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## HIGHER SPEED LIMITS AND SAFETY: THE CASE OF PRODUCE HAULERS

by  
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### INTRODUCTION

Despite heightened concerns regarding motor carrier safety, in the spring of 1987 the U.S. Congress enacted legislation permitting states to increase speed limits to 65 miles per hour along most rural portions of the Interstate System and, subsequently, along rural portions of comparable roadways. It is generally recognized that accidents tend to be more severe the higher the speeds of the vehicles involved. Relative to automobiles, heavy trucks have larger mass, longer stopping distance, and more limited maneuverability; in addition, the probability of jackknifing increases at higher speeds. In its recent report to Congress, the Office of Technology Assessment found a strong positive relationship between posted speed limits and fatal truck accidents. It concluded:

In view of the major role speed plays in fatal truck accidents and the many characteristics of heavy vehicles that make more difficult and time consuming to stop safely, Congress may wish to reexamine the decision to permit truck speeds of 65 mph at the discretion of States and to explore other methods of controlling excessive speeds for heavy vehicles. (OTA, p. 105)

Along with speed, driver fatigue is widely recognized as a major safety hazard. Drivers are normally paid on a piece rate basis (i.e., by the mile or load),<sup>1</sup> and shipper/receivers or carriers normally set schedule requirements. Therefore, drivers may have incentives to drive longer and/or faster than is prudent or legal. In a study of 346 severe accidents involving motor carriers, U.S. D.O.T. found 27 percent due to excessive speed, 25 percent linked to driver fatigue or dozing at the wheel, and a further 21 percent associated with inattention, which could be a sign of fatigue. Moreover, 11 percent of the drivers had falsified log books or were otherwise found to be in violation of Hours of Service Regulations (HSR).<sup>2</sup>

A possible safety benefit from higher speed limits could be less pressure on drivers to speed or drive for long periods. With higher speed limits, a driver should be able to complete the same amount of work as before in a shorter time without violating speed limits or HSR. This advantage could be reduced or eliminated if schedules were adjusted to require more work per unit time. For example, Beilock and Capelle (1988) found that among general freight haulers, the combination of schedule adjustments and the 65 mph speed limit had resulted in very modest reductions in pressures to speed or violate HSR.

In this paper, the effects of higher speed limits on the pressures experienced by produce haulers to violate speed or HSR are examined. These pressures are measured, in this study, in terms of the relationship between the time allowed drivers to move from origin to destination points and the amount of time necessary to legally cover these distances. Schedules with smaller allowed time to legally-necessary time ratios will be referred to as being "tighter." The exact methodology employed for measuring schedule tightness is discussed in the next section. Produce haulers are of particular interest because they are likely to be subjected to greater shipper/receiver-induced pressures to deliver quickly than are those hauling most other goods. Indeed, a comparison of produce haulers and nonproduce haulers indicates that the former are much more likely

to be on schedules which would force violations of speed limit or HSR.<sup>3</sup> This follows because produce is highly perishable and because most of the buying activity on wholesale produce markets is concentrated into a few hours each day. A late delivery to a market, even by as little as an hour, can result in a much reduced price received or force expensive refrigerated storage for a day (if available) or both.

The specific objectives of this paper are to:

1. Develop and compare schedule tightness estimates for long-distance produce haulers before and since passage of legislation permitting 65 mph speed limits.
2. Examine the sensitivity of the results to assumptions regarding previous driving times and average speeds attainable with 65 miles per hour speed limits.
3. Assess whether or not there are significant differences in schedule tightness by driver, carrier, or trip characteristics.

## DATA AND METHODOLOGY

Data for this study are drawn from two surveys of produce haulers as they exited the Florida Peninsula. The first survey was conducted for three, two-day sessions during the 1984/85 growing season. One thousand three hundred and forty-six drivers were interviewed.<sup>4</sup> The second effort involved interviewing 1,762 drivers over four, two-day sessions during the 1987/88 growing season.

The sites for both surveys were the Florida Agricultural Inspection Stations located on U.S. 1-10, 1-75, and 1-95. All trucks passing the stations are required to stop. These three sites account for 85 to 90 percent of all traffic and all other roadways have similar stations (so avoidance is not an option). Refusal rates at each station were low, averaging under 10 percent.<sup>5</sup>

Drivers were asked a wide range of questions regarding their current produce load, the trip which brought them to Florida, and some demographic information. Interspersed among these were questions regarding: pickup points, drop points, number of drivers, and latest time the driver could arrive at the first drop without being late.<sup>6</sup> The answers to these questions, a record of the time and place of the interview, and mileage estimates<sup>7</sup> were used as inputs in calculating schedule tightness. The spreading of these questions across the interviews and the nonthreatening approach used for the survey essentially eliminated the problem of response bias due to self-protection motives. In over 3,000 interviews no respondent ever indicated awareness that we were developing information to estimate schedule tightness.

The tightness of a schedule may be gauged by either the amount (or percent) of time over or under the legal limit necessary to drive while obeying speed limits, or by the average speed necessary while obeying HSR. For this study, the latter approach was adopted. The estimated average speed necessary to maintain the schedule (as far as the first destination subsequent to the interview) is denoted as SCHSPD. Three basic assumptions were made:

1. The driver drove nonstop from central or southern Florida to the interview sight. For 1984/85 this driving time was assumed to be 4 hours. For 1987/88 driving time to the interview sites were estimated according to distance calculations. As a practical matter, the two approaches were essentially identical.<sup>8</sup>
2. The driver was fully rested prior to the trip. (That is, there were no driving or on-duty hours that would affect HSR calculations.)
3. All roadways in a state used by a trucker had speed limits equivalent to the highest speed limit in that state.

Except for stops for fuel and meals, the assumption that drivers drove nonstop from the origin points to the interview sites is probably true in virtually all instances. The interviews were conducted each day from 6:00pm to 1:00am. It seems unlikely if many drivers passing the inspection stations during these hours had slept between picking up their loads and reaching North Florida. This would not be true if the interviews had been conducted from 3:00am through noon.

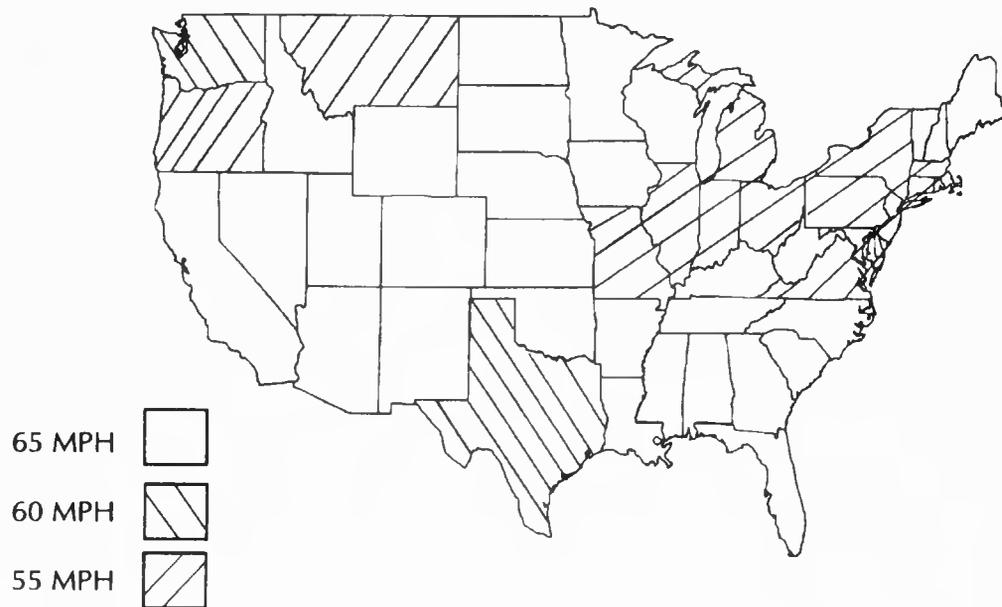
Assuming that drivers were fully rested prior to their current journey is extremely conservative. As part of the analysis of the 1987/88 data, this assumption was relaxed. Also conservative is the assumption that all roadways used to cross a state have speed limits equal to the highest in the state. The assumption is particularly unrealistic for speeds over 55 MPH, because such speeds are legal only on eligible rural Interstates and comparable limited-access highways. The effect of relaxing this assumption for states with maximum speed limits over 55 MPH will also be explored.

To facilitate the pre/post 65 MPH comparison of schedules, 55-MPH-time-equivalent distances (DIST55) were calculated as follows:

$$(1) \quad \begin{array}{lll} \text{DIST55} & = & \text{DIST} * (55/\text{SPDMAX}) \\ \text{where: DIST} & = & \text{actual distance} \\ \text{SPDMAX} & = & \text{maximum speed limit in state} \end{array}$$

In other words, DIST55 is the distance which could be traveled at 55 MPH in the same time as the actual distance could be crossed at the prevailing maximum speed limit. For example, if the actual distance to be traversed across a state was 300 miles and the prevailing maximum speed limit in the state was 55 MPH, then the actual (300 mile) distance would be employed in calculating schedule tightness. However, if the prevailing maximum speed limit was 60 MPH, then 275 miles ( $300 \times 55/60 = 275$ ) would be used in the calculation, and 253.85 miles ( $300 \times 55/65 = 253.85$ ) would be

FIGURE 1  
MAXIMUM SPEED FOR TRUCKS ON RURAL INTERSTATE HIGHWAYS, 1987-1988



used if the maximum speed limit were 65 miles per hour. This adjustment, is intended to eliminate or control for changes in speed limits; i.e., to make SCHSPD estimates consistent regardless of the speed limits in force. The maximum speed limits in force for trucks in each of the 48 Continental U.S. States at the time of the 1987/88 survey are presented in Figure 1.

To accomplish objective 2, the analysis was repeated, using the 1987/88 data, with the following modifications:

1. To test sensitivity to previous driving time, schedule tightness was successively recalculated with 1, 2, 3, ... and 8 hours of driving time added to the origin-to-survey site portion of the movement.
2. The analysis was also repeated with the following maximum legally attainable speeds assumed:

<u>Maximum legal speed limit</u>	<u>Maximum legally attainable speed</u>
60	57.5
65	60

and

<u>Maximum legal speed limit</u>	<u>Maximum legally attainable speed</u>
60	55
65	55

For Objective 3, contingency table analysis or simple correlations between schedule tightness measures, on the one hand, and selected driver, carrier, and trip characteristics, on the other

hand, was performed. While of interest, misleading results from such univariate analyses is possible as an uncontrolled covariate(s) may mask true relationships. Therefore, a multivariate approach was desirable. To meet this need, the following regression was estimated:

$$(2) \text{ SCHSPD} = b_0 + b_1 \cdot \text{DIST2} + b_2 \cdot \text{RAT65} + b_3 \cdot \text{DRIVERS} + b_4 \cdot \text{EXPER} + b_5 \cdot \text{AUTH} + b_6 \cdot \text{PRIV} + b_7 \cdot \text{OWNOP} + b_8 \cdot \text{VALUE} + E$$

Where:

- $b_0 \dots b_8$  = unknown parameters to be estimated
- DIST2 = actual distance from interview site to the next destination.
- RAT65 = the proportion of DIST2 through states with maximum speed limits above 55 MPH
- DRIVERS = the number of drivers in the tractor
- EXPER = the years of professional driving experience of the individual driving the truck at the time of the interview
- AUTH = equals 1 if the firm owning the tractor has an ICC authority, zero otherwise
- PRIV = equals 1 if a private carrier, zero otherwise
- OWNOP = equals 1 if an owner-operator, zero otherwise
- VALUE = equals 1 if strawberries, tomatoes, or ornamentals, zero otherwise

The rationales for postulating that SCHSPD might be a function of each of these variables are briefly discussed below.

HSR mandate periodic rests. If schedules do not fully account for these stops, violation-inducing schedules will result (i.e., SCHSPD's will tend to be higher than are legally attainable). The longer the distance, the longer the driving time necessary, and the more legally required rest stops, *ceteris paribus*. Therefore, if stops are not fully accounted for in schedules, schedules will tend to be higher, the longer the distance (DIST2). By similar reasoning, if schedules have not been fully adjusted to take advantage of higher-than-55 MPH speed limits, SCHSPD and the proportion of DIST2 with higher speed limits (RAT65) should be inversely related.

Team driving allows one driver to rest without stopping the vehicle. Therefore, it is expected that, on average, SCHSPD would be lower for similar trips if team drivers are used (i.e., if DRIVERS is greater than one).

EXPER is included on the premise that more experienced drivers may differ from their less experienced colleagues regarding the tightness of the schedules they are willing to accept or expected to meet. There may also be differences in SCHSPD across carrier types (OWNOP and PRIV, with for-hire fleets as the omitted category) and between those holding and not holding Interstate Commerce Commission Authorities. Reasons for such hypotheses include the widespread perception among drivers that owner-operators are the most likely to disregard speed and HSR (Beilock and Capelle, 1987), and the Office of Technology Assessment's findings that ICC-exempt carriers have higher violation rates and more serious safety problems (OTA, p. 99).

Tomatoes, strawberries, and ornamentals are among the most valuable and/or perishable crops hauled out of Florida. Freight rates for higher valued commodities generally tend to be higher. DeVany

and Saving suggest that this may be due to demands for expedited service. If true, delivery schedules for these commodities would be expected to be tighter, *ceteris paribus*, than for less valuable commodities.

## RESULTS

### Pre and Post 65 MPH Scheduling

The results indicate that between 1984/85 and there has been a marked easing of the schedules produce/ornamentals drivers operate under. The average SCHSPD for 1984/85 was 50.5 MPH versus 40.9 MPH in 1987/88. This difference is easily significant at the .01 Level of probability.

What percent of the drivers in each year had violation-inducing schedules? The rule of thumb for the U.S. Department of Transportation's Office of Motor Carrier Standards is that for trips over 10 hours duration (as was the case for virtually all in the samples) on roadways with 55 MPH speed limits, average speeds over 45 MPH are suspect (violation-suspect schedules) and over 50 MPH are considered impossible without violating the speed limit or HSR or both (violation-inducing schedules). By this rule, 44 percent of the drivers in 1984/85 had violation-suspect schedules and 35 percent had schedules which were clearly violation-inducing. The corresponding percentages in 1987/88 were 32 and 22 percent, respectively (Table 1). While the drop in clearly violation-inducing schedules from a over a third to less than a quarter is impressive, it should be remembered that this is still a very high percentage and that extremely conservative assumptions were used to develop the estimates. The impacts of relaxing those assumptions are discussed in the next subsection.

The results also suggest that the easing of schedules is due in large measure to higher speed limits, rather than to changes in schedules. In Figure 2 the percentages of drivers whose schedules required them to exceed speeds from 30 to 80 MPH (while obeying HSR) are presented. A smaller percentage of the 1987/88 drivers needed to exceed each speed level to stay on schedule than was true for the 1984/85 drivers. However, if the 55 MPH National Speed Limit had still been in force in 1987/88, the results for both years would have been virtually identical over a wide range of speeds (in Figure 2 and Table 1, compare 1984/85 and 1987/88-unadjusted).

TABLE 1  
PERCENTAGES OF DRIVERS NEEDING TO EXCEED SELECTED  
AVERAGE SPEEDS

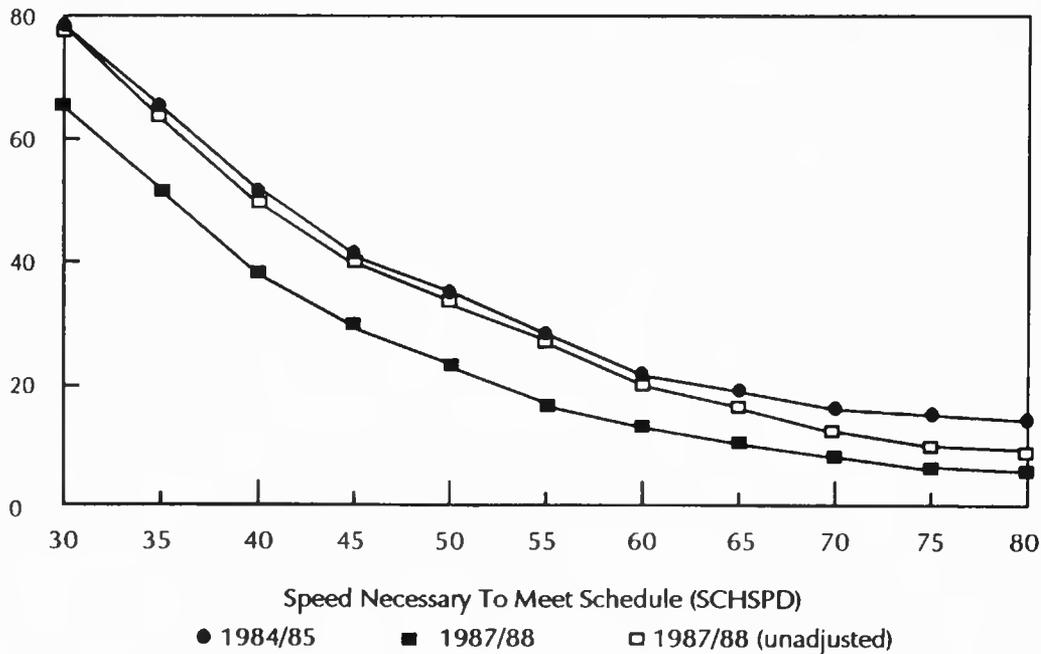
	Average Trip Speed		
	<u>45 MPH</u>	<u>50 MPH</u>	<u>55 MPH</u>
1984/85 drivers	44	35	38
1987/88 drivers	32	22	15
1987/88 drivers (1/2 adj) <sup>1</sup>	37	29	20
1987/88 drivers (unadjusted) <sup>2</sup>	43	34	28

Notes: <sup>1</sup>Maximum attainable speeds with 60 MPH speed limits assumed to be 57.5 MPH. For states with 65 MPH speed limits, maximum attainable speeds of 60 MPH assumed.

<sup>2</sup>All states treated as though they had 55 MPH speed limits.

FIGURE 2  
SCHEDULE TIGHTNESS BEFORE AND AFTER 65 MPH SPEED LIMITS

Percent of Drivers Needing Higher  
Speed to Meet Schedule



## RELAXING ATTAINABLE SPEED AND PREVIOUS DRIVING ASSUMPTIONS

The assumption that all roadways used have speed limits equal to the highest in the state no doubt results in underestimates of schedule tightness. This is likely to be particularly true for states with speed limits exceeding 55 MPH, because such speed limits are only applicable to rural portions of selected limited-access highways. It may seem more reasonable, therefore, to discount a portion of the speeds above 55 MPH. As discussed in the previous subsection, without such discounting, the 1987/88 schedules appear to be much looser than those in 1984/85, but with complete discounting (i.e., with no "credit" for supra-55 MPH speeds) the results for both years are essentially identical (Figure 2 and Table 1).

Taking the middle ground of crediting half of the supra-55 MPH speeds (equivalent to assuming that half the roadways used in a state have supra-55 MPH speed limits) still results in significant improvements over 1984/85. While in 1984/85 the average SCHSPD was 50.5 MPH, the 1987/88 average would be 43.7 MPH and only 29 percent would have clearly violation-inducing schedules (Table 1).

Assuming the driver had not logged driving or on duty time prior to the current produce haul is also extremely conservative. Earlier in the day, many, if not most drivers spent several hours of driving or on-duty time dropping off the previous load and repositioning for one or several pickups. Driving during the days immediately preceding the produce haul would also have an impact if the driver is close to the 60 hour limit (see footnote 2). However, there was not sufficient time with each respondent to determine his/her recent driving/on-duty history and, moreover, such inquiries would have alerted drivers regarding our intent to determine legal and illegal schedules.

Schedule tightness is very sensitive to the amount of prior driving time. Going from zero to 4 hours prior driving time, the number of drivers with violation-suspect schedules (i.e., SCHSPD over 45 MPH) increases by nearly a fifth from 32 to 38 percent of all drivers, and the violation-inducing schedules (i.e., SCHSPD over 50 MPH) increases by nearly half from 22 to 31 percent of all drivers (Table 2). With 8 hours prior driving, 44 percent of all drivers have violation-suspect schedules and 35 percent have violation-inducing schedules. Again, it was impossible to determine the actual number of previous driving and on-duty hours for each driver. Therefore, the conservative approach of assuming none was adopted. The sensitivity of the results to this assumption suggests that considerably more drivers actually have violation-suspect or violation-inducing schedules than is indicated under the zero prior driving time assumption.

#### DIFFERENCES IN SCHSPD ACCORDING TO CARRIER, DRIVER, AND TRIP CHARACTERISTICS

Identifying driver, carrier, and trip characteristics associated with tight schedules would be of value to policymakers and industry participants. In this subsection, the associations of selected characteristics with SCHSPD are examined via both univariate and multivariate analyses.

##### Univariate Analysis

There are no indications of (statistically significant) differences regarding schedule tightness across carrier types or between carriers possessing and not possessing ICC Authorities (Table 3). These results are consistent with the position that structural changes and reduced economic regulations do not or only tangentially impact upon attained safety Levels.

TABLE 2  
RELATIONSHIP BETWEEN (SCHSPD) AND THE NUMBER  
OF HOURS ASSUMED DRIVERS IMMEDIATELY PRIOR TO  
CURRENT TRIP

<u>Hours of prior driving time</u>	<u>Percent of drivers with SCHSPD over</u>	
	<u>45 MPH<sup>1</sup></u>	<u>50 MPH<sup>2</sup></u>
0	32	22
1	34	25
2	36	28
3	37	29
4	38	31
5	39	31
6	40	32
7	43	33
8	44	35

Notes: <sup>1</sup>Violation-suspect schedule.

<sup>2</sup>Violation-inducing schedule.

Team drivers are only about a third as likely as single drivers to have violation-suspect or violation-inducing schedules (Table 3). This finding no doubt reflects understandable reticence on the part of some carriers to employ a second driver. According to USDA estimates (Buxton), variable costs for a fleet-owned produce truck were 92 cents per mile in April 1989, of which fully 33 cents was associated with the driver (pay, food allowance, etc.). Unless a

second driver can significantly reduce transit time, it is clear that team driving is extremely expensive. However, the dramatic differences in schedule tightness suggest the importance of team driving.

Consistent with DeVany and Saving's contention that higher valued cargoes receive expedited service, the schedules are much tighter for strawberry, ornamental, and tomato loads, on average, than for other commodities (Table 3). This result may also explain, at least in part, why higher valued produce and ornamentals tend to command higher freight rates than do other commodities for similar hauls.

Suggesting that legally mandated rest periods are not fully accounted for in schedules, the distance to the first post-interview destination is positively correlated with SCHSPD (Table 3). The percent of that distance through states with speed limits over 55 MPH is negatively correlated with SCHSPD. This result suggests that dispatchers have not fully adjusted schedules to take advantage of higher speed limits.

Years of professional driving experience is negatively related to SCHSPD (correlation significantly different from zero at the .05 level, Table 3). This may reflect increased prudence with greater experience. Alternatively, this result (and the others presented in this subsection) may be an artifact of not controlling for other variables, such as trip distance. For this reason I now turn to the multivariate analysis.

### Multivariate Analysis

Considering the exploratory nature of this work, the results of the regression analysis are quite good. The equation is highly significant, the signs and magnitudes of the parameter estimates are consistent with expectations, and several are highly significant (Table 4). Only 10 percent of the variation in SCHSPD is explained by the

TABLE 3  
SCHEDULE TIGHTNESS AND SELECTED CARRIER,  
DRIVER, AND TRIP CHARACTERISTICS

<u>Item</u>	Drivers with SCHSPD over			
	45 MPH		50 MPH	
	<u>Percent</u>	<u>Chi sq.</u>	<u>Percent</u>	<u>Chi sq.</u>
Carrier status:				
For-hire fleet	30		21	
Private carrier	33		27	
Owner-operator	33	2.8	21	3.8
ICC Authority:				
Yes	34	1.8	24	
No	31		21	1.9
Drivers:				
Single	36	24		
Team	10	52.8***	9	24.3***
High value cargo: <sup>1</sup>				
Yes	40		29	
No	30	13.1***	20	11.9***

<u>Item</u>	<u>Correlation with SCHSPD</u>
Distance to first post-interview destination (DIST2)	.11***
Percentage of DIST2 through states with speed limits above 55 MPH	-.11***
Years of driving experience	-.06**

Notes: <sup>1</sup>High value cargoes considered to be strawberries, ornamentals, and tomatoes.

- \*\*\* statistically significant at the .01 level
- \*\* statistically significant at the .05 level
- \* statistically significant at the .10 level

**TABLE 4**  
**MULTIVARIATE ANALYSIS OF SCHEDULE TIGHTNESS**

Dependent variable: SCHSPD

<u>Independent variables</u>	<u>Estimated parameters (standard error)</u>
Intercept	59.44 (3.49)
DIST2	.0065*** (.0013)
RAT65	-.095*** (.023)
PRIV	1.20** (.55)
OWNOP	.13 (1.34)
AUTH	3.20*** (1.24)
DRIVERS	-14.59*** (1.60)
EXPER	-.13*** (.048)
VALUE	5.59*** (1.33)

Equation statistics:

F Statistic	18.88***
R2	.10
Number of observations	1,454

Notes: \*\*\* statistically significant at the .01 level  
 \*\* statistically significant at the .05 level  
 \* statistically significant at the .10 level

equation. However, this is not surprising due to the limited information available. The inclusion of data on factors such as price levels and trends for commodities at the various destinations,<sup>9</sup> vehicle age and condition, driver health and prior driving/on-duty history no doubt would have improved the explanatory power of the equation.

The parameter estimates associated with DIST2 and RAT65 are both easily significant at the .01 level and are, respectively, positive and negative. This supports the results of the univariate analysis that schedules tend to be tighter the longer the distance and looser the greater the percentage of that distance over roadways with speed limits in excess of 55 MPH.

The parameter estimate associated with PRIV is positive and significant at the .05 level, indicating that private carriers tend to maintain somewhat tighter schedules than for-hire fleets (incorporated in the intercept). The parameter estimate associated with OWNOP also is positive, but is not different from either for-hire fleets or private carriers at any conventional level of probability.

Carriers possessing ICC Authorities appear to maintain tighter schedules than those not possessing such authorities. The parameter estimate associated with AUTH is significant at the .01 level and indicates that drivers for carriers with ICC Authorities must average 3.2 MPH faster to stay on schedule than drivers for independent carriers. This result flies in the face of the "common wisdom" expounded by many in the trucking industry that carriers subject to economic regulation are the more safety conscious. It should be noted that the relationship between AUTH and SCHSPD was not significant at conventional levels in the univariate analysis. Evidently not controlling for the other covariates masked the relationship.

The relationship between SCHSPD and EXPER is also stronger when controlling for the covariates (significant at the .01 level in the multivariate analysis and at the .05 level in the univariate analysis). The negative sign of the estimated parameter indicates that the more

experienced the driver, the looser the schedule, *ceteris paribus*. While the estimated relationship is highly significant in a statistical sense, the magnitude of the parameter is small (.13). For a one MPH reduction in SCHSPD based on experience, an individual would have to have driven nearly additional 8 years.

The relationship between VALUE and SCHSPD is positive and highly significant in both the univariate and the multivariate analyses. The estimated parameter in the equation indicates that drivers hauling tomatoes, strawberries, or ornamentals must average 5.59 MPH faster to stay on schedule than drivers hauling other commodities.

### SUMMARY AND CONCLUSIONS

It is generally recognized that accident severity tends to increase with speed. From a safety standpoint, therefore, the only benefit from increased speeds would be reduced fatigue resulting from shorter driving times per unit distance. This advantage, however, could be dissipated if schedules were adjusted. The primary purpose of this study has been to determine the impact on the tightness of the schedules maintained by produce/ornamentals haulers from abandoning the 55 MPH National Speed Limit. This group of drivers was of interest because they operate under unusually tight schedules, presumably due to the value and perishability of their cargos (Beilock and Capelle 1987). The role of value in scheduling was supported in this study by the finding that drivers hauling higher-valued perishables (i.e., tomatoes, strawberries, and ornamentals) operate under much tighter schedules, on average, than do those hauling lower-valued perishables.

In addition to tight schedules, produce/ornamentals haulers frequently operate under fairly rigid schedules. This rigidity is primarily the result of the manner in which much of the product is marketed and distributed. Most produce is delivered to wholesale

produce markets, chainstore warehouses, or individual supermarkets. Each of these tend to operate in fairly set 24 hour cycles, with produce/plant deliveries being desirable only for specific periods. The large majority of transactions at wholesale produce markets normally take place during a three to 3-4 hour period each day (usually from 2:00 AM to 6:00 AM). Produce that is late may have to be sold at a steep discount or stored overnight, if refrigerated space is available. Chainstore warehouses normally do not hold extensive inventories of perishable produce or plants. Rather, they endeavor to coordinate deliveries as close to outshipment times as possible. It is not uncommon for produce to be distributed to local delivery vehicles directly from the incoming linehaul truck. Similarly, individual stores have minimal storage capacities. Most produce and plant deliveries are immediately used to replenish the display cases. For all three of these facility types (i.e., wholesale produce markets, chainstore warehouses, and individual stores) deliveries a few hours early or late are highly undesirable. Unless a carrier can deliver a full day earlier, often there is no advantage to altering schedules.

The rigidity of the schedules is believed by the author to be the primary reason for the finding that scheduling demands on drivers have eased as a result of the return to speed limits above 55 MPH. The comparison of the 1984/85 and 1987/88 data indicated virtually no changes in schedules. The higher speed limits in effect in 1987/88 resulted, therefore, in reduced schedule tightness. It should be stressed that the extent to which the salutary effects of eased schedule tightness offset the negative effects increased accident severity with higher speeds is entirely unknown.

Similar results may be expected for shipments of other types of freight for which transportation demand conditions create rigidity in delivery schedules. Conditions which suggest rigid delivery schedules include: deliveries directly to retailers and deliveries to receivers having limited storage capacities and/or essentially immutable sales or production schedules.

Schedule tightness was found to increase with distance. This suggests that schedules typically do not fully account for legally-mandated rest periods. Another indication of this was the much lower rate of violation-inducing schedules among team drivers than among those operating solo. It may be prudent, therefore, for enforcement efforts regarding compliance with Hours-of-Service Regulations to focus on solo, long-distance drivers.

Perhaps the most surprising finding was that drivers for carriers possessing ICC Authorities tend to have tighter schedules than those who operate independently. A possible explanation for this result is that possession of an ICC Authority is an indication of carrier sophistication and organizational ability. If profit enhancement by optimizing equipment and personnel usage is a carrier's primary goal, then it would be expected that more sophisticated carriers would have tighter schedules, *ceteris paribus*. Whatever the reason, combined with the finding that there are only minor differences in schedule tightness across carrier types, the study suggests that at least this dimension of safety will not suffer as a result of economic deregulation.

Finally, while increased speed limits appear to have reduced schedule tightness among produce/ornamentals haulers, the problem is still severe. Employing extremely conservative assumptions, it is estimated that nearly a third of the drivers had violation-suspect schedules and over one in five had violation-inducing schedules. Relaxation of those assumptions resulted in far higher estimates of schedule tightness.

## FOOTNOTES

\*This study was funded in part by the Market Facilities Branch, Agricultural Marketing Service, United States Department of Agriculture.

<sup>1</sup>In a survey of 1,762 long distance drivers, 93 percent were paid by the mile or load (Beilock, 1988).

<sup>2</sup>Hours of Service Regulations set legal limits to driving and on-duty hours. The basic provisions are:

1. 10 Hour Rule: For every 10 hours of driving time there must be at least 8 hours off-duty time.
2. 15 Hour On-Duty Rule: No person may drive after having been on duty for 15 consecutive hours.
3. No person may drive for more than 60 hours in 7 consecutive days.

<sup>3</sup>Beilock and Capelle (1987) found that 27 percent of a sample of nonproduce drivers had violation-inducing schedules versus 44 percent for produce haulers.

<sup>4</sup>The results of that study were presented in Beilock (1985).

<sup>5</sup>The high level of cooperation was due to several factors. The agricultural inspection stations normally are nonthreatening to truckers. Few citations are written and delays are normally slight. The enumerators wore University of Florida identification and introduced themselves as students. The questionnaires were brief, drivers were not asked to identify themselves or their company, and were assured of anonymity.

<sup>6</sup>The latest time which the driver believes he/she can arrive at a destination may differ from the actual requirements of the carrier or receiver. Such differences may be due to miscommunication between carrier and driver, the driver misjudging the leeway he/she actually has, or the driver having personal reasons for wishing to arrive earlier or later. However, for the purpose of gauging the tightness of the schedule the truck actually operates under, the driver's perception of the schedule, rather than that of the carrier or the receiver, is relevant.

<sup>7</sup>The source for calculating mileages was Household Goods Carrier's Bureau.

<sup>8</sup>The 1984/85 interviews took place during months in which virtually all produce originated between 200 and 350 miles south of the interview sites. However, nearly a third of the 1987/88 interviews were conducted when production areas located within a few miles of the interview sites were active. Therefore, while the 4 hour driving time rule for 1984/85 was a reasonable (though somewhat conservative) estimate, calculations based upon actual mileages were important for 8.

It should be noted that detailed questioning regarding previous driving and on-duty time was not undertaken both due to interview time constraints and likely problems with response bias (i.e., evasion).

<sup>9</sup>Falling (rising) produce prices would encourage receivers to demand faster (slower) deliveries, *ceteris paribus*.

## REFERENCES

- Beilock, R. "Are Drivers Forced to Speed?" Logistics and Transportation Review 21, 3 (1985):277-91.
- Beilock, R. The 1986 RCCC Motor Carrier Safety Survey Regular Common Carrier Conference, Alexandria, VA, 1987.
- Beilock, R. The 1987 RCCC Motor Carrier Safety Survey Regular Common Carrier Conference, Alexandria, VA, 1988.
- Beilock, R. and R. Capelle, Jr. "Economic Pressure, Long Distance Trucking, and Safety" Journal of the Transportation Research Forum 28, 1 (1987):177-85.
- Beilock, R. and R. Capelle, Jr. "The Effect of the 65 Mile Per Hour Speed Limit on Motor Carrier Schedule Tightness and Driver Perceptions of Safety Conditions" Journal of the Transportation Research Forum 29, 1 (1988):9-17.
- Buxton, F. "Fruit and Vegetable Truck Cost Report No. 4, April 1989" Agricultural Marketing Service, Market News Service, USDA, May 1989.
- DeVany, A. and T. Saving "Product Quality, Uncertainty, and Regulation: The Trucking Industry" American Economic Review 67 (1977): 583-94.
- Household Goods Carriers' Bureau Mileage Guide No. 13 Household Goods Carriers' Bureau, Alexandria, VA, 1985.
- Office of Technology Assessment Gearing Up For Safety U.S. Congress, Office of Technology Assessment, OTA-SET-382, Washington, 1988.

U.S. Department of Transportation Analysis and Summary of Accident Investigations, 1977-79 U.S. D.O.T., Bureau of Motor Carrier Safety, 1981.