The National and Regional Importance of

Wholesale Produce Markets*

by

Richard Beilock
Associate Professor of Food and Resource Economics
Food and Resource Economics
University of Florida
Gainesville, FL

James Patterson
Agricultural Economist
U.S. Department of Agriculture

Timothy Shell
Former Graduate Student
Food and Resource Economics
University of Florida
Gainesville, FL

Abstract

The results of a three-year study to establish baseline estimates of the importance of wholesale produce markets (WPM) are reported. It is estimated that a third of all produce marketed in the United States and Canada goes through WPM. These facilities tend to be most important in larger urban areas. Gate and unloading fees commonly charged at WPM may place them at a competitive disadvantage relative to off-market sites.

Introduction

This paper presents the results of a three year study of wholesale produce markets (WPM). The primary objective of the study was to establish baseline estimates of the importance of these facilities in the logistical chain linking the producer and the retailer. This knowledge is necessary to facilitate planning by government officials and industry participants. The main focus was on markets located in consumption areas. The secondary objective of the study was to examine the relative efficiencies of WPM and other off-market facilities in handling inbound and outbound long-distance (linehaul) traffic. The approach used was

to determine if there were differences in freight rates related to use/non-use of WPM. For this analysis, it was assumed that freight rate linehaul transportation markets are responsive to costs. If freight rates received by linehaul carriers serving WPM are higher (lower) than for those serving individual shipper/receiver docks, it would suggest that there are additional costs associated with serving WPM (individual docks).

Discussion

Fresh fruits and vegetables (produce), like all freight, can be shipped directly from the producer to the retailer or be routed through one or more intervening points. Stopovers at intervening points may be desirable to provide storage; consolidate small shipments into truckload, carload, or container-sized lots for more economical long distance movement; breakdown large lots of product into individual shipments for local deliveries (break-bulk); and facilitate exchange.

As most types of produce cannot be stored for extended periods, the value of intervening points for storage is limited.[1] The importance of the consolidation and break-bulk functions depends primarily upon two factors. The first is the economic advantage associated with small shipments. If retailers order full truckload shipments, there is no need for consolidation or break-bulk. In reality, consumers' demand for freshness, the scarcity of refrigerated storage facilities at most retail facilities, and the cost/flexibility advantages associated with lower inventories often make smaller produce shipments desirable.

The number and dispersion of pickup (delivery) sites for the shipments making up a truckload also is a factor in determining the need for intervening points, such as WPM. In general, the larger the number of pickup (delivery) points and the wider their dispersion, the more the advantage of using consolidation (break-bulk) facilities so that smaller vehicles can make local pickups (deliveries). In this regard, the dispersion of city populations into the suburbs appears to favor the use of markets. However, concurrent with this trend was the rise of supermarket chains. In the typical suburban community virtually all produce is marketed from a few, large supermar-

kets. Smaller retail outlets for produce usually are either unimportant or nonexistent. Moreover, many supermarket chains maintain their own break-bulk facilities. In central cities there may be several hundred small retailing outlets. Moreover, the road systems found in suburbs are usually better suited for large, linehaul vehicles than are the streets of inner cities. In balance, therefore, the spreading of urban populations into the suburbs is generally viewed as a reason for a diminished importance of produce markets since the 1950s (Manalytics).

Vertical integration by supermarkets is another reason for hypothesizing a reduced role for WPM. As the word "market" implies, WPM are sites for legal exchanges (i.e., purchases) as well as physical exchanges. Unlike small green-grocers, supermarkets typically purchase their produce in production regions and assume responsibility for transport to the consumption area. As the produce arriving in the consumption area is already owned by the retailer, there is no need to go through a WPM for the purpose of facilitating purchases.

While supermarkets have been pointed to as the primary reason for the decline in importance of WPM, it should be stressed that the extent or even the fact of a decline has never been demonstrated. Indeed as was noted in the introduction, the main purpose of this study was to establish benchmark estimates of the importance of WPM.

Data and Methodology

Primary Data Collection

The primary data source for this study is a survey of 4,701 truck drivers hauling produce from the Florida Peninsula during the 1986/87, 1987/88, and 1988/89 crop years. Interviews were conducted at the outbound Florida Agriculture Inspection Stations along U.S. I-10, U.S. I-75, and U.S. I-95. According to Florida Department of Agriculture & Consumer Services statistics, these stations account for between 85 and 90 percent of all traffic out of the Peninsula. The inspection stations are always open and similar facilities are located on all other roadways linking the Peninsula with the rest of the nation.

In each year, interviews were carried out for four two-day sessions in November, January, March, and late May or early June. Interviews were conducted from 6:00 PM to 1:00 AM, which tend to be the high traffic times for outbound produce. Interviews were attempted with all drivers of combination vehicles hauling produce. Refusal rates were low, normally under 10 percent.

Comment on the Data Collection Strategy

Developing data directly from WPM located in destination areas would have been difficult, if not impossible for two primary reasons. First, determining the locations of all produce markets and obtaining their cooperation would have been problematical. Second, unless the exceedingly costly step of on-site data collection at each market were undertaken, a consistent data set could not have been developed.

Another important problem related to collecting data from markets is the absence of information regarding off-market deliveries. Produce arrivals information is only collected in 23 U.S. and 5 Canadian cities (USDA, 1988a&b). Outside of these cities there would be no way to determine the shares of produce going through markets.[2]

Given these problems, the alternative strategy of estimating the importance of destination markets to Florida was decided upon. Florida was selected as the focus for the study because of its importance as a produce supplier (2nd in the nation) and the above-described complete coverage afforded by the Florida Agricultural Inspection Stations.

WMP Importance

Determining the importance of WPM was the basic goal of the study. For produce shipped from Florida, the methodology was straightforward. The United States (less Hawaii) and Canada were divided into four consuming regions (Figure 1). Two basic assumptions were made:

1. The market/non-market split for outshipments observed for a commodity were

representative of all outshipments from the State.

2. The commodity-specific distribution of destinations observed were representative of all outshipments from the State.

Employing these assumptions, the total amount of commodity i shipped to region k (Q_{ik}) is:

$$(1) \quad Q_{ik} = Pr_{ik} * SHP_i$$

where:

Pr_{ik} = The observed proportion of commodity i shipped from Florida going to region k.

SHP_i = The total amount of commodity i shipped from Florida as reported in USDA (1987-89a).[3]

The total amount of commodity i that goes through WPM located in region k (MKT_{ik}) is:

$$(2) \quad MKT_{ik} = PM_{ik} * Q_{ik}$$

where:

PM_{ik} = The observed proportion of commodity i shipped from Florida and going to region k which goes through a market.

The total amounts of all commodities going from Florida to a region and that part which goes through a market can be estimated simply by summing across all commodities. Using these totals, the proportions of all produce passing through markets is derived.

The proportion of each Florida-origin commodity passing through markets was also estimated for selected urban areas by employing the observed proportion of the commodity going to each city (i.e., city-specific PM_{ik}'s). The selected urban areas are: Atlanta, Boston, Chicago, Montreal, New York/Newark, Philadelphia, Toronto, and Washington/Baltimore. These eight urban areas were most frequently cited by the survey respondents as destinations. To estimate the
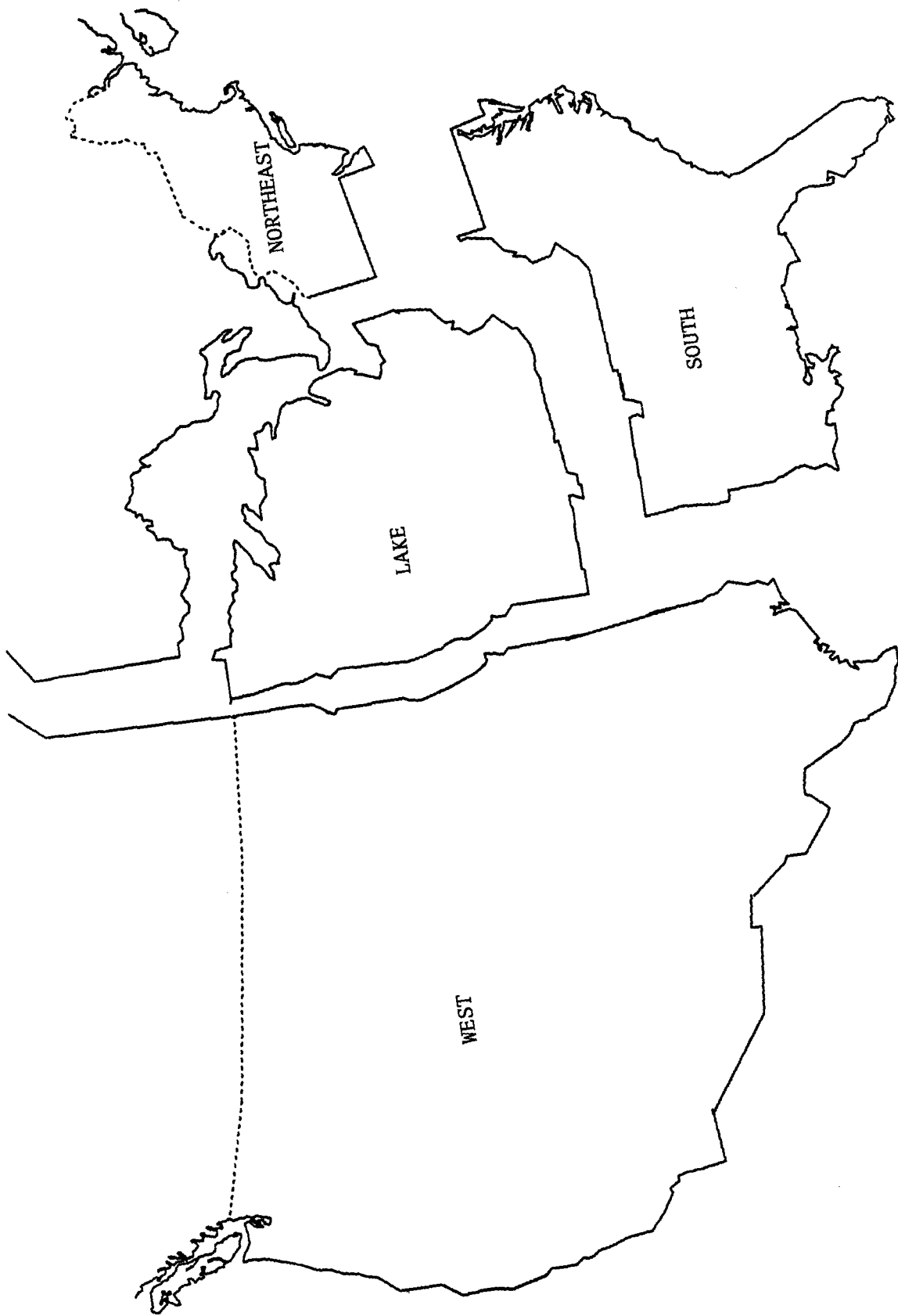
FIGURE 1: DESTINATION REGIONS

proportion of all Florida-origin commodities arriving in a city and going through markets, the commodities are weighted by the estimated volumes (Q_{ik}'s) for the region in which the city is located.

Estimates were also made of WPM-usage rates for commodities shipped from all origins. The key assumption for these calculations was that the probability of a commodity arriving at a destination to go through a WPM does not depend upon the mode or the point of origin. For example, a truckload of lettuce arriving in New York City was assumed to be equally likely to go through a WPM regardless of its origin. Because of the low market share for boxcars (less than 6 percent in 1988, USDA (1987-89a)), the assumption of equal WPM-usage rates across modes seems reasonable, at least for most commodities. Trailer-on-flatcar traffic, the only other non-truck option of any significance, is essentially indistinguishable from truck traffic at the time of delivery.

While a wide variety of fresh fruits and vegetables are shipped from Florida, some commodities are not shipped at all or not in sufficient quantities to develop estimates of WPM-usage rates (PM_{ik}'s). The arbitrary rule used in this study was that the WPM-usage rate for a commodity was estimated only if there were 20 or more observations to a consumption region or at least 10 observations for an urban area. A listing of the commodities for which there were sufficient observations for each region and city is presented in Appendix 1.

Costs to Linehaul Carriers of Serving WPM Relative to Individual Docks

The secondary goal of the study was to determine if there were differences between WPM and individual shipper/receiver docks with regard to pickup/delivery costs incurred by linehaul carriers. Indeed, there are reasons for hypothesizing that such differences may exist. Many WPM are considerably older than most supermarket warehouses and other individual shipper/receiver facilities. For example, the South Water Market in Chicago opened in 1925. Congestion is likely to be more severe, ceteris paribus, at

facilities originally designed for smaller vehicles than are now commonly in use. Moreover, WPM often are located in the heart of metropolitan areas, whereas supermarket warehouses usually are in the suburbs. Congestion on surrounding streets may also impose costs on linehaul carriers.[4] Security problems in and around markets may be more or less severe than at off-market sites. WPM handle larger volumes than most individual docks, and would be able to take advantage of any associated economies of size. Also, their locations may be more familiar to drivers, resulting in lower search costs. Assuming linehaul services are competitively priced or, at least, sensitive to costs, differences between the costs of serving WPM and individual shipper/receiver docks should be reflected in freight rates.

To investigate the existence of such differences, the following reduced-form equation was estimated using data from the 1988/89 survey:

$$(3) \quad RATE = B_0 + B_1*DIST + B_2*DIST2 + B_3*COMMOD + B_4*NOV + B_5*JAN + B_6*MAR + B_7*PKUP + B_8*MPKUP + B_9*DROP + B_{10}*MDROP + B_{11}*GTUNLD + B_{12}*RT10 + B_{13}*RT75 + E$$

Where:

RATE = Per truckload freight rate.

DIST = Trip distance in miles.

DIST2 = DIST squared.

COMMOD = The average daily loss in value of the commodity due to spoilage.

NOV, JAN, MAR = Equals 1 if the observation obtained, respectively, during the November, January, and March survey sessions. Zero otherwise. The omitted category is the May/June survey session.

PKUP,
DROP = Equals the total number of pickups and drops, respectively.

MPKUP = The total number of WPM pickups.

MDROP, GTUNLD =
The sum of all anticipated gate and unloading fees.

RT10,
RT75 = Equals 1 if the observation obtained, respectively, on routes I-10 and I-75. Zero otherwise. The omitted category is I-95.

E = Unexplained residual.

An explanation of the overall rationale for the equation and for each of the explanatory variables is presented in Appendix 2.

The parameter estimates of particular interest in the current study are those associated with MPKUP and MDROP. An estimate which is significantly different from zero for the parameter associated with MPKUP (MDROP) would suggest that costs incurred by linehaul carriers making pickups (drops) at WPM differ, on average, from those at individual shipper (receiver) docks.

Results

Florida-Origin Produce: Total and by Region

It is estimated that 37 percent of all produce shipped from Florida to the United States and Canada is routed through WPM (Table 1). WPM-usage rates are highest in the NORTHEAST and LAKE regions and lowest in the SOUTH and WEST. The interregional differences are thought by the authors to reflect differences in degrees of urbanization. As will be discussed below, urban areas tend to have higher WPM-usage rates. In this regard, it should be noted that the WPM-usage rates in WEST for produce shipped from Florida are likely to be lower than for produce shipped to WEST from all regions. The reason for suspecting this is that, unlike other regions, the distribution of shipments from Florida does not correspond well with the population distribu-

tion. Florida produce shipments to WEST are concentrated in the eastern portions of this region, and tend not to go to the highly urbanized West Coast.

There were considerable differences observed in WPM-usage rates across commodities. At one extreme, under 30 percent of grapefruit, lettuce, and potatoes went through markets (Table 1). By contrast, about 40 percent of each of the following went through wholesale produce markets: bananas (imported through Florida ports), beans, peppers, tomatoes, and watermelons. Reasons for these differences are not immediately apparent.

Florida-Origin Produce:
Selected Urban Areas

As might be expected, urban areas tend to have higher WPM-usage rates than do more rural areas. This tendency is reflected in Table 1 by the higher WPM-usage rates for the selected cities than for the regions in which they reside. The sole exception is Montreal with a 33 percent WPM-usage rate, compared to the 44 percent WPM-usage rate for the NORTHEAST.

The importance of WPM in urban areas is impressive. In five of the eight selected cities, over half of all produce shipped from Florida goes through WPM, and in a sixth city, Toronto, just under half goes through WPM. Nearly two-thirds of produce shipped from Florida to New York City goes to WPM. In fact, it is estimated that between 4 and 5 percent of all trucks hauling produce from Florida goes to one location, Hunt's Point in The Bronx, New York City.

Produce From All Sources:
Total and by Region

In Table 2 (column 1) and Figure 2 are the WPM-usage rate estimates for produce shipped from all origins. As might be expected, the WPM-usage rate estimates for Florida-origin and for all produce are close for most regions and cities. Differences in the estimates reflect differences in the weights assigned to each commodity. For the Florida-origin produce WPM-usage rate estimates the weights are based on the mix of

Table 1

Estimated Wholesale Market Use Rates for
Selected Florida-Origin Commodities: 1986/87-1988/89

...........Selected Commodities..............

Destination	Bananas	Beans	Corn	Grapefruit	Lettuce
	(percent of observations to WPM)				
SOUTH	46	46	32	13	29
NORTHEAST	21	55	44	30	29
LAKE	40	23	38	28	25
WEST	100	*	22	13	20
ALL REGIONS	41	45	37	24	28
ATLANTA	63	*	60	*	*
CHICAGO	*	*	*	33	*
NEW YORK CITY	67	85	78	45	56
PHILADELPHIA	*	0	50	50	*
BOSTON	0	50	58	29	*
TORONTO	25	25	64	55	60
MONTREAL	*	100	25	21	25
WASH/BALT	*	*	*	24	*

...........Selected Commodities..............

Destination	Oranges	Peppers	Potatoes	Tomatoes	W'melon
	(percent of observations to WPM)				
SOUTH	33	31	33	38	31
NORTHEAST	38	44	26	41	43
LAKE	31	37	11	41	26
WEST	11	33	27	29	86
ALL REGIONS	33	39	23	38	38
ATLANTA	37	70	*	56	67
CHICAGO	57	29	*	79	40
NEW YORK CITY	61	78	100	59	58
PHILADELPHIA	59	44	56	48	77
BOSTON	47	54	33	56	75
TORONTO	45	53	44	47	54
MONTREAL	33	53	50	19	33
WASH/BALT	42	*	43	55	60

Table 1 Cont'd

	All Observed Commodities (percent of observations to WPM)	Percent Observed of All[3] Commod.
SOUTH	31	65
NORTHEAST	43	55
LAKE	35	49
WEST	33	29
ALL REGIONS	37	67
ATLANTA	61	36
CHICAGO	53	22
NEW YORK CITY	65	18
PHILADELPHIA	53	13
BOSTON	51	17
TORONTO	48	33
MONTREAL	33	26
WASH/BALT	39	33

Notes:

1. * denotes insufficient observations to calculate WPM-usage rates.

2. Bananas are not produced commercially in Florida. However, appreciable volumes are imported via Florida ports and trucked out of the State.

3. See Appendix 1.

Table 2

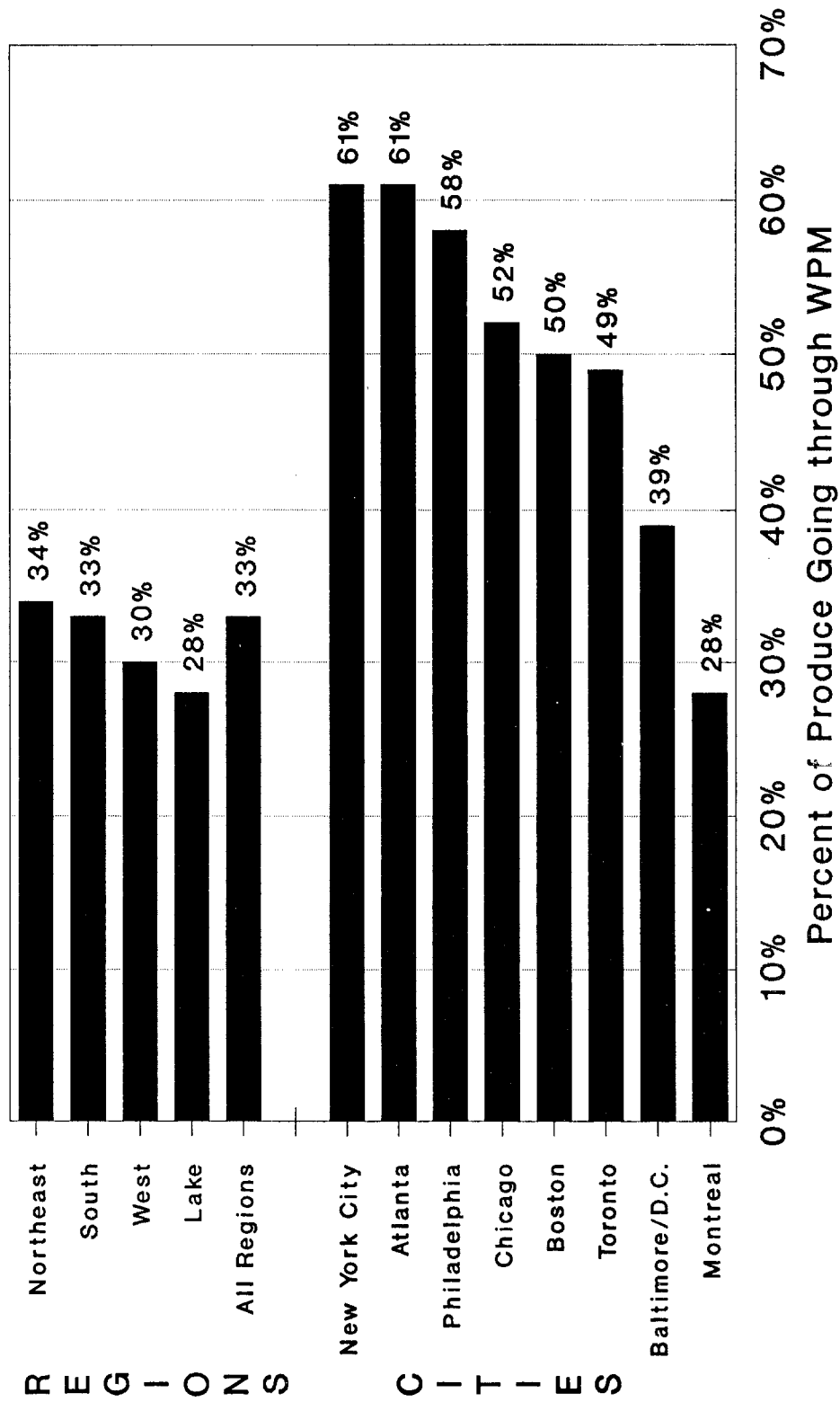Estimated Wholesale Market Use Rates
for All Produce: 1986/87-1988/89

| Destination | Percent of all commodities through WPM | | |
	If boxcar same	If no boxcar	If all boxcar
SOUTH	33	32	36
NORTHEAST	34	30	42
LAKE	28	25	36
WEST	30	30	31
ALL REGIONS	33	31	37
ATLANTA	61	61	62
CHICAGO	52	52	53
NEW YORK CITY	61	60	61
PHILADELPHIA	58	58	58
BOSTON	50	49	51
TORONTO	49	45	52
MONTREAL	28	25	36
WASH/BALT	39	38	40

Note:

The first column contains WPM-usage rate estimates for produce shipped from all regions. The types of produce examined are limited to those for which there were at least 20 observations per region or 10 per city in the survey. The percentages of all produce, by weight, that these produce types account for is presented in the last column of Table 1.

The second column is identical to the first, except it is assumed that no boxcar deliveries are made to WPM. The final column if identical to the first, except it assumes that all boxcar deliveries are made to WPM.

Figure 2: Estimated WPM Use Rates for Produce from All Origins

R E G I O N S

- Northeast — 34%
- South — 33%
- West — 30%
- Lake — 28%
- All Regions — 33%

C I T I E S

- New York City — 61%
- Atlanta — 61%
- Philadelphia — 58%
- Chicago — 52%
- Boston — 50%
- Toronto — 49%
- Baltimore/D.C. — 39%
- Montreal — 28%

Percent of Produce Going through WPM

0% 10% 20% 30% 40% 50% 60% 70%

Beilock, Patterson, and Shell

Florida-origin produce reported in USDA Arrivals to a region or city. For the estimates of produce from all origins, the weights are based on the USDA Arrivals mix of produce to a region or city from all origins. In assessing the estimates, it should be remembered that only those produce types are included for which the survey yielded at least 20 (10) observations of a region (city). Estimates of the percentages of all commodities, by weight, included in the estimates are presented in Appendix 1.

It is estimated that one-third of all produce marketed in the United States and Canada are routed through wholesale produce markets. Interregional differences in WPM-usage rates for all produce appear to be much smaller than for Florida-origin produce. The relative ranking of the regions is the same, except for LAKE. For Florida-based produce LAKE ranks second with regard to WPM-usage, but drops to last place for all produce.

An assumption in estimating WPM-usage rates was that there were no intermodal differences. There are three primary long-distance delivery systems for produce: truck, trailer-on-flatcar, and boxcar. The first two arrive at the receivers' docks as over-the-road vehicles. Therefore, assuming that the trailer-on-flatcar WPM-usage rate and the observed truck WPM-usage rate is consistent seems highly plausible. Produce shipped by boxcars, however, normally arrives at its final destination by rail. If there are differences with respect to rail access, on average, between receivers located on and off WPM, then differences in WPM-usage rates for produce shipped by boxcar and by other means might be expected.

The range of possible overall WPM-usage rates due to differences between WPM-usage rates for produce shipped via boxcar and via truck or trailer-on-flatcar are presented in Table 2. In column 2, the overall WPM-usage rates are shown if no produce shipped via boxcar is routed through WPM. In the final column of Table 2 the WPM-usage rates are presented if all produce shipped via boxcar go through WPM. Owing to the small share of all produce shipped by boxcar, the range of overall WPM-usage rates is not large in most

cases. For example, if no produce shipped by boxcars went through WPM, the WPM-usage rate to all regions would only drop from 33 percent (assuming all modes the same) to 31 percent. If, on the other hand, all produce shipped by boxcar went through WPM, the WPM-usage rate to all regions would be 37 percent. Reflecting their relatively high degree of dependance upon boxcar shipments of produce, alternative assumptions for boxcar WPM-usage rates have their greatest impacts on overall WPM-usage rates in NORTHEAST and LAKE.

Produce From All Sources:
Selected Urban Areas

Overall WPM-usage rate estimates for the selected urban areas are presented in Table 2 and Figure 2. Differences between these estimates and those for Florida-origin produce are fairly small (compare Tables 1 and 2). Again, the importance of WPM in urban areas is evident. For only two of the eight selected urban areas (Montreal and Washington/Baltimore) does appreciably less than half of all produce goes through WPM. For Atlanta and New York City, WPM-usage rates exceed 60 percent. As was true for the consumption regions, assumptions regarding WPM-usage rates for produce shipped via boxcar generally are not critical (Table 2).

WPM and Linehaul Freight Rates

The secondary objective of this study was a determination of the impacts, if any, on linehaul freight rates of pickups or drops at WPM, as opposed to pickups/drops at individual shipper/receiver docks. If there are differences, it would suggest that the costs to carriers of serving WPM differ, on average, from serving individual shipper/receiver docks. For example, higher (lower) freight rates associated with serving WPM might be due to greater (less) congestion at such facilities than at individual shipper/receiver docks. This analysis would not be able to identify the source of freight rate differentials (such as congestion). However, it would determine if a differential exists, thereby signaling the existence of possible relative inefficiencies at WPM or individual shipper/receiver docks.

The results from estimating the model via standard multiple linear regression were somewhat disappointing. While the magnitudes and signs of the parameter estimates were reasonable, only 26 percent of the variation in freight rates was explained. It was suspected that this was due to distance-related heteroskedasticity. A large proportion of produce deliveries from Florida go to cities located between 1,000 and 1,400 miles from Orlando.[5] Relatively few deliveries are made for shorter or longer distances. Analysis of the residuals from the uncorrected model, via the Park's Test, confirmed the presence of distance-related heteroskedasticity. Explanations of this test and of the correcting procedure are presented in Appendix 3.

The results of the model estimation after correction for heteroskedasticity are presented in Table 3. The equation is highly significant and explains 89 percent of the variation in freight rates. Seven of the 13 explanatory variable parameter estimates were significantly different from zero at the .01 level. The signs and magnitudes of these seven estimates appear reasonable. The parameter estimate associated with DIST indicates that truckload freight rates rise by $.65 per additional mile. Not including depreciation as a variable cost, the USDA's estimates for per mile variable cost for produce haulers over the sample period was around $.75 (USDA, 1987-89b). The parameter estimates associated with the three binary variables for the survey months indicate that the highest rates are paid in June, when Florida's shipments are at their peak. This is consistent with earlier findings of a positive relationship between freight rates and total shipment volumes (Beilock and Shonkwiler). The parameter estimates for the two binary variables for the route taken by the driver indicate that the highest rates are paid for loads moving up the Eastern Seaboard.

Gate and Unloading Fees

The final statistically significant parameter estimate is associated with anticipated gate and unloading fees (3.21 for GTUNLD). It indicates that freight rates rise by $3.21 for every additional dollar of such fees that are anticipated by the carrier. This estimate is statistically different

from 1.0 (or $1.00) at the .01 level of probability. There are at least two explanations for this "hyper-sensitivity" of freight rates to gate and unloading fees. First, there is widespread resentment among carriers that they are subject to gate fees and must arrange off-loading. Many drivers feel they are taken advantage of by receivers and unloaders and, in some cases, actually coerced into paying for unloading at all or paying unreasonable charges for the service (Mahan). It seems reasonable, then, that carriers might demand premiums for performing these undesirable transactions. Second, there is usually some uncertainty regarding the level of these fees. GTUNLD is the sum of gate and unloading fees drivers anticipated they would pay at the destination. If carriers are risk-averse, they would require a premium over the expected charges.

There is an important policy implication associated with this finding. In placing responsibility for gate fees and unloading on the carrier, the receiver does not escape paying for these services. Indeed, the fact that the parameter estimate is greater than 1.0 suggests receivers would enjoy lower total transport costs if they accepted direct responsibility for these services.

This finding has particular importance for receivers on WPM. The average gate and unloading charge incurred by carriers was four times higher at WPM: $32.65 at WPM versus only $8.04 at non-WPM destinations.[6] Due to these differences in gate and unloading charges, it is estimated that per truckload freight rates for produce going through WPM are $79.00 higher, on average, than for produce going to individual receiver docks:

	WPM	non-WPM
Average gate/unloading fees	$32.65	$8.04
X Per dollar impact on freight rate	X 3.21	X 3.21
Total impact on freight rate	$104.81	$25.81

This, however, probably overstates differences in total transportation costs. Receivers unloading themselves at no charge, directly bear these costs. The point estimate associated with GTUNLD indicates that for each additional dollar of gate and unloading fees anticipated by the carrier, the

Table 3

Freight Rate Model Estimation
After Correcting for Heteroskedasticity

Variable	Parameter Estimate	Standard Error	
Intercept	1080.	164.3	***
DIST	.6508	.1975	***
DIST2	.00005385	.00005361	
COMMOD	2.692	6.610	
NOV	-228.7	72.31	***
JAN	-318.1	76.81	***
MAR	-275.3	73.03	***
PKUP	-9.376	14.25	
MPKUP	-56.84	64.67	
DROP	-42.23	38.10	
MDROP	-36.41	45.21	
GTUNLD	3.212	.7352	***
RT10	-241.7	79.33	***
RT75	-200.7	56.50	***

Equation statistics			
F Statistic	432.0		***
R^2	.89		
Number of observations	752		

Note:

*** Denotes statistically different from zero at the .01 level of probability.

Data for the estimates came from the authors' 1988/89 survey. One thousand twenty-four observations could not be used due to incomplete information. This was primarily due to driver uncertainty regarding freight rates or, in the case of private (i.e., own-account) carriage, the absence of an explicit freight rate.

freight rate is $3.21 higher. As argued above, the $2.21 premium probably is due to price risk and transactions costs. At very least, receivers could directly pay the same gate and unloading charges now paid by carriers. In other words, assuming that the anticipated charges approximate the actual charges, receivers paying gate and unloading charges via the freight rate, rather than directly, overpay by $2.21 for every $1.00 in actual charges. This overcharge averages $72.16 ($32.65 X 2.21) for receivers on WPM but only $17.77 ($8.04 X $2.21) for off market receivers.

Pickups and Drops

All of the parameter estimates associated with pickups and drops (PKUP, MPKUP, DROP, MDROP) were insignificantly different from zero at any conventional level of probability. This result is only somewhat surprising because most of the pickup and drop related costs were probably accounted for in other variables. In particular, DIST and DIST2 include inter-pickup and inter-drop distances and GTUNLD accounts for out-of-pocket gate/unloading fees.

Of particular note, however, is the fact that pickups or drops at WPM were not associated with significantly higher or lower freight rates than for loads going to individual shipper/receiver docks (i.e., both MPKUP and MDROP were not significantly different from zero). This result suggests that WPM are not at an advantage or disadvantage, on average, relative to individual shipper/receiver docks with respect to factors which might alter the delivery costs to a carrier. These factors include accessibility, congestion, and safety.

Summary and Conclusions

This work develops baseline estimates of the volumes of produce which pass through wholesale produce markets in the United States and Canada. Due to the rise of off-market distribution facilities for supermarket chains, it has been generally assumed that the role of WPM has shrunk, perhaps to insignificance. However, it is estimated that 37 percent of all Florida produce and 33 percent of produce from all origin points are distributed through WPM. In larger urban

areas WPM often account for the majority of all produce. Clearly, WPM continue to play a major role in the produce logistical system.

The relationship between WPM and linehaul freight rates was examined. Assuming that freight rates are sensitive to costs, differences between freight rates associated with the use of WPM would suggest differences in costs to carriers of serving these facilities and serving off-market shipper/receiver docks. Possible sources of differences would be congestion, security, and difficulty in locating the facility. The results suggest no differences in costs to carriers from such causes. Freight rates are neither elevated nor lowered due to WPM use for pickups or drops.

Freight rates, however, were found to be highly sensitive to anticipated gate and unloading fees. It was estimated that freight rates rise by over $3.00 for every $1.00 in anticipated gate and unloading fees. Likely reasons for this extreme sensitivity to anticipated fees are price risk and transactions costs, including carrier aversion to the paying of gate fees and responsibility for unloading. Such fees are five times more likely to be anticipated by drivers going to WPM and average four times as much than for those going only to individual receiver docks. This result suggests that receivers at WPM should consider assuming direct responsibility for paying gate fees and arranging unloading.

Notes

[1] The two principal exceptions are potatoes and apples, which may be stored for up to 10 and 13 months, respectively.

[2] Even in the 23 urban areas there would be the problem of defining boundaries. For example, if a WPM serves a city but is beyond its boundaries (as is the case for Boston), should it be excluded?

[3] An alternative approach to using the observed proportion of product going to a region would be to combine population data with the arrivals information collected by USDA, AMS. As shown by Beilock and Portier, the two approaches yield nearly

identical estimates. *Fresh Fruit and Vegetables Shipments: by Commodities, States, and Months* provides monthly, commodity-specific totals of total outshipments from a state. Destinations are not indicated.

[4] Other possible cost associated with inner city locations of some facilities relate to crime. When questioned regarding problems at WPM, several drivers indicated theft and vandalism to be severe problems in some cities.

[5] Included in this group of cities are New York, Philadelphia, Pittsburgh, Cleveland, Detroit, Chicago, St. Louis, and Dallas/Fort Worth.

[6] The differences in average gate and unloading charges between WPM and other locations reflects differences in the frequency of these charges, rather than in their levels. Only 12 percent of carriers going to non-WPM destinations indicated they would be required to pay gate and unloading charges. In sharp contrast, 58 percent of those going to WPM anticipated paying these fees.

References

Beilock, R. and K. Portier. "Using USDA Fresh Fruit and Vegetable Arrivals to Determine the Distribution of a State's Production," *Northeast Journal of Agricultural and Resource Economics*, 18,1 (1989): 35-45.

Beilock, R. and J. Shonkwiler. "Modelling Weekly Truck Rates for Perishables," *Southern Journal of Agricultural Economics*, 15,1 (1983): 83-87.

Florida Department of Agriculture & Consumer Services. *Bureau of State Farmers Markets Fifty-First Annual Summary*, Florida Department of Agriculture & Consumer Services, Winter Haven, FL, 1986.

Frederic R. Harris, Inc. *Distribution Network for Fresh Fruit and Vegetables Sold in Small Retail Establishments in New York City*, report prepared for The New York City Office for Business Development, New York City, 1988.

Mahan, R. *Unloading Problems in the Transport of Perishable Commodities*, Unpublished Masters thesis, University of Florida, 1989.

Manalytics. *A Long-Term Study of Produce Transportation*, Volumes 1-3 U.S. D.O.T. report, 1977.

USDA. *Fresh Fruit and Vegetable Arrivals in Eastern Cities*, Agricultural Marketing Service, USDA, 1988a.

USDA. *Fresh Fruit and Vegetable Arrivals in Eastern Cities*, Agricultural Marketing Service, USDA, 1988a.

USDA. *Fresh Fruit and Vegetable Shipments: by Commodities, States, and Months*, Agricultural Marketing Service, USDA, (annual) 1987-1989a.

USDA. *Fruit and Vegetable Truck Cost Report*, Agricultural Marketing Service, USDA, (monthly) 1987-1989b.

Produce Types for Which Wholesale
Produce Market Usage Rates Were Estimated

..................Destination...................

Produce type	South	Northeast	Lake	West	All Regions
Avocados					X
Bananas	X		X		X
Beans	X	X			X
Cabbage	X	X			X
Carrots		X			X
Celery	X	X	X		X
Chinese Cabbage					X
Corn (Sweet)	X	X	X		X
Cucumbers	X	X	X		X
Eggplant					X
Grapefruit	X	X	X	X	X
Honeydews					X
Lettuce	X	X			X
Limes					X
Oranges	X	X	X	X	X
Peppers	X	X	X		X
Potatoes	X	X	X	X	X
Radishes					X
Squash					X
Strawberries	X	X	X		X
Tangerines					X
Tomatoes	X	X	X	X	X
Watermelons	X	X	X	X	X
Percent of all produce (weight)	65	55	49	29	67

Appendix 1 Cont'd.

....................Destination....................

Produce type	ATL	CHIC	NYC	PHIL	BOST	TRNT	MONT	WSH/BLT
Bananas	X							
Cabbage	X		X					X
Celery								X
Corn (Sweet)	X				X	X		
Cucumbers	X		X		X			X
Grapefruit	X	X	X	X	X	X		X
Lettuce						X		
Oranges	X	X	X	X	X	X		X
Peppers	X	X	X	X	X	X		
Potatoes						X		X
Tomatoes	X	X	X	X	X	X	X	X
Watermelons	X	X	X	X	X			X
Percent of all produce (weight)	36	22	18	13	17	33	26	33

Notes: WPM-usage rates are calculated for a produce type if the survey yielded at least 20 observations, if a region, or at least 10 observations, if a city. An X denotes that this criterion was met. The percentages of all produce for which WPM-usage rates are calculated are based on USDa 1988A&b.

Appendix 2

Explanation of Reduced Form Freight Rate Equation

In equation (3), freight rates are estimated as a function of supply factors (carrier costs) and demand factors. On the supply side are DIST, DIST2, COMMOD, GTUNLD, and the pickup and drop measures. Intertemporal shifts in the demand (and/or supply) for produce transport are captured by the binary variables denoting the survey session; demand differences across regions are captured by the binary variables denoting the route. The expected signs of each of these variables are discussed below.

As fuel, driver, and maintenance costs all are positively related to distance, the parameter estimate associated with DIST would be expected to be positive. Dispatching and other fixed or one-time costs associated with each trip can be spread over the total number of miles. Also, given direct costs and uncertainties associated with searching for a load, there is likely to be value in employing a vehicle and driver for longer periods. This may be reflected in discounts for longer distance hauls. Therefore, the per mile increase in total freight rates may be expected to fall as distance increases. If a tapering distance-freight rate gradient exists, the estimated parameter associated with DIST2 would be negative.

It is common for freight rates to be positively related to the value of the cargoes. This is known as a value-of-service rate structure. From a shipper/receiver's point of view, the urgency of delivery is a function of a load's value and expected change in value per unit of time. The higher the value, ceteris paribus, the higher the carrying cost. Also the larger the expected diminution (addition) in value over time, the faster (slower) the desired delivery. There may be additional costs associated with expedited service. For example, it may be necessary to use team drivers. Also, higher risks are borne by carriers who take responsibility for higher-valued, possibly more damage-prone commodities. If these factors are important in produce haulage, the parameter estimate associated with COMMOD would be positive.

The binary variables for the survey sessions are intended to capture seasonally-related shifts in demand and supply. Because of wide month-to-month variations in volumes of produce shipped from Florida, shifts in demand for transport are expected to dominate. Indeed, Beilock and Shonkwiler have shown freight rates to be positively related to volume of produce shipped.

Additional pickups and drops normally require additional time, labor, and management inputs. Therefore, as the number of these increases, the freight rate would be expected to increase, ceteris paribus. To capture this effect, four explanatory variables were included: PKUP, DROP, MPKUP, and MDROP. The first two are, respectively, the total numbers of pickups and drops. MPKUP and MDROP, the numbers of pickups and drops, respectively, made at WPM, are included to capture cost differences related to WPM use.

Carriers often are required to pay entry or "gate" fees at a receiving area. Moreover the services of freelance unloaders (known as lumpers) may be needed. Assuming rates are sensitive to costs, rates would be expected to move with these out-of-pocket expenses. GTUNLD, the sum of these costs, therefore is included as an explanatory variable. GTUNLD is actually the anticipated gate and unloading fees. If, as seems likely in many cases, there is uncertainty regarding GTUNLD, carriers would require a risk premium. Moreover, there may be non-trivial transactions costs for carriers in arranging for unloading. Therefore it is expected that GTUNLD will be both positive and greater than one.

Different market conditions across the United States and Canada may result in freight rate differentials. To capture this effect, binary variables are specified indicating if the vehicle was heading out of Florida westward (along I-10) or northwestward (along I-75). Trucks heading along the Eastern Seaboard (along I-95) form the omitted category.

Appendix 3

With the Park's Test for heteroskedasticity, a model is employed to explain the variance of the uncorrected model:

(1) $\quad S = L_o * DIST^{L1/2}$

Where:

S = The residual of the uncorrected model.

L_o, L_1 = Unknown parameters

The model is estimated as:

(2) $\quad \text{Log } (S) = \text{Log } (L_o) + L_1 * (\text{Log } (DIST))/2$

The results are summarized below:

Variable	Parameter estimate (Standard error)
Intercept	7.314 (.729)
Log(DIST)	-.247 (.103)
F Value	5.723

The parameter estimate associated with Log(DIST) and, consequently, the model had an attained significance level of .02.

To correct for heteroskedasticity, the original model is multiplied through by $DIST^{-L1/2}$.