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B823: Transporting Fresh Blueberries from Maine to the Boston Market: A Look at the Economic Alternatives

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TRANSPORTING FRESH BLUEBERRIES FROM MAINE TO THE BOSTON MARKET:

A LOOK AT THE ECONOMIC ALTERNATIVES

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I. INTRODUCTION

The transport of fresh produce to market requires special care and timing. The highly perishable nature of fresh berries is of particular concern when making transport decisions. The berries must arrive at their destination while still at their peak quality and in sufficient volume to satisfy the wholesaler's demand. At the same time, shipping costs must be kept under control if the firm is to be profitable. Two choices to consider for marketers of fresh berries are: 1) By how much would per unit shipping costs be reduced, while maintaining sufficient quality, if the volume per shipment increases? and 2) Should a truck be purchased or should shipping be contracted with a firm specializing in transport? The purpose of this publication is to demonstrate the use of partial budgeting and break-even analysis as management tools applied to transporting fresh blueberries from Maine. This information should enable the marketers of fresh blueberries and other similar fresh produce to assess the relative costs and benefits of transport alternatives.

A study was initiated at the University of Maine to investigate various transportation alternatives available to marketers of fresh blueberries and similar fresh-market enterprises to determine economies of size in shipping. Several methods of economic analysis, including partial budgeting and break-even analysis, were used to assess the feasibility of several transportation alternatives. The alternatives analyzed were: 1) contract shipping services, while using various percentages of truck capacity, 2) purchase of a truck and large trailer (20,000 lbs capacity), and 3) purchase of a truck and smaller trailer (10,000 lbs capacity). Three modifications of Alternatives 2 and 3 were made to assess the effect of scheduling cargo for the return trip to Maine (backhaul). Scheduled backhauls were evaluated as 0%, 50% and 100% use of the truck. Break-even numbers of shipments, relative to per unit costs of contract transport services, were calculated for each truck size and backhaul assumpti

The parameters used in the study are based upon current (1988) fresh cargo transport conditions for blueberries in Maine. Baseline transport costs are for a hypothetical fresh market cooperative or individual fresh packing firm, typical of the size currently operating in Maine. The transport decisions analyzed in the study are typical of most smaller firms transporting a product, however. The method used and the results of the analysis should, therefore, be of use to any firm faced with similar transport decisions.

II. FRESH BLUEBERRY MARKETING AND TRANSPORT IN MAINE

Blueberries are a highly perishable fruit. Minimizing the time between harvesting and delivery to the retailer is critical for maintaining quality and providing the longest possible shelf-life. The producer has control over how the berry is picked, packaged and stored prior to shipping. While enroute to the wholesaler, the berries are held under refrigerated conditions and delivered at the highest quality possible. Once the berries are received by the wholesaler, the producer no longer has control over storage conditions. The quality of product that the consumer sees on the retailer's shelf can be influenced strongly by the handling conditions used by the wholesaler. To minimize the risk of lost quality at this stage, Maine producers must use care to see that the berries arrive at market as fresh as possible. This is problematic for smaller volume marketers who must either ship small lots at a time to ensure freshness or store some berries for a time until a full shipment is ready.

To strengthen their position in the fresh fruit market, fresh blueberry producers in Maine approved a market order to ensure minimum quality standards for each pint of blueberries shipped out of Maine. Producers who pack greater than 5,000 pints and ship further than 75 miles from their packing location are also bound to comply with the market order. The Fresh-Pack Blueberry Market Order (Maine Depart-

ment of Agriculture, Food and Rural Resources) sets minimum tolerance levels on green, wet and over-ripe berries as well as on foreign debris. Wholesalers are assured of receiving a quality product and can make their purchases of wild blueberries without the risk of uncertain quality.

At present, fresh blueberries are shipped to Boston under contract with a local trucking firm or are shipped by an individual producer. Most often, the contracted loads that are sent to Boston occupy only two-thirds to three-quarters of the capacity of the refrigerated trailer. The forty-four foot trailer accommodates twenty-two pallets, and with twelve-pint masters being stacked eleven high, the truck carries a maximum of 20,328 pints (lbs) of berries. On a normal delivery, the truck will make five to six stops in Boston. More stops than this are assumed to adversely affect the quality of the berries.

To maintain the quality of fresh blueberries during transport, no other products are shipped in the same load. The blueberries are shipped at 36° F, and temperature is monitored by a thermostat in the trailer. USDA guidelines for shipping perishable products recommend bracing the pallets in the center of the trailer (Ashby et al.1987). Bracing facilitates air flow around the load, minimizes heat conducted through the trailer walls and prevents shifting of the pallets, which can restrict the movement of air and crush the lower trays (Ashby et al.1987).

To construct the baseline budget (Table 1), several assumptions were made. Assume, to begin, that one transport was made approximately every two and two-thirds days for a total of 8 transports over the season. This assumption is based on the practice observed during the 1987 season in Maine. When the truck reaches Boston, an average of five stops are assumed to be required to deliver the berries. The first stop is included in the trucking firm's rate structure, and the four additional stops cost $45.00 each for unloading. Mileage from Washington County to Boston totals 310 miles one way at a rate of $1.80 per mile. The dispatcher for the trucking firm indicated that without a backhaul from Boston, the blueberry firm would be charged twice the

normal mileage rate for transport services and is, therefore, considered a conservative estimate for the benefits accruing to the shipping company for this service. Table 1 contains a summary of the seasonal cost for the eight contracted shipments to Boston.

Table 1. The Baseline Budget for Transporting Eight Shipments of Fresh Blueberries to Boston by Contract with a Trucking Firm During the 1988 Season.

Cost per Shipment:	
310 miles x $1.80 per mile	$ 558.00
4 additional stops in Boston @ $45.00 each	180.00
Cost per Season (8 shipments)	$5904.00

III. PARTIAL BUDGETING

Partial budgets are used to assess the changes in profits or losses for an enterprise when changes in current operating procedures are considered (Boehlje and Eidman 1984). All resulting added and reduced revenue and expenses are calculated to determine the profitability of instituting the change (Figure 1). This method of analysis provides a systematic way to compare all the costs and benefits of various options available to the decisionmaker.

Proposed Change

1. Additional Income + Reduced Expenses = Total Added Revenue
2. Reduced Income + Additional Expenses = Total Added Costs
3. Total Added Revenue - Total Added Cost = Additional Profit (or Loss) from the Proposed Change

If the change results in additional profit, then it should be considered as a viable alternative. The most profitable alternative among the proposed changes and the current practice should be chosen.

FIGURE 1
THE GENERAL FORMAT FOR A PARTIAL BUDGET

In this study, partial budgets are constructed to determine the profitability of purchasing a truck and trailer to transport fresh blueberries, as opposed to contract shipping.

IV. ALTERNATIVE 1 - INCREASING THE PROPORTION OF THE TRAILER CAPACITY USED

During the 1988 season, most fresh blueberry marketing firms in Maine arranged their own transport. Some firms shipped blueberries in trucks owned by the firm and others contracted shipping services during the blueberry harvest season. For those firms that shipped blueberries through a trucking firm, there was usually not enough volume to utilize the full capacity of the truck and trailer. This resulted in higher per-unit shipping costs than could be possible if full loads were shipped. Achieving full loads could result from either increasing the amount of fresh blueberry marketings by the firm or by coordinating transport to Boston with other fresh blueberry packers in Maine. Note that achieving full loads by simply reducing the number of trips per season was not considered because of the reduced quality of berries that would result from the increased waiting time between shipments.

The cost per pint for shipping loads that ranged from 50% to 100% of the trailer capacity were calculated to determine the savings that would result from increasing the proportion of trailer capacity used. Total shipping costs were taken from Table 1. As expected, per-unit shipping costs decline as a larger proportion of the truck capacity is used (Figure 2). The rate of decline slows between 70% and 80% of capacity. This is due partially to the fact that an additional stop in Boston is assumed to be needed for loads greater than 70% of truck capacity. A cost savings of $.022 per pint (36%) is realized with full loads compared with 60% capacity loads.

Other costs associated with increased percentage of capacity could change as well depending on the source of the increased volume. These other costs would include packaging and marketing costs for an individual firm. If, however, the increased volume comes from the coordination of shipments with additional firms, then packing and marketing costs for the individual firm will remain the same, but there may be some costs associated with the coordination. For this study, however, the assumption is that the increased volume shipped is a result of coordination among firms and that the costs of coordination are relatively small. An individual firm would compare the cost savings described in Figure 2 with the additional costs associated with the increased volume per load, from either source mentioned above, to determine the profitability of increasing the volume shipped per load.

V. ALTERNATIVE 2 - INTEGRATING TRANSPORT INTO THE MARKETING FIRM BY PURCHASING A TRUCK AND A LARGE, REFRIGERATED TRAILER

The second and third alternatives are concerned with integrating the transport function into the marketing firm by purchase of a truck and a large or small trailer, respectively. Three variations of alternatives 2 and 3 are investigated with regard to scheduling backhaul. The two investment decisions were analyzed using 1988 prices and a 4%, inflation-adjusted, real rate of interest (U.S. Department of Labor).

To evaluate the investment in transport equipment, the value of a tractor-trailer unit is budgeted over its useful life. Costs to be considered include those pertaining to ownership such as depreciation, interest, insurance, licensing, annual maintenance, housing, taxes and other regulatory costs. Other costs are the variable, or operating, costs which include fuel, lubrication, repairs and labor.

The annual transport cost incurred if a truck is purchased will be compared with that of continuing to contract the transport services of an outside shipper. Even if the purchase is feasible, there are other

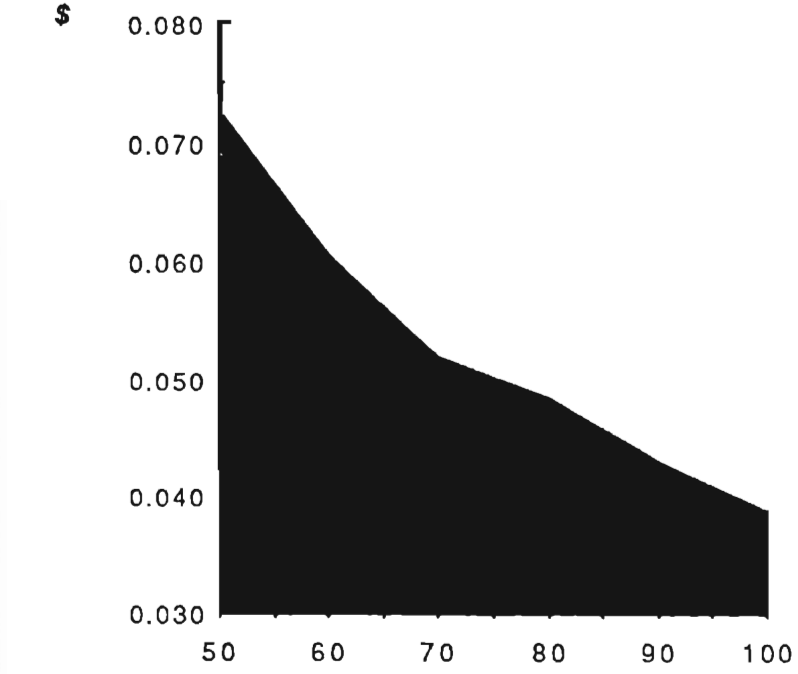

FIGURE 2

ALTERNATIVE 1 - THE EFFECT ON PER UNIT SHIPPING COSTS OF INCREASING THE PROPORTION OF TRAILER CAPACITY USED PER SHIPMENT

issues, which are not easily quantified, that management would have to consider before making the decision to buy. If a single truck is purchased, the firm would limit its transports to at most once a day because of the round-trip driving time to Boston with delivery stops. If more than one truckload had to be shipped in a day, management would have to arrange an alternative shipping method. Furthermore, downtime for the equipment might hamper the smooth flow of blueberries into the Boston market. On the plus side are the tax advantages associated with ownership of depreciable equipment. Although these advantages are quantifiable, they would vary by an individual firm's

total tax liability, so all costs and profits calculated here are assumed to be before-tax figures.

Ownership Costs

Ownership costs for the investment are those costs that accrue regardless of how often the equipment is used or how much volume is shipped. These costs include annual maintenance, depreciation, interest, taxes, insurance, and housing (Table 2).

The quoted price for a new tractor-trailer, which is the same size as is currently used by the trucking firm, is estimated to be $103,000 for a heavy-duty, commercial truck suitable for transporting fresh produce. The budgeted truck cab is a non-sleeper type with a diesel engine; the trailer is equipped with a refrigeration unit. Taxes, title and licensing, at the time of purchase, would total $3,000. The total initial cost for the investment is, therefore, estimated to be $106,000.

After conferring with several trucking companies, we estimated the annual maintenance costs for the truck to be $20,000. On a weekly basis, maintenance is $384.62 or approximately $2500.00 over the six week period. If the truck is leased out in the off-season, the leasing arrangement is assumed to cover the additional maintenance costs incurred.

Depreciation and interest for the vehicle are computed using the capital recovery method (Appendix). An inflation-adjusted, real interest rate of 4% and a useful life of 10 years are used to calculate the capital recovery factor of 0.1233. The capital recovery method of computing depreciation and interest accounts for the opportunity costs of the yearly loss in the value of the vehicle plus interest payments and the opportunity cost of the unrecovered salvage value of the vehicle (Boehje and Eidman 1984). The estimates for the average useful life of 10 years and the salvage value of $22,000 were obtained from personal communications with local truck dealers.

Table 2. Projected Annual Ownership Costs for Purchasing a Truck and Refrigerated Trailer Values at $106,000.00.

Annual Maintenance	$ 2,500.00
Depreciation and Interest	11,237.00
Insurance	4,800.00
Housing	800.00
Excise Tax and Registration - Town of Machias	2,568.00
State Certification and Weight Registration	306.00
TOTAL Ownership Costs in First Year	**$22,211.00**

The Town Office of Machias and the Maine Department of Motor Vehicles were contacted to determine the costs to register a commercial vehicle and the yearly tax payments. The yearly excise tax is due the town office each year. The charge for registering the vehicle is also included (Appendix). The Maine Department of Motor Vehicles, located in Calais, is responsible for collecting the fee for weight restrictions on the truck. The budgeted truck would be registered for 26,000 lbs. empty weight and for 46,000 lbs. for the six weeks in which it would be used to haul blueberries to Boston. A diesel fuel sticker would also be required. Because the vehicle would not be hauling more than 54,000 pounds in a load, no federal highway taxes would be payable to the State Commercial Vehicle Department.

A representative estimate for insurance rates was obtained from an independent insurance carrier. Liability insurance for the truck was set at $500,000 and collision coverage was also included.

Housing for the vehicle was calculated as 1.25% of the average investment. The average investment was computed by dividing by two the sum of the purchase price and the salvage value (Appendix).

Operating Costs

Operating costs are those costs that occur as a result of using the truck to haul blueberries. These costs include fuel use, lubrication, repairs and labor (Table 3).

Fuel usage for the truck is computed for an average of six miles per gallon and diesel fuel at $1.10 per gallon (Appendix). Standard formulae for farm implements normally set the cost for lubrication at 15% of fuel usage. Because the truck and trailer will be used on paved roads, costs of lubrication should be less than the standard rate. For this reason, a rate of 10% of fuel costs is used to estimate lubrication costs (Appendix).

Repair costs are calculated as 60% of list price over the useful life of the vehicle (Boehlje and Eidman 1984). The useful life of ten years was used to calculate an average annual repair cost, which will increase at an increasing rate as the number hours of use increases during the year (Appendix).

Hourly labor costs of $5.50 were assumed for the truck driver for the 1988 season. This hourly rate was increased by 10% to account for fringe benefits. The 620 mile, round trip from Machias to Boston would take approximately 20 hours when time for deliveries and rest stops are included (Appendix).

The backhaul revenues (Table 4) are calculated as the mileage from Boston to Machias multiplied by the $1.80 per-mile, transport rate. This method of valuation assumes that trucking rates are competitive, so that the firm could bid for backhauls at the same rate as the other trucking firms in the market. We are also assuming that the number of stops made per trip is not part of the firm's compensation for leasing the truck. Backhaul revenues will vary by the number of trips made to Boston and by the proportion of trips assumed for which a backhaul was scheduled

Table 3. Projected Operating Costs by Number of Shipments for a Truck and Large, Regrigerated Trailer to Transport Blueberries to Boston in 1988.

8 Shipments	
Fuel	$ 909.40
Lubrication	90.94
Repair	1,368.50
Labor	968.00
Total Operating Costs	**$3,336.70**
12 Shipments	**$5,366.60**
16 Shipments	**$7,548.40**
20 Shipments	**$9,856.40**
32 Shipments	**$17,403.60**
44 Shipments	**$25,710.70**

Table 4. Backhaul Revenue by Number of Shipments and Proportion of Total Shipments for Which Backhauls Are Able to be Scheduled

Number of Shipments	Backhauls Scheduled	
	50%	100%
8	$2,232.00	$4.464.00
12	3,348.00	6,696.00
24	6,696.00	13392.00
44	12,276.00	24,552.00

Partial budgets were constructed to evaluate the profitability of changing from current practices to Alternative 2 under three assumptions regarding backhaul revenue and two assumptions regarding the total number of yearly shipments able to be scheduled for the truck and trailer. These assumptions are that backhauls can be scheduled for: 1) none of the shipments (0% backhaul) (Table 5), 2) half of the shipments (50% backhaul) (Table 6) and 3) all of the shipments (100% backhaul) (Table 7). The number of shipments considered were the number of shipments to transport a typical volume of blueberries during the season only (eight) and a hypothetically large number of shipments which includes the transport of blueberries, but also includes additional shipments contracted by the firm to haul other cargo in the off season.

In terms of added profitability, as the number of shipments and the percentage of backhauls increase, the added profit of purchasing a large vehicle increases. If forty-four shipments (36 additional shipments in the off-season) and backhauls can be contracted, then purchase of a large truck would be a profitable venture for the firm. This high number of additional shipments and backhauls probably is more than can be reasonably expected, however, given the specialized nature of the transport vehicle and the competition from other trucking firms in the area.

Table 5. Partial Budgets for Buying a Truck and Large, Refrigerated Trailer with 0% Backhaul Compared to Contracted Shipping Services.

	8 Shipments[a]	44 Shipments[b]
1. Increased Income		
Shipping Revenue	$0.00	$26,568.00
Reduced Expenses		
Contracted Trucking Expense	5,904.00	5,904.00
Total Added Revenue	**$5,904.00**	**$25,992.00**
2. Increased Expenses		
Variable and Ownership Costs of Truck	$25,548.00	$42,308.00
Reduced Income	0.00	0.00
Total Added Costs	**$25,548.00**	**42,308.00**
3. Total Change in Profitability	**-$19,644.20**	**-$16,316.00**

a. This column assumes no off-season use of the truck.

b. This column assumes 36 additional trips in the off-season with no backhauls for any of 44 total shipments.

Table 6. Partial Budgets for Buying a Truck and Large, Refrigerated Trailer with 50% Backhaul Compared to Contracted Shipping Services.

	8 Shipments[a]	44 Shipments[b]
1. Increased Income		
Backhaul Revenue + Shipping Revenue	$2,232.00	$32,364.00
Reduced Expenses		
Contracted Trucking Expense	5,904.00	5,904.00
Total Added Revenue	**$8,136.00**	**$38,268.00**
2. Increased Expenses		
Variable and Ownership Costs of Truck	$25,548.00	$42,308.00
Reduced Income	0.00	0.00
Total Added Costs	**$25,548.00**	**$42,308.00**
3. Total Change in Profitability	**-$17,412.00**	**-$4,040.00**

a. This colulmn assumes no off-season use of the truck.

b. This colulmn assumes 36 additional trips in the off-season with backhaul for 22 of the total shipments.

Table 7. Partial Budgets for Buying a Truck and Large, Refrigerated Trailer with 100% Backhaul Compared to Contracted Shipping Services.

	8 Shipments[a]	44 Shipments[b]
1. Increased Income		
Backhaul Revenue + Shipping Revenue	$ 4,464.00	$44,640.00
Reduced Expenses		
Contracted Trucking Expense	5,904.00	5,904.00
Total Added Revenue	**$10,368.00**	**$50,544.00**
2. Increased Expenses		
Variable and Ownership Costs of Truck	$25,548.00	$42,308.00
Reduced Income	0.00	0.00
Total Added Costs	**$25,548.00**	**$42,308.00**
3. Total Change in Profitability	**-$15,180.00**	**$8,236.00**

a. This column assumes no off-season use of the truck.

b. This colulmn assumes 36 additional trips in the off-season with backhauls for all 44 of the shipments.

VI. ALTERNATIVE 3. INTEGRATING TRANSPORT INTO THE MARKETING FIRM BY PURCHASING A TRUCK AND A SMALLER, REFRIGERATED TRAILER

Another, similar option would be to purchase a trailer half the size of the one used by the contract trucking firm and make more trips per season. This would reduce the ownership costs by one half, but increase the operating costs. The capacity of the truck would be limited to 10,000 pints per trip or at most, 250,000 pints over a 25 day blueberry season. For the smaller vehicle, we assumed that fuel usage would be 60% of the larger vehicle, and lube costs also were adjusted accordingly. Labor costs per trip remained the same, and repair costs were adjusted downward to reflect the lower list price.

Analysis of this option in terms of the effect on per-unit operating costs as the number of scheduled shipments increases is presented in Table 8. If only twelve shipments are assumed then it would be more cost effective to continue to contract out the transport function. As the number of shipments increases, the per-unit cost of contracted services becomes less favorable, however. Compared to hiring the trucking firm to ship full loads at $.0385 per pint, the firm would be better off purchasing the smaller truck, in terms of per-unit shipping costs, if more than eight additional shipments could be scheduled during the off-season.

Break-Even Analysis

The break-even point in terms of shipping cost minimization is that number of shipments where the per unit shipping costs incurred by purchasing a truck is equal to the per unit cost of shipping with the contracted shipping services. Total costs of shipping with the purchased equipment will depend upon the number of backhaul shipments that are able to be scheduled and upon the number of additional shipping jobs that can be obtained during the off-season.

Table 8. The Effect on Per Unit Shipping Costs of Purchasing a Smaller Truck and Shipping Full Loads to Boston with 0% Backhaul.

	Number of Shipments			
Costs	**12**	**16**	**24**	**44**
Ownership	$11,105.60	$11,105.60	$11,105.60	$11,105.60
Operating	3,559.30	4,942.00	7,890.00	16,067.30
Total Seasonal Shipping	$14,664.90	16,074.60	18,995.60	27,172.00
Per Unit Shipping	0.0601	0.0493	0.0389	0.0304

Scheduling off-season shipments would entail some additional administrative costs to the firm unless the firm can lease the truck to a trucking company for the going rate per shipment. For simplicity, we assumed that the latter is true and that the lease rate is the prevailing, competitive mileage rate in the industry. In this case, no economic profit should be earned by the firm for additional shipments, but the ownership costs can be spread over a larger number of shipments, thus decreasing the per unit cost to the firm of shipping its blueberries.

If backhaul revenue is used to defray some of the shipping costs, then the break-even number of shipments decreases for each size vehicle as shown in Tables 9 and 10. Note that in Table 9, there is no break-even number of shipments if zero backhaul revenue is assumed. This is because the repair costs are increasing at an increasing rate, and there is no additional revenue per shipment to offset them.

Table 9. Summary of Transport Costs Per Pint for a Truck and Large Trailer.

	Percentage of Trailer Capacity Used					
	70%			100%		
	Backhaul			Backhaul		
Number of Transports	0 %	5 0 %	1 0 0 %	0 %	5 0 %	1 0 0 %
	--- Dollars per Pint ---					
8	0.2244	0.2048	0.1852	0.1571	0.1434	0.1296
12	0.1615	0.1419	0.1223	0.1131	0.0993	0.0856
16	0.1307	0.1111	0.0915	0.0915	0.0778	0.0640
20	0.1127	0.0931	0.0735	0.0789	0.0652	0.0514
24	0.1010	0.0814	0.0618	0.0707	0.0570	0.0432*
28	0.0929	0.0733	0.0537*	0.0650	0.0513	0.0376
40	0.0792	0.0596	0.0400	0.0554	0.0417	0.0280
44	0.0765	0.0569	0.0373	0.0536	0.0399*	0.0261
48	0.0744	0.0548	0.0352	0.0521	0.0384	0.0246
52	0.0727	0.0531*	0.0335	0.0509	0.0372	0.0235

* Note: refers to the number of shipments above which the per-unit cost of purchase is lower than the per-unit cost of contracting shipping services. Compare the 70% backhaul columns to $.0519 and the 100% backhaul columns to $.0385.

Table 10. Summary of Transport Costs Per Pint for a Truck and Small Trailer.

	Percentage of Trailer Capacity Used					
	70%			100%		
	Backhaul			Backhaul		
Number of Transports	0 %	50 %	100 %	0 %	50 %	100 %
	--- Dollars per Pint ---					
8	0.1173	0.1075	0.0977	0.0821	0.0753	0.0684
12	0.0859	0.0761	0.0663*	0.0601	0.0532	0.0464*
16	0.0705	0.0607*	0.0509	0.0493	0.0425*	0.0356
20	0.0615	0.0517	0.0419	0.0430	0.0362	0.0293
24	0.0556*	0.0458	0.0360	0.0389*	0.0321	0.0252
28	0.0516	0.0418	0.0320	0.0361	0.0292	0.0224
40	0.0447	0.0349	0.0251	0.0313	0.0244	0.0176
44	0.0434	0.0336	0.0238	0.0304	0.0235	0.0167
48	0.0423	0.0325	0.0227	0.0296	0.0228	0.0159
52	0.0415	0.0317	0.0219	0.0290	0.0222	0.0153

* Note: refers to the number of shipments above which the per-unit cost of purchase is lower than the per-unit cost of contracting shipping services. Compare the 70% backhaul columns to $.0519 and the 100% backhaul columns to $.0385.

VII. SUMMARY AND CONCLUSIONS

Alternative 1

As the volume shipped in each load increases (a greater proportion of the truck capacity is used), per unit shipping costs decrease. A cost savings of up to 36% can be achieved by increasing the use of truck capacity from 60% to 100%. This savings could be realized by 1) increasing the firm's seasonal volume or 2) coordinating shipments with other small firms.

Alternative 2

The decision to purchase a truck and large trailer will be influenced greatly by the amount of off-season use that the freshpack firm can schedule. A relatively large amount of off-season shipments are required to make the purchase feasible even if 100% backhaul can be arranged for transports made during blueberry season and for transporting other products.

Alternative 3

By purchasing a smaller trailer, the firm will be more likely to achieve cost savings relative to the present transport arrangements. Scheduling backhaul transports will still be critical in making this a feasible decision. Increasing the percent of capacity of the truck used will be less important, however, because it represents a smaller increase or decrease in total volume over which costs are averaged at the same time. It is more likely that the smaller trailer will be used at full capacity for each shipment.

Considering current volumes for fresh blueberries marketed in Maine, Alternative 1 represents the best choice for a fresh-pack blueberry firm. As total marketing transport becomes possible, the decision to purchase a truck will be more feasible.

It is important to note, however, that any firm faced with the decision to purchase must first asess its effects on the cash flow of the business. Furthermore, by assuming long-term credit liabilities, future credit-worthiness will also be affected since the ability to schedule additional shipments is uncertain. Unless a contract can be obtained in advance, this financial risk may outweigh any expected gains from a truck purchase. A small firm may want to achieve the cost savings by coordinating with other firms, at least until its own volume shipped increases substantially.

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APPENDIX

Example calculations made for the budgets in the decision to purchase a truck and a large, refrigerated trailer.

Depreciation and Interest

Capital Recovery Method (CRM)

(Purchase Price - Salvage) ^{x} CRM Factor + (Salvage ^{x} interest)

($106,000 - $22,000) * 0.1233 + ($22,000 * .04) = $11,237.20

$$\text{CRM Factor} = \frac{\text{interest}}{1 - (1 + \text{interest})^{\text{LIFE}}} = \frac{.04}{- \text{LIFE}} = 0.1233$$

where, interest = the inflation-adjusted, real rate of interest
LIFE = expected useful life of the equipment

Taxes

Town of Machias

(The tax rate is assessed on the purchase price of the equipment.)

Year	Tax Rate (% of purchase price)	Registration
1	2.40%	$24.00
2	1.75	24.00
3	1.35	24.00
4	1.00	24.00
5+	0.65	24.00

Housing

Average Investment x 1.25%

$64,000 x 0.0125 = $800

$$\text{Average Investment} = \frac{\text{Purchase Price} + \text{Salvage Value}}{2}$$

$$= \frac{\$106,000 + \$22,000}{2} = \$64,000$$

Fuel

620 miles / 6 mpg	=	103.33 gal
103.33 gal * $1.10/gal	=	$113.67/trip
Fuel cost for 8 trips	=	$ 909.36
12 trips	=	$1364.04

Lube and Routine Maintenance

10% of fuel cost

Lube cost for 8 trips	=	$ 90.94
12 trips	=	136.40

Repair

Lifetime repair costs = 60% ^{x} List Price with a 2500 hr wear-out life

$$TAR\% = 0.096(X)^{1.4},$$

where TAR% = total accumulated repairs as a percentage of list

price X = 100 times the ratio of accumulated hours to wear-out life.

(taken from standard agricultural engineering repair tables) (Boehlje and Eidman 1984)

8 trips = 160 hrs or $TAR\% = 0.096^{x}\ (100(160/2500)^{1.4} = 1.29\%$
12 trips = 240 hrs or $TAR\% = 0.096^{x}\ (100(240/2500)^{1.4} = 2.28\%$

Labor

$5.50/hr * 1.1 = $6.05

20 hrs/trip or

20 hrs * 8 trips = 160 hrs * $6.05 = $ 968.00
20 hrs * 12 trips = 240 hrs * $6.05 = 1452.00