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ECONOMICS OF INVESTMENT IN TRANSPORTATION EQUIPMENT BY GRAIN MERCHANDISING FIRMS

County elevator operators in North Dakota have two options in shipping their grain to market, truck and rail. Additionally, they can choose between for-hire service or private carriage. In the strictest sense, for-hire service involves hiring a firm that will provide both the equipment and a driver. Private carriage, on the other hand, involves transporting one's own goods to market via self-provided transportation equipment (plus a driver).

Investment in transportation equipment by grain merchandising firms in North Dakota typically involves acquiring tractor/trailer rigs or grain rail cars. Acquisition of a tractor/trailer rig, is by definition, private carriage since the elevator manager would also need to provide a driver. However, in the case of a private rail car the elevator manager would still need the railroad to provide a service, that being motive power. Thus, it is quasi private carriage in that both shipper and carrier are providing equipment to facilitiate the movement.

Investment Alternatives

The analyses that follow are concerned with four investment alternatives: (1) purchase of tractor/trailer rig; (2) lease of tractor trailer rig; (3) purchase of jumbo covered hopper car; and (4) lease of jumbo covered hopper car.

Net Present Value Analysis

Cash outlays and inflows for each investment alternative were discounted using a net present value (NPV) approach. Net present value of one dollar in the future was computed as:

$$NPV = \frac{\$1}{(1 + i)^n}$$

where: NPV = net present value
i = discount rate
n = number of years or number of time periods

For example, NPV of one dollar five years from today at 12 percent interest (discount rate) would be:

$$NPV = \frac{\$1}{(1 + .12)^5} = \frac{\$1}{\$1.76} = \$0.57$$

Rail Car Acquisition

Private acquisition of rail cars (mostly jumbo covered hopper cars) by county elevators is typically accomplished through lease arrangements with car companies (i.e., North American Car Corporation) or via subleases with grain companies (i.e., Benson Quinn, Harvest States, etc). In 1980, for example, 12 elevators reported owning jumbo covered hopper cars (JCHCs) while 175 elevators reported leasing them.

Grain elevators must first have permission from the railroad that serves them in order to place private cars into service. Receiving authority to use the equipment is typically referred to as OT-5. OT-5 is obtained by forwarding a written application to Association of American Railroads (AAR). AAR subsequently notifies the applicable carrier who in turn either approves or disapproves the application. While many private rail cars were placed into service in the 1970s and early 1980s, OT-5 authority is difficult to obtain today. An abundance of rail equipment currently exists and railroads are reluctant to allow private car use when they are not achieving full utilization from their equipment.

Utilization

The most critical factor in determining the relative profitability of leasing or owning JCHCs is utilization. Shippers who use privately owned equipment receive mileage credits from the railroads. These credits are based on loaded mileage accrued by the rail car. For example, if a JCHC is shipped to a market destination 1,000 miles (one way mileage) from origin and the mileage credit is 24 cents per loaded mile, $240 (1,000 x 24¢) would be paid to the shipper for that period. The shipper would receive only $120, however, if he shipped to a market destination only 500 miles from origin (assuming equal shipment times to each market).

An effective measure of utilization for a JCHC is a "car cycle". A car cycle is simply the number of days it takes to receive the empty rail car from the time it was shipped. Typical car cycle times to various market destinations from North Dakota are as follows:

Destination	Minimum	Maximum	Average
Duluth/Superior	9	25	15
Minneapolis/St. Paul	11	30	16
Pacific Northwest	14	42	24

These turnaround times are beneficial in assessing utilization standards for JCHCs.

Mileage Credits

Besides utilization the amount of the mileage credit is also an important factor in determining relative profitability of using private JCHCs. Mileage rates are published in an Interstate Commerce

Commission (ICC) tariff (ICC PHJ 6007-H), but railroads can (and often do) deviate from these rates. Typical rates in effect today in North Dakota are 24 cents and 15 cents per loaded mile.

Lease Versus Purchase

What type of input do you need to determine whether you should lease or purchase a jumbo covered hopper car (assuming the railroad serving your elevator will grant you OT-5 authority)? Basic analysis can be made using four factors.

1. Distance from market.
2. Car cycle.
3. Mileage credit.
4. Purchase price or lease payment

If these factors are known, a simple NPV table can be constructed for whatever term is desired.

Example

1.	Distance from market:	400 miles
2.	Car cycle:	10 days
3.	Mileage credit:	25¢/loaded mile
4.	Lease payment:	$500 per month

We will also assume that the rail car is available for service 300 days during the year (the car is idle or being serviced the other 65 days). From the above data we then want to calculate revenues and costs:

Revenue = loaded mileage x mileage credit

$$= \frac{(300)}{10} \times 400 \times 25¢$$

$$= 30 \times 400 \times 25¢$$

$$= 12{,}000 \times 25¢$$

$$= \$3{,}000$$

Cost = lease payment

= $6,000/year

Next, we will construct a NPV table:

5-YEAR LEASE

Year	Cost	Revenues	Net Revenue		NPV* Factor	NPV
1	$6,000	$3,000	$-3,000	*	.8929	$-2,679
2	6,000	3,000	-3,000	*	.7972	-2,392
3	6,000	3,000	-3,000	*	.7118	-2,135
4	6,000	3,000	-3,000	*	.6355	-1,907
5	6,000	3,000	-3,000	*	.5674	-1,702
			-15,000			$-10,815

*12% discount rate

We can do the same for a purchase alternative:

1. Distance from market: 400 miles
2. Car cycle: 10 days
3. Mileage credit: 25¢/loaded mile
4. Purchase price: $39,500

Assumptions

1. Finance $39,500 for 5 years at 12%. Yearly payment would be about $11,000.
2. Rail car is available 300 days.
3. $20,000 salvage value in year 5.

Again, calculate revenue and cost:

Revenue = loaded mileage x mileage credit

$$= \frac{(300)}{10} \times 400 \times 25¢$$

= 30 x 400 x 25¢

= 12,000 x 25¢

= $3,000/year

(additional $20,000 in year 5 because of salvage value)

Cost = principal plus interest

= $11,000/year

5-YEAR PURCHASE

Year	Cost	Revenues	Net Revenue		NPV* Factor	NPV
1	$11,000	$3,000	$-8,000	*	.8929	$-7,143
2	11,000	3,000	-8,000	*	.7972	-6,378
3	11,000	3,000	-8,000	*	.7118	-5,694
4	11,000	3,000	-8,000	*	.6355	-5,084
5	11,000	23,000	+12,000	*	.5674	6,809
			$-20,000			$-17,490

*12% discount rate.

Problem

1.	Distance from Market:	1,000 miles
2.	Car Cycle:	15 days
3.	Mileage Credit:	30¢/loaded mile
4.	Lease Payment:	$7,500/year
5.	Time Rail Car is Available:	300 days
6.	Term of Investment:	3 years

Calculate:

1. Annual number of trips:
2. Annual utilization:
3. Revenue:
4. Cost:

Set up a NPV table using data listed above:

LEASE

Year	Cost	Revenues	Net Revenues		NPV* Factor	NPV
				*	.8929	
				*	.7972	
				*	.7118	
				*	.6355	
				*	.5674	

*12% discount rate

Set up a NPV table for a purchase scenario. Assume a $11,000/year payment and a $20,000 salvage value. Utilization is the same as the previous example.

PURCHASE

Year	Cost	Revenues	Net Revenues	NPV* Factor	NPV
				* .8929	
				* .7972	
				* .7118	
				* .6355	
				* .5674	

*12% discount rate.

This last example illustrates why it is important to discount values when comparing investment alternatives. If we compare the "Net Revenue" columns of the lease NPV tables we see that the lease scenario has net revenues equal to $-7,500 compared to $-5,000 for the purchase alternative. Comparison of these two values would indicate that leasing is more costly than purchasing. However, if revenues are discounted at 12 percent per year we see that the purchase scenario is the more costly venture (NPV of revenues of $-5,407 versus $-6,677). NPV analyses can get more detailed than the foregoing examples. Following are two such examples:

COMPARISION OF NPV OF PURCHASING AND LEASING HOPPER CARS

INPUTS:	HOPPER PURCHASE PRICE	$ 48000.00
	UTILIZATION (IN LOADED MILES PER YEAR)	10500.00
	MILEAGE ALLOWANCE (IN DOLLARS PER LOADED MILE	0.2400
	ECONOMIC LIFE OF HOPPER CAR (IN YEARS)	5
	SALVAGE VALUE (IN DOLLARS)	25000.00
	MAINTENANCE COST (PER YEAR)	1000.00
	LEASE PAYMENT (PER YEAR)	5160.00
	DISCOUNT RATE (PERCENT)	0.14
	TYPE OF DEPRECIATION	EXPENSING+ACRS
	YEAR IN WHICH INVESTMENT TAX CREDIT IS TAKEN	1.00
	COMPOUND INTEREST RATE	0.00
	TAX BRACKET	0.46

	LEASE				PURCHASE				
YEAR	REVENUE	TAXABLE INCOME	PROFIT AFTER TAXES	NET PRESENT VALUE	REVENUE	DEPR	TAXABLE INCOME	NET CASH FLOW AFTER TAXES	NET PRESENT VALUE
				IN DOLLARS					
1	2520	-2640	-1426	-1250	2520	11450	-9930	10388	9110
2	2520	-2640	-1426	-1096	2520	9460	-7940	5172	3978
3	2520	-2640	-1426	-962	2520	9030	-7510	4975	3358
4	2520	-2640	-1426	-844	2520	9030	-7510	4975	2945
5	2520	-2640	-1426	-740	27520	9030	17490	18475	9588
SUM	12600	-13200	-7128	-4893	37600	48000	-15400	43984	28979

NET PRESENT VALUE OF LEASING A HOPPER CAR	$ -4893
NET PRESENT VALUE OF PURCHASING A HOPPER CAR	$ -19021

COMPARISION OF NPV OF PURCHASING AND LEASING HOPPER CARS

INPUTS:	HOPPER PURCHASE PRICE	$ 48000.00
	UTILIZATION (IN LOADED MILES PER YEAR)	10500.00
	MILEAGE ALLOWANCE (IN DOLLARS PER LOADED MILE	0.5400
	ECONOMIC LIFE OF HOPPER CAR (IN YEARS)	5
	SALVAGE VALUE (IN DOLLARS)	25000.00
	MAINTENANCE COST (PER YEAR)	1000.00
	LEASE PAYMENT (PER YEAR)	5160.00
	DISCOUNT RATE (PERCENT)	0.14
	TYPE OF DEPRECIATION	EXPENSING+ACRS
	YEAR IN WHICH INVESTMENT TAX CREDIT IS TAKEN	1.00
	COMPOUND INTEREST RATE	0.05
	TAX BRACKET	0.00

	LEASE				PURCHASE				
YEAR	REVENUE	TAXABLE INCOME	PROFIT AFTER TAXES	NET PRESENT VALUE	REVENUE	DEPR	TAXABLE INCOME	NET CASH FLOW AFTER TAXES	NET PRESENT VALUE
	- IN DOLLARS -								
1	5670	510	510	447	5670	11450	-6780	8970	7867
2	5953	793	793	610	5953	9460	-4507	4953	3809
3	6251	1091	1091	737	6251	9030	-3779	5251	3545
4	6564	1404	1404	831	6564	9030	-3466	5564	3294
5	1362	-3798	-3798	-1971	31892	9030	21862	30892	16033
SUM	25800	0	0	654	56330	48000	3330	55630	34547

NET PRESENT VALUE OF LEASING A HOPPER CAR	$	654
NET PRESENT VALUE OF PURCHASING A HOPPER CAR	$	-13453

Truck Acquisition

Analysis of truck acquisition can be accomplished in much the same manner as rail car acquisition. Again costs and revenues must be calculated. Revenues, in this case, would be defined as the applicable transportation rate that would have been used in the absence of the tractor/trailer rig. For purposes of this discussion the 3-car rail rate for wheat will be used.

Truck Ownership Costs

Purchase Costs:

Tractor:	58,000	
Trailer:	21,000	
Total:	79,000	at 12% for 5 years = $21,900

Utilization: 400 miles from market or 125 trips/year

800 bushels x 125 trips = 100,000 bushels

Specific Costs:

FC	$21,900	-- payment on tractor/trailer
FC	660	-- titling and sales tax (annualized over 5 years)
VC	20,000	-- fuel (6 mpg at $1.25/gal)
VC	35,000	-- driver (salary + benefits)
VC	12,000	-- maintenance + tires
FC	6,500	-- insurance
	$96,060	total cost

= $97,000 ÷ 100,000 bushels = 97¢/bu. or $1.62/cwt.

For an origin approximately 400 miles from destination, the 3-car rail rate for wheat is 90¢/cwt. Thus, without backhauls the truck could not compete with the rail rate.

The following calculations detail the level of backhaul revenues required in order for trucking to be a feasible option.

relative to shipping grain via a 3-car rail rate:

$$X = \frac{TC-RR}{TC}$$

where: X = proportion of backhaul revenues to fronthaul costs

TC = truck cost

RR = rail rate

example: $X = \frac{\$1.62 - 0.90}{1.62}$

$= .444$ or 44%

Thus, backhaul revenues must be at least 44% of fronthaul costs in order for private truck ownership to be feasible relative to shipping via the 3-car rail rate. Backhaul revenues can also be calculated on a truckload basis:

480 cwt. x \$1.62/cwt. = \$778 TC by truck

480 cwt. x \$0.90/cwt. = 432 TC by 3-car rail

\$346 backhaul revenues required

\$346 ÷ \$778 = 44%

A NPV table would be constructed as follows:

NPV OF TRUCK OWNERSHIP

Year	Truck Costs	Revenue*	Net Revenue		NPV Factor	NPV
1	\$97,000	\$54,000	\$-43,000	*	.8929	\$-38,395
2	97,000	54,000	-43,000	*	.7972	-34,280
3	97,000	54,000	-43,000	*	.7118	-30,607
4	97,000	54,000	-43,000	*	.6355	-27,327
5	97,000	54,000	-43,000	*	.5674	-24,398
			\$-215,000			\$-155,007

*defined as (3-car rail rate * cwt. shipped)

90¢ x 60,000 cwt.

Problem

Assume that your elevator has just purchased a tractor/trailer combination.. Your calculations indicate that average trucking costs come to $1.50 per cwt. The 3-car rail rate is $0.90 per cwt. Backhaul revenues would have to be what percent of fronthaul costs in order to make this trucking operation feasible?

$$X = \frac{TC - RR}{TC}$$

TC = truck cost

RR = rail rate

X = proportion of backhaul revenues to fronthaul costs.

Example

Assume truck costs are again $97,000/year. However, now consider an origin 250 miles for destination. Annual utilization is 100,000 mi. Also, the 3-car rail rate is now 64¢/cwt.

Calculate:

Utilization (bushels/yr.):

Utilization (cwt./yr.):

Cost (per cwt.):

Required backhaul revenues in relation to fronthaul costs:

Construct a NPV table based on the above data: Round revenue to highest $1,000.

NPV OF TRUCK OWNERSHIP

Year	Truck Costs	Revenue	Net Revenue	NPV Factor	NPV
				.89	
				.80	
				.71	
				.64	
				.57	

Example

Use data from the previous example. However, now assume that backhauls will account for $38,000 in revenue. Construct another NPV table. Will this trucking operating now be a feasible alternative?

NPV OF TRUCK OWNERSHIP

Year	Truck Costs	Revenue	Net Revenue	NPV Factor	NPV
				.89	
				.80	
				.71	
				.64	
				.57	

Example

Utilization: 250 miles from market or 200 trips/year.

800 bus. * 200 trips = 160,000 bu.

480 cwt. * 200 trips = 96,000 cwt.

$97,000 ÷ 160,000 bu. = 61¢/bt. or $1.02/cwt.

Required reduction in fronthaul costs relative to 64¢/cwt. 3-car rail rate:

Volume Cost Analysis

Truck Ownership

FC:

$21,900	P & i
660	Titling & sales tax
6,500	Insurance
$29,060	TFC

VC:

$35,000	Driver
20,000	Fuel
12,000	Maint. & tires
$67,000	TVC

Fronthaul Revenue:

3-car rail rate ($0.90 cwt.) times cwt. shipped

($0.90) * 60,000 cwt. = $54,000

With zero backhaul revenue, VC cannot be covered. Thus, there is no contribution to overhead.

Alternative Backhaul Scenarios:

Truck costs:

TFC = $30,000

TVC = $67,000

TC = $97,000

Assume:

Backhaul revenues equal 25% of total costs

25% * $97,000 = about $25,000

Revenue:

Fronthaul = $54,000

Backhaul = $25,000

Total Revenue = $79,000

TR > TVC Therefore, the trucking operation is contributing to overhead.

Break Even Volume

$$BE = \frac{TFC}{CTO}$$

$$CTO = \frac{\$79,000 - \$67,000}{60,000 \text{ cwt}} = \$0.20 \text{ / cwt.}$$

$$BE = \frac{\$30,000}{\$0.20} = 150,000 \text{ cwt.}$$

Double Backhaul Revenue

$$BE = \frac{TFC}{CTO}$$

$$CTO = \frac{\$104,000 - \$67,000}{60,000 \text{ cwt}} = \$0.62/\text{cwt}$$

$$BE = \frac{\$30,000}{\$0.62} = 48,387$$

Break Even Formula

$$BE = \frac{TFC}{\left\{\frac{(FR + BR) - TVC}{U}\right\}}$$

where: TFC = Total Fixed Cost

TVC = Total Variable Costs

FR = Fronthaul Revenue

BR = Backhaul Revenue

U = Utilization (units)