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Importance of Empty Backhauling and Special Services to Cost of Exempt Truck Service

T.H. MAZE

Exempt motor carriers often provide a number of special services (such as multiple pickups, paying for loading and unloading, and multiple deliveries) at little or no charge. These services allow greater flexibility in the shipping of agricultural commodities. However, these services carry a significant cost for the carrier, and, because the truck service buyer does not bear these costs through an additional charge, he has no incentive to limit the number of services he requires. Because these practices are uncommon in other sectors of trucking, it is proposed that much of the cost of these services represents a resource misallocation. Empirical evidence taken from the Florida produce truck service market is used as an example of the significance of these costs. A second issue addressed is the cost of empty backhauling by returning exempt carriers. In the market studied (the Florida produce market), regulation, rather than a natural commodity flow imbalance, appears to be causing empty backhauling. Although empty backhauling inefficiently increases the average cost of truck service, more importantly, it distorts the values paid for agricultural truck service. Empirical evidence collected from the Florida market is used to show that the distortion of prices is much more important than the average costs of inefficient empty backhauling.

It is common for carriers of perishable agricultural commodities to provide multiple pickups and deliveries with tractor-semitrailers. In addition, carriers often provide loading and unloading services by hiring freelance labor at shippers' and/or receivers' docks. The willingness of agricultural carriers to provide such "special services" at no charge or little charge has been hailed as a benefit of agricultural exemption from motor carrier regulation (1). On the other side of the coin, on return trips agricultural carriers often have to backhaul empty. The problem of empty backhauling is often attributed to too much regulation, the argument being that carriers without regulated authority who haul exempt agricultural commodities cannot return with regulated commodities (2). The fact that most commodities bound for agricultural areas are regulated promotes an imbalance in flows of commodities that agricultural carriers may haul on their fronthauls and backhauls.

The intent of this paper is twofold. The first purpose is to show that the existing pricing structure of produce truck service is causing a resource misallocation. Because each additional special service is not priced at its cost, the buyers of truck services do not bear the cost of requiring added special services. Hence, buyers are not being given the proper pricing signals to make efficient choices and a resource misallocation results. Furthermore, estimates of the costs of special service will be used to show that these costs are quite significant. The second purpose of the paper is to shed new light on the costs of regulatory constraints that cause empty backhauling. Typically, the costs of empty backhauling are assumed to be equal to the average costs of truck travel times the empty miles traveled. However, the situation is more complex than this. Regulation causes an artificial scarcity of truck suppliers bound for agricultural areas and results in a distortion of truck service markets in both directions (inbound and outbound). An example is used to show that the distortion of the markets causes a greater burden on agricultural truck-service buyers than just average costs of empty backhauling.

FREIGHT MARKET

The area investigated was the Florida produce truck-service market. During 1978-1979, Florida produce shippers depended almost totally on truck transpor-

Table 1. Interstate produce truckload shipments: 1978.

Region	No. of Truckloads			
	Total Yearly	Largest Weekly	Weekly Avg	Week of Yearly High
Florida	165 499	7 157	3 183	First week of June
U.S. total	1 083 379	26 615	20 892	Third week of May

tation. Only a few shipments of dense, high-sale-volume commodities were made by piggyback or rail car during 1978 (3). Annually, approximately 165 000 truckloads of produce are shipped from Florida, or about 15 percent of all interstate produce shipments (see Table 1). The size distribution of firms that haul Florida produce is similar to that of all agricultural carriers (4):

No. of Trucks	Firms (%)
1	45
2-5	35
6-10	7
≥11	13

Seventy-three percent of Florida produce truckloads are arranged by truck brokers compared with 51 percent nationally (5). Thus, brokers play a dominant role in the Florida market.

Because a trucking firm may move its equipment around the country to meet needs for truck transportation, the trucker sometimes has to lead a gypsy-like life. Random truck operating patterns create confusion for those attempting to investigate the operations of these truckers. Therefore, this discussion proposes three simplifying generalizations about truck operating patterns:

1. When the truck leaves Florida with a load of produce, the truck is on its fronthaul trip.
2. When it returns to Florida, the truck is on its backhaul trip.
3. The sum of the two legs is a truck cycle tour.

Thus, the smallest unit of output of the trucking firm is a complete tour. During the tour, the trucking firm supplies service in both directions, and hence the firm's expected revenue for its output is the sum of the prices the firm expects to receive in both directions. However, the price received for service in either direction may not be greater than the firm's marginal costs for that leg. This is obviously true when a truck backhauls empty; the cost of empty backhauling must then be covered by the fronthaul revenue. By viewing the prices in both directions as being dependent on one another, a relation between the markets in each direction can be established.

By viewing truck service in terms of a tour, one can isolate the fraction of the output, and hence the cost of service, devoted to each special service or empty backhaul within the tour. Specifically, in the analysis a ratio is developed of the average revenue received to the average output of the tour (miles traveled). As special services or empty backhauling is incrementally removed from the tour, the change in the ratio indicates the percentage of the average revenue (cost) that covers the portion of the tour removed.

The analysis estimates the quantity of special services rendered by truckers while hauling Florida produce based on field surveys of Florida produce haulers. The expected revenue to be received during a tour must at least cover the marginal cost of the

service rendered during the tour. This means that the sum of the expected prices to be received in both directions must at least equal the marginal cost of the tour and that neither price necessarily has to be equal to the cost of that particular leg. Instead, prices for truck service in the direction of the greatest commodity flow are expected to be greater than in the reverse direction, which would cover the costs of those that are forced to return empty due to the directional commodity flow imbalance. Thus, by viewing service in terms of a two-way tour, buyers in both directions can be allocated their relative share of the cost of truck service.

ANALYSIS

The analysis uses the results of written surveys given to Florida produce haulers during the winter of 1978-1979 to characterize their truck cycle tours. The discussion of the results is divided into three sections. The first section uses information taken from the surveys to estimate the quantity of special services rendered by truckers while hauling Florida produce. The second section uses the same information to estimate the quantity of empty backhauling accrued by returning produce haulers. Finally, the truck cycle tours of Florida produce haulers are coupled with revenue estimates to estimate the average costs of special services and empty backhauling and the market distortion caused by regulatory constraints placed on the commodities that returning produce carriers may haul.

Special Services

When hauling Florida produce, it is quite common for a trucking firm to supply special services. During the collection of field data, many operators complained that they supplied special services but that the prices offered them were insensitive to the quantity of the services they render. For example, a trucker who accepts a load that requires few special services (fewer stops and loading-unloading charges) receives the same price as a second trucker who is going to the same destination and rendering more special services (more stops and loading-unloading charges). This was noted as a common complaint by Taff (6). In a study of national produce trucking by Manalytics, Inc. (7), it was found that any payment for supplying special services was quite uncommon and, when an additional sum is paid, it amounts to "little more than token recognition of the expenses involved". Thus, special services rendered by produce haulers are not priced with respect to the cost of each additional service.

Two questionnaires were distributed to facilitate the estimation of the average quantity of special services rendered on Florida produce fronthauls: (a) a mail-out questionnaire and (b) a hand-out fronthaul questionnaire. The mail-out questionnaire asked trucking firms general questions about their normal experiences when hauling Florida produce and specific questions about their last Florida produce haul. A total of 290 mail-out questionnaires were distributed and 131 were completed and returned. The hand-out fronthaul questionnaire was given to produce haulers as they stopped for inspection at one of Florida's three interstate portals (I-95, I-75, and I-10). This questionnaire asked specific questions about the Florida produce fronthaul the driver was on at the time. A total of 355 questionnaires were distributed and 67 were completed and returned. These two bodies of data are merged to provide the information on special services presented here.

In loading, the accumulation of a full truckload

of produce often requires multiple pickups. Table 2 gives the number of loading stops made by trucks when accumulating a load of produce. Boston, New York, and Philadelphia are the only destinations with more than 10 fronthaul samples. The remainder is spread across 32 other U.S. and 4 Canadian cities.

The mean number of loading stops was 2.32, and the number of stops varied from 1 to 9. The way in which trucks were routed from pickup to pickup caused the truck to travel an average of 65 miles out of the way of the line-haul trip path for every pickup beyond the first. Because few of the respondents indicated that they were charged to load, charges for loading averaged only $6/load.

In unloading, there were often multiple delivery stops. Table 3 gives the number of stops made while delivering Florida produce. The mean number of stops was 1.51, and the number of stops varied from 1 to 7. The way in which trucks were routed between delivery stops caused the trucks to travel an additional 28 miles out of the way for every additional stop beyond the first.

When produce trucks are making deliveries, unloading fees of some kind are often paid by the trucker. Terminals sometimes charge to let trucks enter, often the trucker will have to tip or pay off platform workers to expedite unloading, and the trucker is frequently coerced into hiring labor at the terminal to unload. To estimate the frequency and total cost of these unloading practices, the mail-out questionnaire asked operators, with regard to their three most common destinations, (a) whether they are charged to enter or leave the unloading area, (b) whether they tip or pay off platform workers, (c) whether they are required to hire labor to unload, and (d) what the usual total cost of these expenses is.

The distribution of responses as to whether the trucker encountered unloading charges is given in Table 4 for the three practices individually and for all combinations. Values are given for all destinations that received more than 10 responses, and the rest are spread across 13 other U.S. and 4 Canadian cities. Table 5 gives the responses summed for each charging practice and the mean and total costs of these charges. At all unloading destinations, the trucker was charged to enter 50 percent of the time, tipped or paid off platform workers 49 percent of the time, and was required to hire labor to unload 42 percent of the time. The distribution of the total cost of all three charging practices is given in Table 6. The average total charge for all destinations is $33.40.

To compare these results with practices in regulated truck service, it must first be understood that the regulated service is terminal oriented. When a truckload of regulated commodities is made up of packages from different origins [less than truckload (LTL)], a full load is usually consolidated at a terminal and truck service is charged at an LTL rate that is higher than a truckload (TL) rate. Even if an LTL load is picked up from different origins but not consolidated at a terminal, it still receives an LTL rate. If a TL shipment requires more than one delivery (split deliveries), the shipper is usually charged a flat rate per stop. Hence, in the scheme of the regulated trucking industry, multiple pickups and deliveries bear a price.

Loading-unloading charges are uncommon in other sectors of trucking. The Interstate Commerce Commission recently surveyed 156 owner-operators trip leased to regulated carriers; when asked about their experiences on their last trip, none reported being charged to enter or leave the loading-unloading area, 3 percent reported tipping or paying off platform workers, and 3 percent were required to hire labor to unload (8). This may be compared with the responses of 50, 49, and 42 percent, respectively, when Florida produce haulers were asked the same questions.

Empty Backhauling and Backhaul Special Services

Empty backhauling is a fundamental problem of most haulers of agricultural commodities (1). Typically, greater amounts of freight originate in agricultural areas than are delivered there. This imbalance causes a greater need for transportation services out of agricultural areas, and naturally some trucks must return empty. Another factor that tends to aggravate the problem of empty backhauling is that unmanufactured agricultural commodities are exempt from regulation and returning manufactured commodities are regulated. This means that, even if manufactured commodity loads are available, firms without regulated authority (exempt trucking firms) cannot carry manufactured commodities back unless the firms are leased to a regulated trucking firm. The natural imbalance between inbound and outbound commodity flows coupled with the imbalance between exempt and regulated goods has caused the problem of empty backhauling.

Recently, Ramirez (9) studied the commodity flows carried by truck between Florida and the remaining 47 contiguous United States. He found that Florida was a much greater sink for truck freight than a source, even during the height of the produce shipping season. Therefore, if trucks were matched to loads, disregarding regulatory constraints, trucks should be leaving Florida empty instead of the reverse. Hence, there is at least no natural imbalance of truck freight that would cause trucks to return to Florida empty.

To facilitate the estimation of the quantity of empty backhaul encountered (and of special services rendered) by returning produce haulers, a hand-out backhaul questionnaire was given to returning produce haulers when they were stopped for inspection at one of Florida's three interstate portals (I-95, I-75, and I-10). This questionnaire asked specific questions about the produce hauler's return trip. A total of 327 questionnaires were distributed to truck drivers, but only 55 were returned.

Although Ramirez's findings show that truck freight originating from all points entered Florida at a faster rate than loads leaving Florida to each point, the responses to the questionnaire showed that 20 percent of the trucks sampled returned empty. This presents an ironic circumstance. As Ramirez discovered, because Florida is a greater receiver of regulated freight than it is a generator of all kinds of truck freight, even under optimal conditions, there should be trucks traveling outbound empty. Because existing conditions are clearly less orderly than the optimal matching of trucks to loads, there must be trucks that currently travel empty out of Florida. In contrast, some produce haulers now travel empty inbound. Thus, there are trucks traveling in both directions empty. It would appear that this gross inefficiency is due primarily to regulatory constraints that prohibit exempt trucking firms from participating directly in regulated inbound freight markets.

On backhauls, loaded trucks also supply special services. The mean number of loading and unloading stops and the mean loading and unloading charges are given in Table 7. The magnitudes and frequencies of special services are much less on backhaul loads than on fronthaul loads. This is largely because special services are almost exclusively rendered for exempt loads or regulated perishables (meat and

Table 2. Frequencies of multiple pickup stops.

Destination	No. of Pickup Stops Required									Avg No. of Stops	No. of Samples
	1	2	3	4	5	6	7	8	9		
Boston										2.23	13
Samples	6	2	2	2	1	0	0	0	0		
Percent	46.2	15.4	15.4	15.4	7.6	0	0	0	0		
New York										1.71	17
Samples	11	3	1	1	1	0	0	0	0		
Percent	64.7	17.6	5.9	5.9	5.9	0	0	0	0		
Philadelphia										1.92	12
Samples	5	4	2	1	0	0	0	0	0		
Percent	41.7	33.3	16.7	8.3	0	0	0	0	0		
Other										2.53	89
Samples	37	19	14	6	4	4	3	1	1		
Percent	41.7	21.3	15.7	6.7	4.5	4.5	3.4	1.1	1.1		
All										2.32	131
Samples	59	28	19	10	6	4	3	1	1		
Percent	45.0	21.4	14.5	7.6	4.6	3.0	2.3	0.8	0.8		

Table 3. Frequencies of multiple delivery stops.

Destination	No. of Stops Required							Avg No. of Stops	No. of Cases
	1	2	3	4	5	6	7		
Boston								1.38	13
Samples	9	3	1	0	0	0	0		
Percent	69.2	23.1	7.7	0	0	0	0		
New York								1.33	17
Samples	12	4	1	0	0	0	0		
Percent	70.6	23.5	5.9	0	0	0	0		
Philadelphia								1.33	12
Samples	10	1	0	1	0	0	0		
Percent	83.3	8.3	0	8.4	0	0	0		
Other								1.58	89
Samples	62	15	4	5	2	0	1		
Percent	69.7	16.9	4.5	5.6	2.2	0	1.1		
All								1.51	131
Samples	93	23	6	6	2	0	1		
Percent	71.0	17.6	4.6	4.6	1.5	0	0.7		

Table 4. Distribution of types of unloading charges.

Destination	Distribution (%)							
	No Charge	Tips or Payoffs Only	Hired Labor Only	Entry Charge Only	Tips or Payoffs and Hired Labor	Tips or Payoffs and Entry Charge	Entry Charge and Hired Labor	Tips or Payoffs, Hired Labor, and Entry Charge
Atlanta	10	10	0	0	0	30	10	40
Boston	12	0	0	8	0	56	12	12
Buffalo	37	9	18	0	0	27	0	9
Chicago	21	7	14	4	18	14	4	18
Cincinnati	37	27	9	0	9	18	0	0
Cleveland	30	8	23	0	15	8	8	8
Detroit	30	5	0	10	0	10	20	25
New York	6	4	0	6	4	30	29	21
Philadelphia	16	10	21	3	10	21	16	8
Raleigh	60	0	30	0	10	0	0	0
Washington, D.C.	5	10	15	0	15	25	20	10
Other	33	10	19	3	6	16	1	12
All	23	8	12	6	7	21	10	13

Table 5. Unloading charges per trip.

Destination	Trucks (%)			Avg Total Unloading Area Charges[a] ($)			No. of Responses
	Paid Tips or Payoffs to Platform Workers	Required to Hire Labor	Charge to Enter Unloading Area	Lower Limit	Mean	Upper Limit	
Atlanta	90	50	70	20.77	31.29	41.81	10
Boston	68	24	84	31.80	39.29	46.77	25
Buffalo	46	27	36	15.87	28.14	40.41	11
Chicago	57	54	39	19.27	34.29	49.31	28
Cincinnati	54	18	18	14.09	25.91	37.73	11
Cleveland	38	46	23	21.13	33.23	45.33	13
Detroit	50	45	65	15.46	27.04	38.62	20
New York	60	54	83	38.88	45.21	51.54	47
Philadelphia	45	55	47	30.54	38.96	47.38	38
Raleigh	10	40	0	5.50	22.00	38.50	10
Washington, D.C.	60	60	55	39.58	46.70	53.82	20
Other	39	34	39	23.79	26.84	32.94	122
All	49	42	50	31.15	33.40	35.65	355

[a] Lower and upper limits are those of the 90 percent confidence interval.

Table 6. Distribution of unloading charge amounts.

	No. of Respondents in Charge Category					
Destination	$0	$1-$25	$26-$50	$51-$75	$76-$100	$101-$125
Atlanta	1	2	5	2	0	0
Boston	3	2	17	2	1	0
Buffalo	4	0	6	1	0	0
Chicago	6	4	13	4	1	0
Cincinnati	4	1	5	1	0	0
Cleveland	4	1	6	2	0	0
Detroit	6	5	5	2	2	0
New York	3	6	26	8	3	1
Philadelphia	6	2	23	4	3	0
Raleigh	6	0	3	0	1	0
Washington, D.C.	1	1	9	8	1	0
Other	42	22	50	7	5	0
All	86	46	168	41	17	1

Table 7. Backhaul special services.

	Avg No. of Stops		Loading Charge[a] ($)			Unloading Charge[a] ($)			
Category	Pickup	Delivery	Lower Limit	Mean	Upper Limit	Lower Limit	Mean	Upper Limit	No. of Responses
All backhauling trucks	1.09	1.12		5.04			14.40		55
All backhauling trucks returning with a load	1.36	1.40	2.85	6.30	9.74	15.29	20.44	25.59	44

[a]Lower and upper limits at 90 percent confidence interval. Confidence intervals are not included when empty backhauling trucks are included in the sample because the loading-unloading charges are strictly zero (or undefined) when no load is carried and thus their variance is zero. Adding them into the estimate of the confidence interval of the mean charge would be meaningless.

frozen foods), which tends to support Taff's finding that the practice of charging for loading and unloading is generally only found in the food industry (10).

Truck Cycle Tour

To estimate the average cost of each special service and of empty backhauling, it is necessary to know the total average price paid for truck service and the portion of the average work effort devoted to each. In the preceding sections, quantities of special services rendered and of empty backhauling were estimated. These estimates are coupled with estimates of the miles traveled (output) and prices paid to estimate the average cost (average price paid) per unit of output for the average truck cycle tour.

The average revenue estimates and other loading-unloading charges are given in Table 8 (1979 dollars). Average estimates are given, including and excluding those trucks that returned empty. Note that the average revenue received by all returning trucks after loading and unloading charges are subtracted is approximately half the fronthaul revenue. Even those that returned loaded average less than 70 percent of the average revenue received on fronthaul loads.

The average number of fronthaul miles traveled is given below (all values are rounded off to the nearest mile, and lower and upper bounds are at the 90 percent confidence interval):

	Avg Fronthaul Miles		
Segment	Lower Bound	Mean	Upper Bound
Pickup	73	86	99
Delivery	10	14	18
Line-haul	1181	1189	1297
Total		1289	

Total fronthaul miles was defined to be the mileage traveled between the first fronthaul pickup until the last fronthaul delivery. Total backhaul mileage is a little less straightforward. For instance, if a trucker obtains a backhaul load, he must first move the truck from the last fronthaul delivery point to the point where the backhaul is to be loaded. This load may be bound for an area outside of the Florida produce-growing region. After dropping off the backhaul load, the truck will have to deadhead into Florida's produce-growing areas. Defining the total backhauling distance as the miles traveled between the last fronthaul delivery and repositioning for the next fronthaul resulted in the estimates given in Table 9.

Those trucks that backhauled empty averaged a total trip length of 554 fewer miles than those that found a load. This difference is partly due to the fact that empty trucks could return directly to Florida whereas trucks that obtain a load are sometimes forced to take a circuitous route. But most of the difference is due to the fact that the majority of empty backhauling is done by trucks returning from nearby urban areas such as Birmingham, Alabama, Savannah, Georgia, and Columbia, South Carolina.

Approximately 13 percent of the returning miles are traveled by empty backhauling trucks. However, even those that obtained loads traveled approximately 11 percent of their return trip empty while repositioning to accept a return load, and approximately 11 percent of their return miles were spent deadheading into a Florida produce-growing area. If all the empty miles are considered, approximately 32 percent of all returning miles are traveled empty.

Costs of Special Services and Empty Backhauling

In the analysis, the incremental changes in the trucking firms' revenue per unit of output (miles traveled) are calculated under six conditions. The incremental change is assumed to be the average cost (to the buyer) of each special service or empty backhaul or some combination under the condition specified:

1. Average revenue per mile is calculated under existing conditions.

Table 8. Average revenue and loading and unloading charges.

| Source | Fronthaul (1979 $) | | | Backhaul (1979 $) | | | | | |
| | | | | All Returning Trucks | | | Loaded Trucks Only | | |
	Lower Bound	Mean	Upper Bound	Lower Bound	Mean	Upper Bound	Lower Bound	Mean	Upper Bound
Freight rate	1137	1213	1289	527	643	759	718	828	938
Loading charge	6	14	22	2	5	8	3	6	10
Unloading charge	31	33	36	10	14	18	15	20	26
Revenues – charges		1166			624			802	

Note: All values are rounded to the nearest dollar. Lower and upper limits are at 90 percent confidence interval.

Table 9. Average backhaul miles by segment.

| Segment | Avg Backhaul Miles | | | | | | | | |
| | All Returning Trucks | | | Loaded Trucks | | | Empty Trucks | | |
	Lower Bound	Mean	Upper Bound	Lower Bound	Mean	Upper Bound	Lower Bound	Mean	Upper Bound
Pickup	7	12	17	6	15	24	-	-	-
Repositioning for load	81	120	159	104	150	196	-	-	-
Delivery	0	2	4	0	3	6	-	-	-
Deadheading in Florida	87	116	145	104	144	184	-	-	-
Line-haul	911	1009	1107	938	1057	1175	647	815	983
Total		1259			1369				

Note: All values are rounded to the nearest mile. Lower and upper bounds are at 90 percent confidence interval.

2. Average revenue per mile is calculated under the condition that all loading and unloading-area charges would no longer be paid by the trucking firm.

3. Average revenue per mile is calculated under the condition that, through better management, trucks hauling exempt commodities would no longer need to make multiple pickups and deliveries.

4. Average revenue per mile is calculated under a combination of conditions 2 and 3 above.

5. Average revenue per mile is calculated under the condition that all trucks obtain revenue loads on backhauls.

6. Average revenue is calculated under a combination of conditions 2, 3, and 5 above.

The average price paid per mile is used as a basis for comparison. With existing conditions as an example, the ratio is calculated by using Equation 1 below. The values derived in the preceding sections are placed in Equation 1 to derive the calculation in Equation 2.

$$[(\text{Average tour revenue}) - (\text{loading and unloading charges})]$$

$$\div \text{ average truck cycle tour mileage} \qquad (1)$$

$$[(\$1213 + \$643) - (\$14 + \$33 + \$5 + \$14)]/(1289 + 1259)$$

$$= \$0.703/\text{mile} \qquad (2)$$

where

$1,213 = average fronthaul revenue,
$643 = average backhaul revenue,
$14 = average fronthaul loading charge for all stops,
$33 = average fronthaul unloading charge for all stops,
$5 = average backhaul loading charge for all stops,
$14 = average backhaul unloading charge for all stops,
1289 = average fronthaul total miles, and
1259 = average backhaul total miles.

The average cost per mile of a truck cycle tour under existing conditions is $0.703. All five remaining improved conditions were calculated in the

same manner. The average cost improvement for each is given in the third column of Table 10; the fourth column gives the percentage average cost improvement. To arrive at the total annual cost of truck service under each condition, the price paid for the entire tour under each condition is multiplied by the annual number of Florida produce truck shipments made. For instance, under existing conditions, $1856 is paid for the average tour. Florida shipped 165 449 truckloads of produce during 1978, for an approximate total cost of $307 million/year for truck service on tours originating with a Florida produce load. The changes in yearly cost from existing conditions are reported for the five improved conditions in the last column of Table 10.

Notice that the total average cost of special services (policy 4) is 8.5 percent of the cost of truck services; annual special services costs to buyers of Florida truck service are $26.1 million. In other sectors of trucking where such costs of services are reflected in the buyer's price, these services are uncommon. Thus, it is not unreasonable to believe that many of these services would not be requested if truck-service buyers were forced to bear their costs. Hence, the major part of the costs of providing special services appears to represent a resource misallocation caused by a pricing system that is insensitive to the number of special services required.

It should also be noted that empty backhauling only accounts for 5.3 percent of the average cost of truck service even though 20 percent of the trucks returned empty. However, those trucks that obtained a load traveled an average 1370 miles whereas those that did not obtain a load backhauled empty from closer cities (on the average) and backhauled empty an average of 815 miles. Trucks that were loaded on their backhauls traveled farther, received less revenue than they would on a comparable fronthaul, and incurred loading-unloading charges. Because the loaded returning truck goes farther, incurs more charges, and receives meager revenues, it should be expected that the average revenue per mile would not be changed greatly by removing the 20 percent of the returning trucks that backhauled empty. However, much more important than the average cost of empty

Table 10. Yearly costs of special services and empty backhauling.

Policy No.	Policy	Cost per Truck Mile[a] ($)	Portion of Total Cost of Service[a] (%)	Yearly Cost ($000 000s)
2	Elimination of loading and unloading charges	0.025	3.6	11.1
3	Elimination of multiple pickups and deliveries	0.042	6.0	18.4
4	Combination of policies 2 and 3	0.060	8.5	26.1
5	Elimination of empty backhauling	0.037	5.3	16.3
6	Combination of policies 2, 3, and 5	0.0101	14.4	44.2

[a]Relative to existing conditions.

backhauling is the disproportion between fronthaul prices and backhaul prices that is caused by the empty backhauling.

As Ramirez's findings showed, under optimal conditions where regulatory constraints are ignored in matching trucks to load, more inbound capacity would be required from all points during all times of the year than would be required in the reverse direction. Then the excess truck service needed for inbound commodity flows would require some trucks to travel outbound empty, and, if the market worked properly, buyers of excess inbound service would bear the costs of empty travel. However, under the current regulatory system, loads are not matched to trucks, trucks return empty to Florida, and the average cost of truck service for a truck that fronthauls produce is increased by 5.3 percent. It should be noted, however, that the average revenue received for Florida-originating truck service ($1213) is nearly double the revenue received, on the average, for all truck service bound for Florida ($643). Even when only the average backhaul revenue is considered for only loaded trucks ($828), the average fronthaul revenue received is approximately 1.5 times greater. Although the 5.3 percent addition in average costs of empty backhauling is artificially caused by regulatory constraints, it causes the agricultural buyer to bear a larger portion of the tour cost than simply the average cost of empty backhauling.

CONCLUSIONS

By using the Florida produce truck-service market as an example, it was shown that the cost of truckers paying loading-unloading fees and making multiple pickups and deliveries with over-the-road trucks is quite significant. Because these services are not priced at their cost, buyers of truck service have no incentive to conserve on the special services they require, and hence a resource misallocation results. Because these services are not common types of truck service where buyers pay for each service, the resource misallocation is probably nearly equal to the cost of these services. Furthermore, this creates interesting means for those firms that can avoid loads requiring special services to accrue lower costs and earn greater returns (11).

Greater efficiency could be achieved by pricing each special service equal to its cost. Buyers of truck service who require few special services would accrue lower costs through reduced prices, and buyers who require special services would be forced to bear their costs. Presumably, once the cost of special services is passed directly to the truck-service buyer, such questionable and atypical practices as coercing truckers into paying off or tipping platform workers would be stopped through pressure by the buyers. Furthermore, shippers and receivers would obtain incentives to find more efficient means to accumulate and disperse loads.

In the Florida example, exempt produce haulers were found backhauling empty even though Florida is

a greater receiver of truck freight from all points in the United States than it is a source of truck freight. Thus, it appears that empty backhauling by Florida produce haulers is largely due to regulatory constraints. But in the Florida sample, empty backhauling accounted for 5.3 percent of the average costs of truck service. In contrast, on the average the revenue truck-service suppliers receive from agricultural loads is approximately twice what they receive for backhaul service. The allocation of empty travel costs that distorts the burden more greatly toward the agricultural buyer (through higher prices) is probably due to the fact that (a) freight transportation demand is generally inelastic (12) and hence transportation buyers are generally insensitive to prices and (b) a backhaul is a joint output of a fronthaul and any revenue received, no matter how meager, will help to cover costs or increase profit margins. In the case of Florida, however, because there is more truck freight flowing into than out of the state, the distortion in the share of empty travel costs is probably caused by regulatory constraints that preclude produce haulers from participating in regulated return truck-service markets. Thus, at least in the Florida case, the cost accrued by agricultural truck-service buyers through regulatory constraints is far greater than simply the average cost of empty backhauling.

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Price Response of Truck-Service Suppliers in an Unregulated Market

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The unregulated Florida produce truck-service market is studied to determine whether truck-service suppliers respond to competitive signals. Each year, Florida has two produce shipping peaks—one in winter and one in spring. Although weekly shipping volumes for the two peaks are approximately the same, the predominant truck-service buyers in the two peaks have very different price bidding behavior. The prices bid in the winter fluctuate with the quantity of truck service supplied, and there is a strong statistical relation between the two. The prices bid during the spring remain rigid, and spot shortages in truck service are generally observed in the spring. By using the winter shipping season as an example, truck-service supply is found to respond efficiently to competitive price signals. This implies that, if spring prices were bid with respect to market conditions instead of at rigid levels, shortages could be alleviated. This finding also provides an example of the efficient response of unregulated truck service to price signals.

Studies in favor of trucking-industry deregulation have generally found that on the average prices will fall and truck services will improve through deregulation. In a previous paper, I postulated that there were two trucking-industry regulation-deregulation issues that have not been investigated (1). Because these areas have been overlooked, arguments for less regulation of the trucking industry are based on a simplified view of average traits of unregulated service. Furthermore, the fact that traits are based on averages could lead to the misconception that generally prices will fall and service will improve through deregulation.

The purpose of this paper is to determine whether truck-service buyers will be able to barter for truck-service quantity and quality through an unregulated market. Pricing determined through an open market is generally ignored in the existing literature. This can best be seen in studies of prices of exempt agricultural truck service (2) and prices of localized, unregulated truck service (3) that are modeled with a nonmarket variable (distance). The use of distance rather than relative scarcity of truck service assumes that prices in unregulated sectors are a function of average costs, much the same as truck-service prices in the regulated sector. Of course, this is not true.

It is important to know whether truck-service suppliers react to price fluctuations (a) for the purpose of making estimates of the benefits (cost savings) of not regulating currently exempted markets and (b) for making forecasts of the benefits of deregulating currently regulated markets. Clearly, if unregulated truck-service supply does not respond to price fluctuations, this must be accounted for in benefit estimates and forecasts. However, because studies of unregulated markets view prices as being a function of average costs, the performance of supply, in an unregulated context, has not been examined. Therefore, benefit studies implicitly assume that, once markets are deregulated, suppliers will efficiently adjust equipment allocations with respect to price fluctuations. Yet this has not been shown to be true. Thus, this paper investigates the truck-service supply response to prices in an unregulated market and specifically models the unregulated Florida produce truck-service response to fluctuations in competitive prices.

FLORIDA MARKET

The volumes of Florida produce truck shipments change dramatically throughout the year. As can be seen in Figure 1, Florida has a large and lengthy peak in the late spring. In 1978, the spring shipments peaked during the first week of June with a weekly volume of 7157 truckloads. The spring peak is largely caused by a peak in vegetable and melon harvesting. For instance, in 1978, Florida shipments of sweet corn, cucumbers, potatoes, and tomatoes peaked in May and watermelon shipments peaked in June (4). Shipping volumes fall off sharply in late June as the harvesting season moves northward.

Florida also has a winter shipping-volume peak in December. Although the winter peak is more short-lived than the spring peak, shipment volumes during the respective peak weeks are almost the same. The winter peak is largely due to increases in the shipments of fresh citrus. For instance, 1978 shipments of oranges, tangerines, and tangelos all peaked in December (4).

Although both peaks have approximately the same intensity and shippers during both peaks use the same pool of trucking firms, the predominant truck-service buyers in the market behave quite differently during the two seasons. The winter season normally passes smoothly, and all shipments are generally hauled without major commodity losses. This is not the case in the spring. The spring shipping peak generally passes with a number of spot shortages of truck service. In expectation of the spring peak, the state government usually puts on an advertising campaign to make trucking firms aware that the Florida peak is coming. In the spring of 1979, the governor even declared a state of emergency and rolled back the state weight laws. In addition, the Florida Farm Bureau generally sets up a station at a freeway rest stop to direct trucks to areas in need of truck service. In spite of such efforts, there generally are at least spot shortages in truck service.