meyer



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Executive Summary

Agricultural producers are adopting new marketing methods in response to institutional and technological changes in transportation. Two recent major changes influencing Idaho producers are barge transport on the lower Snake River and railroad deregulation.

Completion in 1975 of Lower Granite Dam allowed barges to travel up the Snake River as far as the port of Lewiston, Idaho. This gave truck and barge transport a comparative advantage over rail transport in northern Idaho. Commodities are trucked to subterminal elevators at river port sites and then transported by barge to export facilities located in the area of Portland, Oregon.

Railroads recently acquired greater freedom to act competitively because of the 1980 Staggers Rail Act that deregulated the railroad industry. The result has been the offering of multicar rates, the signing of contracts for grain shipment and the development of subterminal elevators at unit train loading sites.

This bulletin describes how Idaho grain producers have adopted marketing methods to take advantage of opportunities offered by changing transport structures. Producers are divided into two groups for comparison. Nondirect shippers are those who market their grain to local country elevators. Direct shippers generally market their grain directly to users or to subterminal elevators capable of loading barges or 25-car trains. Subterminal elevators can offer higher grain prices than country elevators because of volume discounts for shipping and lower per unit handling costs. Producers are hauling grain farther in larger sized trucks to take advantage of the higher prices.

Introduction

This bulletin is part of a series describing the effect of technological and institutional changes in transportation on the production and marketing of agricultural commodities. The purpose of the research is to identify the operating rules and methods used for transporting Idaho's agricultural commodities from farm to market. These rules and methods, upon identification, will provide the basis for evaluating potential rule changes and new technologies. Adoption of production and marketing methods that enhance Idaho's agribusiness industry will possibly result from this evaluation.

Efficient marketing and transport of agricultural commodities from farm to market are essential to farm producers. To realize greater returns, some Idaho grain producers are selling their production directly to users (i.e. feedlots, mills, exporters or malters). Country elevators that have traditionally handled, stored and marketed farmers' grain are being bypassed by producers. Producers are able to market grain directly because of recent institutional and technological changes: railroad deregulation, barge transport up the lower Snake River to Lewiston, on-farm storage and increased truck hauling capacity. Producers who have adapted their marketing patterns to these changes are innovators and are very likely anticipating the future of grain marketing. How common and how different are direct shipping producers from producers using the country elevator? These topics are addressed in this bulletin.

Background Information

Historically, in the latter part of the 19th century and the early part of the 20th century, wagons hauled farm commodities over poorly maintained dirt roads to railroad access points. Commodities were then hauled long distances to terminal markets for processing and distribution. Commodity transport changed as increased numbers of motorized trucks and paved roads introduced before World War II created greater efficiency in short hauling (Shepherd and Futrell 1982). This led to decentralized country

elevators that were usually located along railroad lines where the grain could readily be shipped to export ports or other terminal markets.

Shipment from farm to market of grain produced in Idaho has in recent years been affected by technological and regulatory changes in transportation. Truck use has replaced railroad transport for most shorter hauls because of the development of the interstate highway system and improved secondary roads.

Beginning in 1975, transport by truck to grain subterminals located at lower Snake River ports and then by barge to Portland, Oregon, replaced most rail shipment of wheat from northern Idaho (Abbott and Jones 1979). This resulted in further abandonment of short haul railroad lines. Railroads, freed from outmoded regulation by the 1980 Staggers Rail Act, introduced multiple car freight rates to increase competition with truck or truck-barge shipment. Consequently, unit train loading facilities have developed since 1980 at selected sites in southern Idaho (Fig. 1).

Off-farm storage has also played an important role in determining how producers market grain in Idaho. Large cooperative country elevators possessing substantial storage capacities have developed in northern Idaho where soft white wheat has historically been the major crop grown under dryland conditions. Comparatively, smaller private elevator firms serving primarily in handling and selling grain evolved in southern Idaho where the development of irrigation permitted major increases in grain production at a later time.

River ports and unit train loading sites, both of which are referred to as subterminals, allow for bypassing country elevators. Therefore, producers can bypass by either shipping directly to users or through subterminal sites from which shipment is then channeled to users (Kohl and Uhl 1980).

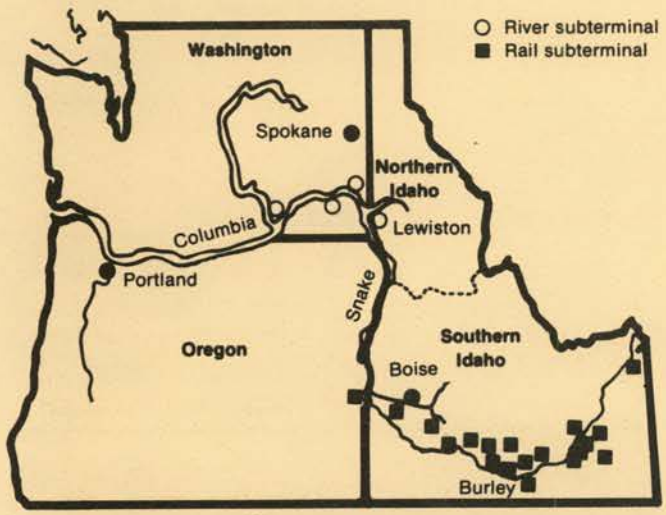

Fig. 1. River and rail subterminals available for shipment of grain produced in Idaho in 1981.

Study Objective

This study's objective was to describe and contrast the characteristics of Idaho grain producers, grouped according to shipment of production directly and nondirectly, and according to farm location in either northern Idaho or southern Idaho. All counties north of and including Idaho County are considered northern Idaho, whereas southern Idaho encompasses the remaining counties (Fig. 1). Grain was categorized according to type: white wheat, red wheat, malting barley, feed barley and all four grains taken together. Specific objectives that highlight differences between the two selling groups included:

1. Identifying grain production sold directly and nondirectly. Production of different grain varieties was not mutually exclusive. A producer could be considered in the analysis several times by producing different types of grains.
2. Comparing producer averages of farm size, production and producer owned on-farm storage.
3. Listing average distances grains were hauled from field to selected storage facilities and market destinations over private roads, county and local roads, and state and federal highways.
4. Profiling direct shipping grain producers in relation to ownership of trucks employed for hauling.
5. Tabulating the number and size of producer-owned trucks employed for grain transport.

Data Description

A survey mailed in September of 1982 to 1,321 Idaho grain producers provided primary data for the study. Nine-hundred sixty-four (964) usable questionnaires were returned, which is a 78 percent response rate. This was achieved using the Dillman "Total Design Method" (Dillman 1978). Information obtained by the survey was for 1981 production.

Coding, tabulation and analysis of data were facilitated through the use of the Statistical Package for the Social Sciences (SPSS). Only farms producing 5,000 bushels or more of grain were included in the subsequent analysis. Seventy-six percent of the producers returning usable questionnaires had farms meeting or exceeding the required minimum production.

Study Results

Grain Production: Direct and Nondirect Shipment — Producers indicated total quantities and percentages shipped directly for four different grains. Table 1 summarizes the figures for southern and northern Idaho. Results are initially discussed for southern Idaho followed by northern Idaho as indicated.

More than one-third of the sampled 1981 southern Idaho production was shipped directly from the farm to users or to subterminals. With a total 1981 production of 118,549,800 bushels of wheat and barley in southern Idaho (Idaho Crop and Livestock Reporting Service 1982), an estimated 40 million bushels would likely be shipped directly. Direct shipment of individual grains ranged from 19.3 percent for red wheat, to 35.8 percent for white wheat, to 43.4 percent for feed barley and up to 52.1 percent for malting barley.

Variation among percentages of direct shipment from the farm for different grain types produced in southern Idaho can be explained in part by referring to a survey of grain movements from elevators to market as reported by Abbott and Jones (1979). Most importantly, shipping by truck rather than by rail increases the probability of bypassing country elevators through loading trucks in fields or from farm storage. Direct shipment is, therefore, associated with increased truck use. Consequently, the relatively low quantity of red wheat shipped directly primarily resulted from the relatively high use of rail shipment of this grain to millers in Ogden, Utah, and Los Angeles, California, for domestic breadmaking. Of all red wheat produced in southern Idaho, 76 percent was shipped by rail and 24 percent by truck.

In this study's survey, 35.8 percent of southern Idaho white wheat was shipped directly by truck from the farm. Comparatively, Abbott and Jones (1979) indicated that 41 percent of the white wheat shipped by elevators to lower Columbia River coastal ports was transported by trucks.

The slightly higher percentage of 43.4 percent for feed barley shipped directly resulted from producers supplying this grain to southern Idaho feedlots. Abbott and Jones (1979) reported elevators conveyed 26 percent of feed barley to southern Idaho destinations with trucks transporting 76 percent. The highest percentage of direct shipment, 52.1 percent for malting barley, reflected the contract nature of sale to malters in brewing centers in Golden, Colorado; Milwaukee, Wisconsin; and Vancouver, Washington.

Table 1 indicates a lower percentage of direct shipped grain for northern Idaho producers. Overall, 18.5 percent, or almost half the percentage for southern Idaho, of 1981 grain production was shipped directly from the farm. The lower percentage of directly shipped grain is most likely caused by the market power of the northern Idaho country elevators which had more than three times the capacity for loading and receiving grain than southern Idaho elevators (Turnbull and Sargent 1978). With a total 1981 production of 34,360,200 bushels of wheat and barley in northern Idaho (Idaho Crop and Livestock Reporting Service 1982), a calculated 6,357,000 bushels would likely be shipped directly.

The direct shipped percentages for white wheat and feed barley, the two major grain crops, vary only slightly. Abbott and Jones (1979) reported country elevators shipped almost all white wheat (85 percent) by truck-barge arrangement through river port subterminals. Alternatively, feed barley was mostly shipped by rail from elevators to neighboring Washington state feedlots because shipments of white wheat dominated available barge capacity.

Red wheat, produced only in the northern most counties of northern Idaho, was not significantly represented to warrant any conclusions. Also, malting barley shipments were almost entirely nondirect. Because of limited representation of red

Table 1. Production and shipment of selected grains of sampled Idaho producers, 1981.

	Production shipped nondirect		Production shipped direct		Total production
Crop	Bushels	% of total production	Bushels	% of total production	Bushels
Southern Idaho					
White wheat	3,554,975	64.2	1,986,635	35.8	5,541,610
Red wheat	3,901,270	80.7	932,697	19.3	4,833,967
Malting barley	622,460	47.9	676,260	52.1	1,298,720
Feed barley	2,423,902	56.6	1,857,228	43.4	4,281,130
All grain[1]	10,502,607[2]	65.8	5,452,820	34.2	15,955,427
Northern Idaho					
White wheat	6,153,841	82.0	1,347,088	18.0	7,500,929
Red wheat	102,628	29.1	249,780	70.9	352,408
Malting barley	926,732	98.0	18,473	2.0	945,205
Feed barley	1,978,078	81.0	463,165	19.0	2,441,243
All grains[1]	9,161,279[3]	81.5	2,078,506	18.5	11,239,785
Total Idaho	19,663,886	72.3	7,531,326	27.7	27,195,212

[1]White wheat, red wheat, malting barley and feed barley.

[2]Includes 1,143,621 bushels of grain produced by direct shippers but shipped nondirect.

[3]Includes 484,564 bushels of grain produced by direct shippers but shipped nondirect.

wheat producers and of malting barley producers shipping directly, no further analysis between direct shippers and nondirect shippers for the two grains was conducted for northern Idaho.

Farm Size, Production and On-farm Storage — Direct shipping producers were hypothesized as operating larger farms than nondirect shippers in terms of acreage, production and on-farm storage volume. Larger farms were assumed to possess the resources of enhanced management and marketing skills required for direct shipment. Tables 2 and 3 address the hypothesis with sample means calculated from the data base.

Southern Idaho figures as listed in Table 2 offer only limited support for the submitted hypothesis. The only significant size difference between direct and nondirect respondents was with feed barley where production was more than 60 percent greater for direct shippers. Although white wheat recorded a similar relationship between subpopulations, 31 percent greater for direct shippers, the difference was not significant because of greater variability in subpopulation distributions.

Although no significant mean differences were recorded for farm size or for on-farm storage, red wheat producers shipping direct had, on the average,

Table 2. Farm size, production and on-farm storage of southern Idaho grain producers shipping direct and nondirect, 1981.

	Nondirect shippers		Direct shippers	
	Mean	Number of respondents	Mean	Number of respondents
White Wheat				
Farm size (acres)	1,011	149	848	86
Production (bu)	20,387	154	26,688	90
On-farm storage (bu)	36,455	114	38,165	74
Red Wheat				
Farm size (acres)	1,651	151	2,309	54
Production (bu)	23,761	152	23,507	52
On-farm storage (bu)	34,954	137	42,396	49
Malting Barley				
Farm size (acres)	1,312	36	1,313	45
Production (bu)	15,421	37	16,934	43
On-farm storage (bu)	40,275	32	34,925	36
Feed Barley				
Farm size (acres)	1,208	166	1,317	115
Production (bu)	12,054	169	19,345[1]	116
On-farm storage (bu)	32,303	142	35,503	98
All Grains[2]				
Farm size (acres)	1,255	243	1,261	214
Production (bu)	33,403	249	36,972	214
On-farm storage (bu)	33,209	200	35,213	180

[1]Significant difference between direct and nondirect means at $p < 0.01$, 2 tailed t-test. Refer to Appendix B for discussion of statistical testing.

[2]White wheat and/or red wheat and/or malting barley and/or feed barley.

Table 3. Farm size, production and on-farm storage of northern Idaho grain producers shipping direct and nondirect, 1981.

	Nondirect shippers		Direct shippers	
	Mean	Number of respondents	Mean	Number of respondents
White Wheat				
Farm size (acres)	1,135	222	1,713[1]	41
Production (bu)	25,808	225	41,322[1]	41
On-farm storage (bu)	38,464	77	66,038[1]	37
Feed Barley				
Farm size (acres)	1,135	164	1,510	31
Production (bu)	11,329	164	20,113[2]	29
On-farm storage (bu)	36,553	62	67,234[1]	29
All Grains[3]				
Farm size (acres)	1,138	222	1,629[2]	49
Production (bu)	36,839	224	54,160[2]	46
On-farm storage (bu)	30,737	75	65,018[1]	45

[1]Significant difference between direct and nondirect means at $p < 0.01$, two tailed t-test. Refer to Appendix B for discussion of statistical testing.

[2]Significant difference between direct and nondirect means at $0.01 < p < 0.05$, two tailed t-test.

[3]White wheat and/or red wheat and/or malting barley and/or feed barley.

40 percent more acreage and 21 percent more on-farm storage than nondirect shippers. No substantial difference was detected between subpopulations of respondents indicating any on-farm storage. For all grain producers, irrespective of shipping method, four out of five respondents had on-farm storage.

Several possible reasons for lack of support for the hypothesis exist. First of all, the population of southern Idaho farms is quite heterogeneous, ranging across a wide geographical and climatological region with both irrigated and nonirrigated crops. Secondly, producers may not have yet responded to unit train loading sites and multicar rates that have been only established in 1980. Finally and probably most importantly, southern Idaho producers who encounter handling and selling rates from country elevators one-third the size of northern Idaho elevators were able to ship directly without possessing the necessary countervailing resources commanded by larger farm operations.

Conclusive evidence, as shown by Table 3, supported the hypothesis in northern Idaho. Subpopulation means for direct and nondirect shipping producers of white wheat, feed barley and all grains were nearly all significantly different by farm size, production and on-farm storage. The differences between subpopulation means for white wheat producers were especially noteworthy. Direct shipping producers had, on the average 51 percent more acreage, 60 percent more production and 72 percent more on-farm storage. Northern Idaho, in contrast to southern Idaho, showed a difference between subpopulations in relation to the presence of on-farm storage. Of grain producers, 98 percent of direct shippers had on-farm storage while only 33 percent of nondirect shippers indicated on-farm storage.

Grain Transport from Farm to Market — Average distances grain was transported by Idaho producers were estimated for four different categories. These destination categories which were not mutually exclusive for individual producers included:

1. Field to commercial storage,
2. Field to market,
3. Field to producer-owned storage and
4. Producer-owned storage to market.

Table 4 indicates one-way mean distances grain was transported, divided among private roads, local and county roads and state and federal highways. Percentages of travel over the three segments are also tabulated along with the number of producers responding to that particular category. The mean distances for grain transport are also graphically portrayed in Figs. 2 and 3 for southern and northern Idaho, respectively.

The data support several conclusions. Within destination categories, direct shippers transported grain farther. For example, the mean distance from field to commercial storage for southern Idaho direct shippers was 15.1 miles and 13.6 miles for nondirect shippers. The same category comparison for northern Idaho yielded significantly different means of 11.4 miles for direct shippers and 6.9 miles for nondirect shippers. Distances from field to market and

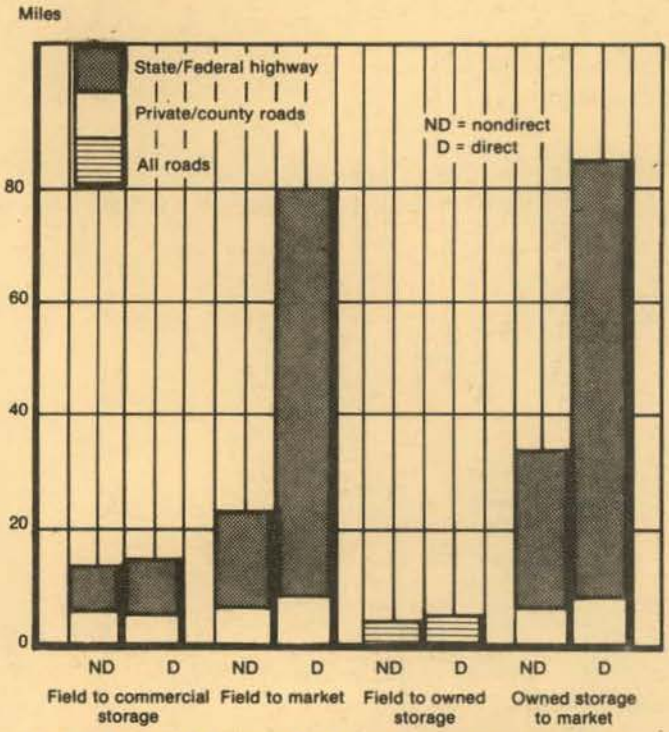

Fig. 2. Transport distances from farm to market for southern Idaho grain producers.

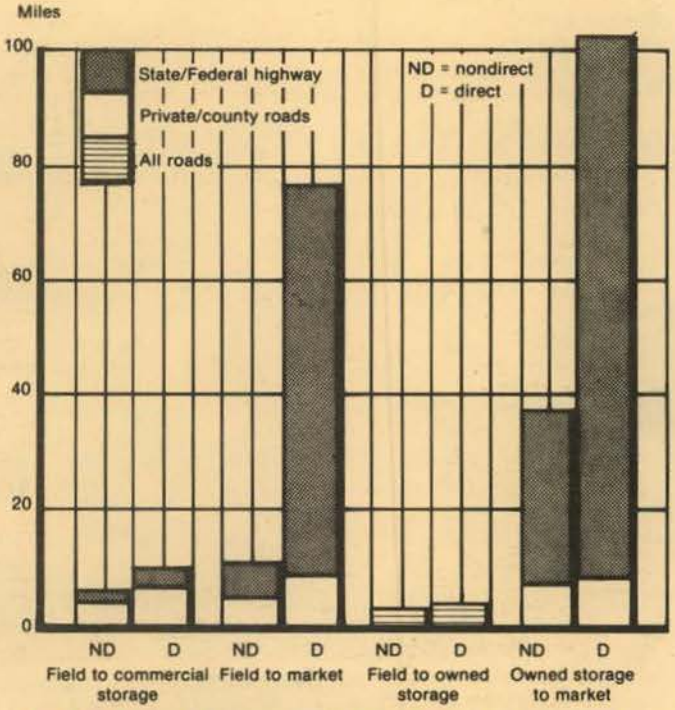

Fig. 3. Transport distances from farm to market for northern Idaho grain producers.

producer owned storage to market showed progressively greater magnitudes. Field to market distance for direct shippers in southern Idaho was 66.4 miles while for nondirect shippers it was 23.1 miles. From producer owned storage to market, the figures were 84.7 and 33.8 miles for direct shippers and nondirect shippers, respectively.

In northern Idaho, differences were even greater. From both field to market and producer owned storage to market, direct shippers transported grain a coincidental 66 miles farther.

Table 4 also shows the percentage of distance grain was hauled over different kinds of roads. Travel over private roads was negligible except from field to producer owned storage. Percentages for local and county roads and state and federal highways varied in relation to distance both within and between destination categories. In general, as transport distance increased, the percentage traveled over state and federal highways increased, while the proportion traveled over local and county roads decreased. This occurred because the major share of additional travel was over state and federal highways.

The number of producers responding to a destination category provides a good profile of grain storage use. Nondirect shippers were more likely to use commercial storage, especially in northern Idaho, where the difference was 94 percent and 59 percent for nondirect and direct, respectively (Table 4). As anticipated, the relationship was reversed for producer-owned storage. With percentages given for producer-owned storage to market, the southern Idaho group showed 64 percent for nondirect and 69 percent for direct shippers having on-farm storage. In northern Idaho, 25 percent of nondirect shippers had on-farm storage compared with 88 percent for direct shippers. This substantial difference coincides with results reported earlier concerning mean bushels of on-farm storage for northern Idaho farms.

On-farm storage is essential for direct shipping producers. It allows producers shorter hauls at harvest, the flexibility to time grain sales and choose market destinations to their best advantage. Unlike commercial storage where cost increases with time, the cost of on-farm storage is relatively fixed per storage period. In addition, on-farm storage allows

Table 4. Mean mileages grain[1] was transported one-way by Idaho producers in 1981 shipping direct or nondirect over private roads, county/local roads and state/federal highways.

	Southern Idaho					Northern Idaho				
	Private road	County/ local road	State/ federal highway	Total distance	Number of respondents	Private road	County/ local road	State/ federal highway	Total distance	Number respondents
Field to Commercial Storage										
Nondirect										
Mean miles[2]	0.5	5.5	7.6	13.6	195	0.3	4.2	2.3	6.9	213
% of total[3]	4	41	56		(78%)[4]	5	62	34		(94%)
Direct										
Mean miles	0.7	4.9	9.5	15.1	145	0.5	6.5	4.6	11.4[6]	29
% of total	5	32	63		(67%)[5]	3	57	40		(59%)
Field to Market										
Nondirect										
Mean miles	0.6	5.9	16.3	23.1	194	0.3	4.8	6.5	11.6	188
% of total	3	25	72		(78%)[4]	3	41	56		(83%)
Direct										
Mean miles	0.8	7.2	58.4	66.4[6]	171	0.5	8.5	68.6	77.6[6]	40
% of total	1	11	88		(79%)[5]	1	11	88		(82%)
Field to Producer-owned Storage										
Nondirect										
Mean miles	0.8	2.9	1.0	4.6	184	0.6	1.7	1.2	3.5	65
% of total	16	62	21		(74%)[4]	16	49	35		(29%)
Direct										
Mean miles	1.0	2.4	1.5	4.9	170	0.8	1.5	1.6	3.9	46
% of total	20	49	31		(79%)[5]	20	39	42		(94%)
Producer-owned Storage to Market										
Nondirect										
Mean miles	0.5	6.2	27.0	33.8	160	0.2	7.1	30.3	37.7	58
% of total	2	18	80		(64%)[4]	1	19	80		(26%)
Direct										
Mean miles	0.3	7.0	77.4	84.7[6]	150	0.4	7.9	95.3	103.5[6]	43
% of total	0	8	91		(69%)[5]	0	8	92		(88%)

[1]White wheat and/or red wheat and/or malting barley and/or feed barley.

[2]Sum of separate road distances may not equal total distance because of rounding error.

[3]May not total to 100% because of rounding error.

[4]Percentage of grain producers shipping **nondirect** who responded to the given category.

[5]Percentage of grain producers shipping **direct** who responded to the given category.

[6]Significant difference between direct and nondirect total distance means at $p < 0.01$, two tailed t-test.

greater freedom in choosing where and how to market grain.

Comparison between individual grains in relation to transport distances was also conducted. Differentiated means for total distances are tabulated in Appendix Tables 1 through 3. In southern Idaho, both direct and nondirect producers transported red wheat farther than white wheat. From field to market, producers shipping nondirect and direct had mean mileages of 38.7 and 89.5, respectively, for red wheat as compared to 20.8 and 39.4 miles, respectively, for white wheat. The differences reflect cultivation of white wheat on irrigated land located closer to market centers, while red wheat is produced farther from communities on dry upland fields.

Comparison of northern Idaho white wheat and feed barley producers, portrayed in Appendix Table 2, shows substantial differences in distances the two grains were shipped directly. For example, the mean distances from producer-owned storage to market were 93.5 and 125.5 miles for white wheat and feed barley, respectively. This difference between the two grains resulted from producers shipping feed barley to Columbia Basin feedlots and shipping white wheat to Columbia River and Snake River ports.

Truck Ownership and Trucking Arrangement — Evidence has been presented, especially for northern Idaho, which suggests direct shipping producers operate larger farms. This should increase the requirement of the number and size of trucks owned by direct shippers as compared to nondirect shippers. Table 5 offers such a comparison for northern and southern Idaho grain producers. For five truck types, differentiated according to size, the total number of trucks and trucks per producer are listed for each shipping sub-population. Overall, for both northern and southern Idaho, significant differences, as tested by a Chi-square test of independence, existed between direct and nondirect shippers. In southern Idaho, with all types combined, each direct shipper owned 3.08 trucks, while each nondirect shipper owned 2.93 trucks.

More informative is the comparison of individual truck types, where for southern Idaho, nondirect shippers owned more 2-axle trucks that average 330 bushels per load. Direct shippers substituted by owning more, larger capacity trucks, especially the 3-axle tandem which carries more than 500 bushels.

Northern Idaho producers presented an even clearer distinction between shipping sub-populations. The ownership of all truck types combined showed 2.49 trucks per nondirect shipper and 3.15 trucks per direct shipper. Nondirect shippers owned more 2-axle trucks (2.32 compared to 2.09 per producer), but direct shippers definitely exhibited a preference for 3-axle (.78 to .14 per producer) and 3, 4 or 5-axle semis (.28 to .03 per producer).

Truck ownership, differentiated according to individual grains, is tabulated in Appendix Table 4. Results and conclusions do not differ markedly from Table 5 where grains are aggregated.

Direct shipping producer responses concerning ownership of all trucks used for direct shipment and the party arranging the trucking are identified in Tables 6 and 7. Table 6 indicates that for southern Idaho producers of malting and feed barley, about 60 percent of the trucks employed for direct shipment were producer-owned. Although 48 percent of

Table 5. Total trucks and trucks per Idaho producer shipping grain[1] direct and nondirect, 1981.

	Nondirect shippers		Direct shippers		
	Total number of trucks	Trucks per producer	Total number of trucks	Trucks per producer	Chi-square statistic
Southern Idaho					
Trucks Type[2]					
2-axle	462	1.99	348	1.71	
3-axle tandem	185	0.80	233	1.14	
3- or 4-axle semi	16	0.07	18	0.09	
5-axle semi	17	0.07	29	0.14	
Totals	680	2.93	628	3.08	22.76[3]
Number of producers	232		204		
Northern Idaho					
Truck Type					
2-axle	501	2.32	96	2.09	
3-axle tandem	30	0.14	36	0.78	
3-, 4- or 5-axle semi	7	0.03	13	0.28	
Totals	538	2.49	145	3.15	76.18[4]
Number of producers	216		46		

[1]White wheat and/or red wheat and/or malting barley and/or feed barley.

[2]Idaho law specifies the maximum gross loads for trucks hauling unprocessed agricultural commodities: 2-axle, 30,000 lb; 3-axle tandem, 47,800 lb; 3-axle semi, 50,000 lb; 4-axle semi, 67,800 lb; and 5-axle semi, 80,000 lb (Idaho Department of Transportation 1983).

[3]Significant chi-square statistic at a = 0.05 and df = 3 strongly suggested dependence between truck type and shipping method. Refer to Appendix B for discussion of statistical testing.

[4]Significant chi-square statistic at a = 0.05 and df = 2 strongly suggested dependence between truck type and shipping method.

trucks used for direct shipment of white wheat were producer owned, 45 percent were owned by buyers or commercial truckers. For red wheat, producers were the least likely to own trucks since 67 percent were either owned by buyers or commercial truckers. Producers were most likely to have arranged for the trucking of the product except for red wheat where one-half of the trucking was buyer arranged. Red and white wheat were more likely than malting and feed barley to be directly shipped by commercial truckers with brokers arranging the trucking.

Northern Idaho direct shipping producers, as profiled in Table 7, were more likely than southern Idaho producers to ship with commercially owned trucks and less likely with buyer-owned vehicles. Commercial trucks transported white wheat for 51 percent of producers; the destination most likely being inland ports on the Snake and Columbia rivers. Although producers arranged the trucking for the majority of direct shipments of both white wheat and feed barley (46 and 52 percent) respectively, near similar percentages were arranged by buyers or brokers combined.

Summary

Idaho grain producers were surveyed and classified according to direct and nondirect shipment of 1981 production. More than one-third (40 million bushels) of grain produced in southern Idaho was shipped directly to users (i.e. feedlots, mills, exporters or malters) or to sub-terminal sites located on rail lines or inland waterways. Grain shipped nondirectly flowed first through local county elevators before being transported to users or to sub-terminal sites. In southern Idaho, differentiation according to grain type showed a range in percentage shipped directly from 19 percent for red wheat, to 36 percent for white wheat, to 43 percent for feed barley and up to 52 percent for malting barley. For northern Idaho, 18.5 percent (6.4 million bushels) of 1981 grain production was shipped directly without much difference between the percentage of white wheat and feed barley shipped directly.

Direct shipping producers were hypothesized as being operators of bigger farms producing more bushels of grain and owning more on-farm storage. Limited support for the hypothesis occurred for southern Idaho producers. Although direct shippers appeared to farm larger acreages with greater production than nondirect shippers, the differences were not significant, mainly because of excessive variability in subpopulation distributions. The exception was with feed barley where direct shippers had a significant 60 percent greater production volume.

Northern Idaho, in comparison, provided substantial support for the hypothesis. Significant differences between direct and nondirect shippers were registered for farm size, production and amount of on-farm storage. Direct shippers producing white wheat had 51 percent more acreage, 60 percent more production and 72 percent more on-farm storage volume. In addition, nearly all direct shippers possessed on-farm storage, while only one-third of nondirect shippers indicated so.

Also surveyed were transport distances, measured in one-way miles, traveled by trucks from farm to market and the percentage of distance traveled divided among private roads, local and county roads and state and federal highways. Farm to market transport was differentiated into four destination categories:

1. Field to commercial storage;
2. Field to market;
3. Field to producer-owned storage; and
4. Producer-owned storage to market.

Within destination categories, direct shippers transported grain farther. This was especially evident from field to market and from producer owned storage to market. In southern Idaho, field to market mileages ranged from 66 miles for direct shippers to 23 miles for nondirect shippers. In northern Idaho, a more substantial difference of 78 miles and 12 miles was registered.

The survey showed as transport distances increased in magnitude, the proportion of travel over state

Table 6. Profile of direct shippers in relation to truck ownership and trucking arrangement, southern Idaho.

	Crop			
	White wheat	Red wheat	Malting barley	Feed barley
	(%)	(%)	(%)	(%)
Ownership of trucks used for direct shipment:				
Buyer	17	35	13	25
Seller	48	26	60	57
Commercial trucker	28	32	20	15
No response	8	7	7	3
Who arranges for trucking of crop?:				
Buyer	28	50	24	32
Seller	43	22	58	44
Broker	10	11	2	3
No response	19	17	16	21

Table 7. Profile of direct shippers in relation to truck ownership and trucking arrangement, northern Idaho.

	Crop	
	White wheat	Feed barley
	(%)	(%)
Ownership of trucks used for direct shipment:		
Buyer	12	6
Seller	37	55
Commercial trucker	51	39
No response	0	0
Who arranges for trucking of crop?:		
Buyer	36	32
Seller	46	52
Broker	15	13
No response	2	3

and federal highways increased while the proportion over local and county roads decreased. Differentiation according to grain type indicated that in southern Idaho, red wheat was transported farther than white wheat, and in northern Idaho, feed barley was transported farther than white wheat. For all Idaho and especially northern Idaho, nondirect shippers were more likely to use commercial storage (94 percent vs. 54 percent).

The number and capacity of trucks owned by producers were compared in relation to direct or nondirect shipping. Direct shipping producers were found to own more trucks overall. In southern Idaho, the comparison showed 3.1 trucks per direct shipper and 2.9 trucks per nondirect shipper. In northern Idaho, the difference was even greater at 3.2 to 2.5 trucks per owner. For both northern and southern Idaho, nondirect shippers owned more 2-axle trucks that direct shippers substituted by owning more 3-axle tandem trucks and semitrailer-tractor combinations.

Direct shipping producers were also querried concerning ownership of all trucks used for direct shipment and for the identity of the party arranging the trucking. In southern Idaho, 60 percent of the trucks used for transport of direct shipped barley were producer-owned. Although a majority, 48 percent, of southern Idaho producers shipping direct indicated white wheat was hauled by producer-owned trucks, a near similar percentage was hauled by buyer and commercial trucks combined. For red wheat, two-thirds of southern Idaho producers indicated hauling by buyer or commercially owned trucks. Southern Idaho producers most likely arranged the trucking of their product except for red wheat where trucking was arranged by buyers for more than one-half of the observations.

In northern Idaho, producers were more likely to ship with commercially-owned trucks and less likely with buyer or producer-owned vehicles. For instance, 51 percent of white wheat producers shipped with commercial trucks. Trucking for a majority of northern Idaho direct shipments was arranged by producers, but a near similar proportion were buyer or broker arranged.

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Appendix A — Supplementary Tables

Table 1. Mean mileages selected grains were transported one-way by southern Idaho producers in 1981 shipping direct or nondirect over private roads, county/local roads and state/federal highways.

	White wheat					Red wheat				
	Private road	County/ local road	State/ federal highway	Total distance	Number of respondents	Private road	County/ local road	State/ federal highway	Total distance	Number of respondents
Field to Commercial Storage										
Nondirect										
Mean miles[1]	0.5	4.9	6.5	11.9	124	0.7	5.9	9.3	15.9	122
% of total[2]	4	41	55		(81%)[3]	4	37	58		(80%)[5]
Direct										
Mean miles	0.4	4.4	8.4	13.2	55	1.4	6.0	12.9	20.2	43
% of total	3	33	63		(61%)[4]	7	30	64		(80%)[6]
Field to Market										
Nondirect										
Mean miles	0.7	5.4	14.7	20.8	121	1.2	6.5	30.9	38.7	127
% of total	3	26	71		(79%)[3]	3	17	80		(84%)[5]
Direct										
Meal miles	0.5	6.1	32.8	39.4[7]	70	1.5	6.5	81.5	89.5[8]	40
% of total	1	15	83		(78%)[4]	2	7	91		(74%)[6]
Field to Producer-owned Storage										
Nondirect										
Mean miles	0.9	3.1	0.9	4.9	103	0.8	2.6	0.8	4.2	130
% of total	18	64	18		(67%)[3]	18	63	20		(86%)[5]
Direct										
Mean miles	0.8	2.0	0.7	3.5	76	1.8	2.4	4.1	8.3	46
% of total	23	58	19		(84%)[4]	21	30	49		(85%)[6]
Producer-owned Storage to Market										
Nondirect										
Mean miles	0.5	5.0	26.3	31.8	91	0.7	7.0	38.0	45.7	115
% of total	1	16	83		(59%)[3]	2	15	83		(76%)[5]
Direct										
Mean miles	0.4	6.1	70.9	77.3[9]	62	0.3	6.7	91.4	98.4[8]	39
% of total	0	8	92		(69%)[4]	0	7	93		(72%)[6]

[1]Sum of separate road distances may not equal total distance because of rounding error.

[2]May not total to 100% because of rounding error.

[3]Percentage of white wheat producers shipping **nondirect** who responded to the given category.

[4]Percentage of white wheat producers shipping **direct** who responded to the given category.

[5]Percentage of red wheat producers shipping **nondirect** who responded to the given category.

[6]Percentage of red wheat producers shipping **direct** who responded to the given category.

[7]Significant difference between direct and nondirect total distance means at $0.05 < p < 0.1$, two tailed t-test. Refer to Appendix B for discussion of statistical testing.

[8]Significant difference between direct and nondirect total distance means at $0.01 < p < 0.05$.

[9]Significant difference between direct and nondirect total distance means at $p < 0.01$.

Table 1 (cont.).

	Malting Barley					Feed Barley				
	Private road	County/ local road	State/ federal highway	Total distance	Number of respondents	Private road	County/ local road	State/ federal highway	Total distance	Number of respondents
Field to Commercial Storage										
Nondirect										
Mean miles[1]	0.8	6.0	4.9	11.6	29	0.6	6.2	7.0	13.8	130
% of total[2]	7	51	42		(76%)[3]	5	45	51		(77%)[5]
Direct										
Mean miles	0.8	5.9	11.0	17.7	30	0.6	4.2	7.8	12.6	78
% of total	5	34	62		(67%)[4]	5	33	62		(67%)[6]
Field to Market										
Nondirect										
Mean miles	0.9	6.0	19.6	26.6	31	1.1	6.9	25.7	33.7	127
% of total	6	23	74		(82%)[3]	3	20	76		(75%)[5]
Direct										
Mean miles	1.2	6.7	74.8		38	0.7	7.2	74.1	82.0[9]	92
% of total	1	8	90	82.8[8]	(84%)[4]	1	9	90		(79%)[6]
Field to Producer-owned Storage										
Nondirect										
Mean miles	1.0	2.6	0.9	4.6	32	1.1	3.2	1.6	5.9	132
% of total	23	58	19		(84%)[3]	18	54	28		(78%)[5]
Direct										
Mean miles	0.8	3.8	3.5	8.0	25	1.0	2.3	1.0	4.3	90
% of total	9	47	44		(76%)[4]	23	55	23		(77%)[6]
Producer-owned Storage to Market										
Nondirect										
Mean miles	0.1	4.7	34.1	38.9	82	0.7	5.7	29.8	36.2	107
% of total	2	12	88		(68%)[3]	2	16	82		(63%)[5]
Direct										
Mean miles	0.6	5.7	79.7	85.9	37	0.1	6.9	86.2	93.2[4]	81
% of total	1	7	93		(82%)[4]	0	7	93		(69%)[6]

[1]Sum of separate road distances may not equal total distance because of rounding error.

[2]May not total to 100% because of rounding error.

[3]Percentage of feed barley producers shipping **nondirect** who responded to the given category.

[4]Percentage of feed barley producers shipping **direct** who responded to the given category.

[5]Percentage of malting barley producers shipping **nondirect** who responded to the given category.

[6]Percentage of malting barley producers shipping **direct** who responded to the given category.

[7]Significant difference between direct and nondirect total distance means at $0.05 < p < 0.1$, two tailed t-test. Refer to Appendix B for discussion of statistical testing.

[8]Significant difference between direct and nondirect total distance means at $0.01 < p < 0.05$.

[9]Significant difference between direct and nondirect total distance means at $p < 0.01$.

Table 2. Mean mileages selected grains were transported one-way by northern Idaho producers in 1981 shipping direct or nondirect over private roads, county/local roads and state/federal highways.

	White wheat					Feed barley				
	Private road	County/ local road	State/ federal highway	Total distance	Number of respondents	Private road	County/ local road	State/ federal highway	Total distance	Number of respondents
Field to Commercial Storage										
Nondirect										
Mean miles[1]	0.3	4.3	2.2	6.8	213	0.3	4.2	2.2	6.7	156
% of total[2]	5	63	32		(94%)[3]	5	62	33		(94%)[5]
Direct										
Mean miles	0.4	5.9	5.0	11.3[8]	26	0.2	6.2	3.9	10.3[7]	15
% of total	3	52	44		(63%)[4]	2	60	38		(48%)[6]
Field to Market										
Nondirect										
Mean miles	0.3	4.9	6.4	11.6	189	0.4	4.7	7.3	12.3	142
% of total	3	42	55		(84%)[3]	3	38	59		(86%)[5]
Direct										
Mean miles	0.5	8.2	59.7	68.4[3]	33	0.4	10.1	90.0	100.5[8]	24
% of total	1	12	87		(80%)[4]	0	10	90		(77%)[6]
Field to Producer-owned Storage										
Nondirect										
Mean miles	0.6	1.7	1.2	3.4	67	0.5	1.8	1.3	3.6	57
% of total	16	49	34		(30%)[3]	14	50	36		(34%)[5]
Direct										
Mean miles	0.7	1.7	2.0	4.4	38	0.8	1.2	1.7	3.7	29
% of total	17	39	45		(93%)[4]	21	33	45		(94%)[6]
Producer-owned Storage to Market										
Nondirect										
Mean miles	0.2	7.3	31.4	38.9	61	0.3	7.2	33.7	41.1	52
% of total	0	8	92		(27%)[3]	0	7	92		(31%)[5]
Direct										
Mean miles	0.3	7.4	85.8	93.5[8]	35	0.2	9.3	116.0	125.5[8]	28
% of total	0	8	92		(85%)[4]	0	7	92		(90%)[6]

[1]Sum of separate road distances may not equal total distance because of rounding error.

[2]May not total to 100% because of rounding error.

[3]Percentage of white wheat producers shipping **nondirect** who responded to the given category.

[4]Percentage of white wheat producers shipping **direct** who responded to the given category.

[5]Percentage of feed barley producers shipping **nondirect** who responded to the given category.

[6]Percentage of feed barley producers shipping **direct** who responded to a given category.

[7]Significant difference between direct and nondirect total distance means at $0.01 < p < 0.05$, two tailed t-test. Refer to Appendix B for discussion of statistical testing.

[8]Significant difference between direct and nondirect total distance means at $p < 0.01$, two tailed t-test.

Table 3. Mean mileages selected grains were transported one-way by northern Idaho producers direct over private roads, county/local roads and state/federal highways.

	Red wheat					Malting barley				
	Private road	County/ local road	State/ federal highway	Total distance	Number of respondents	Private road	County/ local road	State/ federal highway	Total distance	Number of respondents
Field to Commercial Storage										
Mean miles[1]	0.6	2.9	3.8	7.3	3	0.6	4.3	2.3	7.1	47
% of total	9	40	52		(27%)[3]	8	60	32		(89%)[4]
Field to Market										
Mean miles	0.3	6.8	161.2	168.3	7	0.6	3.8	12.6	17.1	45
% of total	0	4	96		(64%)[3]	4	22	73		(85%)[4]
Field to Producer-owned Storage										
Mean miles	1.1	1.3	0.3	2.7	11	0.7	1.7	1.8	4.3	20
% of total	41	48	11		(100%)[3]	17	40	43		(38%)[4]
Producer-owned Storage to Market										
Mean miles	0.3	8.6	223.3	232.1	8	0.7	3.2	50.2	54.2	16
% of total	0	4	96		(73%)[3]	1	6	93		(30%)[4]

[1]Sum of separate road distances may not equal total distance because of rounding error.

[2]May not total to 100% because of rounding error.

[3]Percentage of red wheat producers who responded to the given category.

[5]Percentage of malting barley producers who responded to the given category.

Table 4. Total trucks and trucks per respondent for Idaho producers shipping selected grains direct and nondirect, 1981.

	Nondirect shipping		Direct shipping		
	Total number of trucks	Trucks per owner	Total number of trucks	Trucks per owner	Chi-square statistic
Southern Idaho					
White wheat					
Truck type:					
2-axle	268	1.89	108	1.26	
3-axle	146	1.03	109	1.27	
3- or 4-axle semi	12	0.08	11	0.13	
5-axle semi	16	0.11	11	0.13	
Totals	442	3.11	239	2.78	14.99[1]
Number of respondents	142		86		
Red wheat					
Truck type:					
2-axle	318	2.19	108	2.08	
3-axle	127	0.88	41	0.79	
3- or 4-axle semi	9	0.06	2	0.04	
5-axle semi	10	0.07	12	0.23	
Totals	464	3.20	163	3.13	9.98[1]
Number of respondents	145		52		
Malting barley					
Truck type:					
2-axle	77	2.08	70	1.63	
3-axle	43	1.16	86	2.00	
3- or 4-axle semi	10	0.27	4	0.09	
5-axle semi	12	0.32	3	0.28	
Totals	142	3.84	163	3.79	21.29[1]
Number of respondents	37		43		
Feed barley					
Truck type:					
2-axle	296	1.92	203	1.85	
3-axle	107	0.69	111	1.01	
3- or 4-axle semi	7	0.05	6	0.05	
5-axle semi	9	0.06	21	0.19	
Totals	419	2.72	341	3.10	14.14[1]
Number of respondents	154		110		
Northern Idaho					
White wheat					
Truck type:					
2-axle	497	2.29	86	2.26	
3-axle	30	0.14	28	0.74	
3-, 4- or 5-axle semi	7	0.03	9	0.24	
Totals	534	2.46	123	3.24	54.10[2]
Number of respondents	217		38		
Feed Barley					
Truck type:					
2-axle	375	2.31	61	2.10	
3-axle	20	0.12	24	0.83	
3-, 4- or 5-axle semi	6	0.04	12	0.41	
Totals	401	2.48	97	3.34	68.45[2]
Number of respondents	162		29		

[1]Significant chi-square at a = 0.05 and df = 3 strongly suggested dependence between truck type and shipping method. Refer to Appendix B for discussion of statistical testing.

[2]Significant chi-square at a = 0.05 and df = 2 strongly suggested dependence between truck type and shipping method.

Appendix B — Statistical Testing Procedures

Mean Comparison

Statistical testing of means is based upon the assumption of a normal distribution for sample data. Distributions were checked for non-normality before mean comparisons were attempted for the two subpopulations of nondirect and direct shipping producers. Initially, extremely high valued outliers were identified and excluded by inspection of relative frequency histograms. Measurements of non-normality; skewness and kurtosis, which SPSS calculates by Fisher's g statistics (Hull and Nie 1975) were then inspected for critical values greater than 1.5. The threshold of 1.5, although being rather lenient, especially with populations having many observations, was sufficient to determine obvious non-normal distributions.

Most subpopulation distributions of farm size, production, on-farm storage and transport mileage exhibited non-normality even after outlier exclusion. Most distributions were skewed to the left having many smaller values in proportion to larger values. In addition to non-normality, subpopulation standard deviations were found to be roughly proportional to their means.

Given these problems, the prescribed solution was a log transformation of sample data (Little and Hills 1978). Distributions were then checked for normality under the same conditions as described above. Problems with some distributions still occurred but were remedied by exclusion of additional high outliers.

Upon completion of the procedure for non-normality correction, subpopulation variances were inspected for degree of homogeneity. Using Hartley's Test for Homogeneity of Population Variances (Ott 1977), SPSS calculates $F = \frac{\text{larger } s^2}{\text{smaller } s^2}$ with a null hypothesis of $H_o: \sigma_1^2 = \sigma_2^2$ and an alternative hypothesis of $H_1: \sigma_1^2 = \sigma_2^2$ at a significance level of .05. If the probability of F is greater than .05, meaning homogeneous variances, H_o is accepted and the Student's t test for mean comparison based on a pooled variance was employed. If variances were not homogeneous at the 5 percent level, the Behrens-Fisher test based upon separate variance estimates was used (Nie et al. 1975). Both t-tests were two-tailed.

Chi-Square Test of Independence

Comparison between direct and nondirect shippers in relation to truck ownership relied upon contingency table analysis using the chi-square distribution. Ott (1977) outlines the procedure as follows:

Null hypothesis: The two variables are independent.

Alternative hypothesis: The two variables are dependent.

Test statistic:

$$\chi^2 = \sum_i \sum_j \left[\frac{(n_{ij} - E_{ij})^2}{E_{ij}} \right]$$

Rejection region: Reject H_o if χ^2 exceeds a tabulated value of chi-square for $a = \alpha$ and df = (r-l)(c-l) where r = number of rows in the table and c = number of columns in the table.

The expected number of measurements E_{ij} falling in the i, j cell is taken to be

$$E_{ij} = \frac{(\text{row i total})\ (\text{column j total})}{N}$$

when the two variables are independent.

Cochran was followed in respect to E_{ij} where no E_{ij} can be less than 1 and no more than 20 percent of the E_{ij}'s can be less than 5. If these conditions were not met, smaller categories were combined. For example, separate categories for 3, 4 and 5-axle semi trucks were combined into one category for northern Idaho producers (Table 7 and Appendix Table 4).

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