# Route Choice Characteristics for Truckers

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**This research studies the decision-making process and factors that affect truck routing. The data collection involved intercept interviews with truck drivers at three rest area and truck stop locations along major highways in Texas and Indiana in the United States and Ontario, Canada. The computerized survey solicited information on truck-routing decisions, identity of the decision makers, factors that affect routing, and sources of information consulted in making these decisions. In addition, stated preferences (SP) experiments were conducted, in which drivers were asked to choose between two route alternatives. A total of 252 drivers completed the survey, yielding 1,121 valid SP observations. These data were used to study the identity of routing decision makers for various driver segments and the sources of information used in pretrip planning and en route. A random-effects logit model was estimated with the SP data. Results show that there are significant differences in the route choice decision-making process in the various driver segments, and that these decisions are affected by multiple factors beyond travel time and cost. These factors include shipping and driver employment terms, such as the method of calculating pay and the bearing of fuel costs and tolls.**

Trucks are the dominant mode of freight transportation in the United States. In 2009 trucks carried freight valued at $9.5 billion, which is about 65% of the value of freight transported by all modes. The total annual highway miles driven by trucks increased by 109% between 1980 and 2008 (*1*). This growth rate is higher compared with that of general road traffic. The highway transportation system has not grown at a comparable rate. Its total route length has increased by only 5% during the same period (*2*). This discrepancy contributes to increased congestion, energy consumption, and degradation of the environment and traffic safety.

Understanding the behavior of road users is critical to develop measures to improve the performance of transportation networks. However, while there have been numerous studies of the relevant passenger travel behaviors, the research on truck-routing choices is limited.

Toll road operation is a useful example to demonstrate the need to better understand truck-routing behavior. Heavy trucks are critically important for toll roads because of their importance in generating revenue. Bain and Polakovic found that trucks account for 10% of traffic flow on toll roads, but generate 25% of the revenue (*3*). In many cases, the use of toll roads, after they opened, was lower than originally forecast, with an overestimation of traffic by 20% to 30% in the first 5 years of operation. Furthermore, forecasting errors for truck traffic were larger compared with those for light vehicles (*4*). This uncertainty, often overforecasting flows and revenue, contributes to increased risks in the development of toll roads. Thus, a better understanding of trucks' route choices is important to improve toll road use forecasts. It may also help road operators to design measures that would make toll roads more attractive to trucks.

This research studies the decision-making process and the factors that affect truck routing. The rest of this paper is organized as follows: The next section reviews previous studies that addressed truck-routing behavior. Then, the survey that was developed to collect data on truck-routing decisions is presented. The following sections present analysis of the data. Finally, a conclusion is presented.

## LITERATURE REVIEW

Most studies of truck route choice behavior are value of time (VOT) studies, which consider the trade-off between travel time and cost. Zamparini and Reggiani conducted a meta-analysis of 46 previous studies on truck VOT (*5*). They found a mean VOT of $20/h with a coefficient of variation of 0.66. Some of the differences in VOT values could be explained by the geographic location of the study, the gross domestic product of the country where it was conducted, and the shipping mode (five of the studies addressed rail transport). Wynter found wide variability also in the VOT of French carriers (*6*). A lognormal distribution of VOT, with a coefficient of variation of 0.69, was fitted to stated preference (SP) responses from 408 fleet managers. The study also found that the mean VOT increases linearly with the trip length and varies considerably with various commodity types. Kawamura found even higher variability in VOT among carriers in California in the context of toll lanes (*7*). He estimated a lognormal distribution of VOT with a mean of $23/h and a coefficient of variation of 1.37. Smalkoski and Levinson found a wide range of VOT among carriers in Minnesota, from $21/h to $78/h, depending on the type of facility being served (*8*). They found statistically significant higher VOT for for-hire carriers compared with private fleets ($60/h and $42/h, respectively). In contrast, Bergkvist found that the VOT of Swedish shippers is higher for private carriers compared with for-hire carriers (*9*). With respect to trip length, Bergkvist found higher VOT for short trips (less than 3 h) compared with longer trips. This result contradicts that of Wynter (*6*). De Jong, in a study of UK carriers, also found differences between the VOT of

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for-hire and private carriers (*10*). However, results depended on the way the scenarios were presented: VOT values were lower for private fleets in abstract scenarios, but higher in scenarios defined in a route choice context. Miao et al. recognized the importance of the specific conditions relative to the delivery schedule (*11*). They estimated VOTs between $26/h and $68/h, depending on the geographic location (Wisconsin and Texas) and on the relation to the scheduled arrival time. In addition, they found higher VOT for drivers for private carriers compared with owner–operators (OOs) and for-hire drivers, and for drivers paid by miles compared with other drivers. As expected, drivers who paid the tolls themselves were less willing to use toll roads.

VOT studies are very limited in that they consider only travel time and cost and ignore the effects of any other factors. The wide range of freight VOT values across studies or within one study for various segmentations suggests that additional factors affect routing decisions. However, few studies linked truck route choices to other factors beyond time and cost. Small et al. showed that carriers in California were highly sensitive to late schedule delays (*12*). When the schedule delay was accounted for, the travel time itself was not significant in predicting route choices. Knorring et al. found that long-haul truckers are willing to trade an increase of 1% in their travel distance for a speed gain of 0.4 mph in situations in which they have a choice between a route passing through a metropolitan area and a bypass route (*13*). Hyodo and Hagino found an effect for the road type, in addition to tolls and travel times, on truck route choices in Japan (*14*).

In the context of toll alternatives, Hunt and Abraham found that the attributes of travel time, toll cost, primary road type (freeways or surface streets), and the probability and magnitude of delays had significant effects on truck route choices in SP data collected in Montreal, Quebec, Canada (*15*). The value of delay they estimated was greater than the VOT. Wood studied the factors that affect toll road use (*16*). In most cases, only familiarity with the scenario described in the question (i.e., tolled turnpike, bypass road, or bridge) was associated with an increased willingness to pay tolls. Prozzi et al. conducted a survey of carriers in Texas on their use of toll roads in the state (*17*). The main reasons to use toll roads that respondents provided were time savings and reduced congestion. Some respondents also noted better road quality, safer travel, and shorter distances. The main reason to avoid toll roads was the price.

These studies suggest that it was not only travel time and cost, but also risk of delays, delivery schedule constraints, and the ultimate bearer of costs, that affect route choices and can help explain some of the large variability in estimated VOT values. Studies related to the choice of carrier service [e.g., Jovicic (*18*), Kurri et al. (*19*), Bolis and Maggi (*20*), Fuller et al. (*21*), de Jong et al. (*22*), Danielis et al. (*23*), and Fowkes and Whiteing (*24*)] also show the importance to shippers of the risk of delays and late deliveries and that the value placed on these attributes varies for different shipments, such as truckload (TL) or less-than-truckload (LTL), and by commodity types and values.

## SURVEY

Data on the decision-making process related to truck routing and the factors that affect it were collected with a computerized survey. The survey collected information on the routing decision making for the shipment that was being transported at the time of the interview. In addition, information on the driver and carrier characteristics and the contractual or employment terms for the driver (i.e., basis for calculating compensation and terms related to the costs of fuel and tolls) was collected.

The data collection was based on the characteristics of the driver, the carrier, and the current shipment, as well as on the process of the route decision making, the entities (drivers, carriers, shippers) that are involved in it, and the relevant aspects of the relationships between them. In addition, information on the availability of electronic toll tags was solicited as a factor that may affect the choice of using toll roads. Information related to the employment terms that define the relationships between drivers and carriers or shippers includes the basis for calculating pay, the bearers of fuel costs and tolls, penalties for late deliveries, and metrics used by carriers and shippers to evaluate the performance of drivers. It is expected that these arrangements affect the importance that routing decision makers place on various factors and risks in making these decisions. For example, if drivers make routing decisions, it is plausible that they would be less willing to use toll roads when they personally bear the tolls as opposed to when these are fully paid by the carrier or shipper. Table 1 summarizes the information that was collected in this survey.

Participants were also asked to explain the routing–decision-making process. Specifically, participants were asked about the identity of the decision maker, participants' ability to change routes while on their way for various reasons, and the sources of information they used in planning their routes and to change routes while they were on their way. Finally, they were explicitly asked to report factors considered in making route choices.

In addition, the survey included an SP experiment that aimed to identify key factors that affected route choice and to provide some initial estimates of the trade-offs among them. Respondents were asked to choose between two hypothetical route alternatives. The alternatives were defined by factors such as travel distance, travel time, delay frequency, toll amount, toll payment method, toll bearer, toll reimbursement method (if applicable), and road type. The questions were set in the context of a future trip with the same origin,

**TABLE 1 Exploratory Data Collection**

| Information Category | Data Collected |
|---|---|
| Carrier and current shipment | Private fleet–for-hire carrier<br>TL or LTL<br>Commodity type transported<br>Specialized services (e.g., hazmat, temperature controlled)<br>Electronic toll tag availability |
| Driver | Owner-operator–hired driver<br>Years of experience |
| Employment terms | Method of pay calculation (e.g., by mile, hour, percentage of load)<br>Bearer of fuel costs<br>Bearer of toll costs<br>Penalties for late delivery<br>Metrics for driver performance evaluation |
| Truck routing | Identity of decision maker<br>Flexibility to make changes en route<br>Sources of information used in planning and en route<br>Factors affecting route choices |

destination, and delivery (or pickup) schedules as the trip that the drivers were making at the time of the interview.

The surveys were implemented on Apple iPad tablets with the iSurvey application (*25*). Questions were read to participants and the responses were recorded by the interviewer. Participants were not compensated. The survey was administered during several days between February and June 2012 to drivers at rest areas and truck stops on or near three highway corridors:

- I-35 near Salado, north of Austin, Texas;
- Ontario Highway 401 near Ayr, west of Toronto, Canada; and
- Lake Station on the west end of the Indiana Toll Road.

## RESULTS

Results presented below are derived from the responses in all three locations. For some items, there were differences (questions were added) in the questionnaires used. Therefore, the sample sizes relevant to each analysis differ. The collected data set includes responses from 252 drivers (118 in Texas, 53 in Ontario, and 81 in Indiana).

### Sample Composition

The sample makeup in regard to the characteristics of the driver and the shipment transported is presented in Table 2.

Most truck drivers that participated in the surveys, 75% overall, were hired drivers. Of those, the larger share was of drivers for for-hire carriers and the rest were drivers for private fleets. This result differs from government statistics that suggest a reverse split. The difference may be explained by differences in the use of trucks and in their levels of truck stop use. It may also be a result of incomplete responses and understanding of the specific question. In particular in Toronto, the distinction between for-hire carriers and private fleets was not made clear. Therefore the results for these two groups are shown together. In addition, 19% of drivers are OOs that lease their services to a larger carrier or shipper. The remaining 6% are OOs working under their own authority as self-employed independent contractors and haul freelance. This share is consistent with figures published by the Census Bureau (*26*).

Drivers' levels of experience may affect their familiarity with the road network and their willingness to use alternative routes. Of the drivers, 63% had been driving for more than 10 years, and only 10% had less than 3 years of experience. This result is consistent with reports that warn about the aging of the truck driver population in the United States and the shortage of new drivers (*27*).

At the time of the interviews 78% of shipments transported by the trucks were TL. That figure is a bit higher compared with industry estimates that 60% of trucks are in TL service and that they account for 72% of the mileage (*26*). Of the rest, 10% were LTL shipments and 12% were parcels, empty trips, or others. The reason for the lower-than-expected share of LTL shipments may be that these trips tend to be shorter and truck stops and rest areas may be used less frequently.

Most trips (72%) did not involve any special shipping service. Temperature control was involved 16% of the time, and the shipment of hazmats was involved 5% of the time. These numbers compare well with estimates that refrigerated vans are used in 9% of the truck miles (*26*) and that hazmats constitute 8% of the ton-miles (*1*) driven in the United States.

**TABLE 2 Driver and Shipment Characteristics**

| Characteristic | Overall (%) ($N = 252$) | Characteristic | Overall (%) ($N = 252$) |
|---|---|---|---|
| Driver type | | Shipment type | |
| Hired-company | 56 | TL | 78 |
| Hired-private | 19 | LTL | 10 |
| OO-leased | 19 | Others | 12 |
| OO-own | 6 | Specialized services | |
| Years of experience | | None | 72 |
| Less than 1 | 4 | Hazmat | 5 |
| 1 to 2 | 6 | Wide | 2 |
| 3 to 5 | 9 | Temp. control | 16 |
| 5 to 10 | 16 | Others | 5 |
| More than 10 | 63 | | |
| Not answered | 2 | | |

### Employment Terms

Some aspects of the drivers' employment terms, especially those related to compensation and the bearing of various costs, may affect routing decisions. The employment terms for the overall sample and for the hired and OO segments are summarized in Table 3.

Most drivers were paid a fixed amount for a specific trip, which did not depend on their routing. Most commonly, drivers were paid by book miles. The only two payment calculation methods related to the actual travel time and distance were drivers paid by hours (12%) and to a lesser extent drivers paid by actual miles (12%). Some hired drivers were paid by actual miles or hours (14% and 15%, respectively). These methods were less frequent for OOs (6% and 3%, respectively). Terms were very different for hired drivers and OOs with respect to fuel and toll costs. For 92% of hired drivers, but only 5% of OOs, the company was responsible for fuel costs. The situation with respect to tolls was similar. Of hired driers, 89% reported that their company was fully responsible for tolls, but for OOs it was only 24%. OOs were also less likely compared with hired drivers (50% and 68%, respectively) to have electronic toll collection (ETC) tags.

**TABLE 3 Employment Terms by Driver Type**

| Characteristic | Overall (%) ($N = 252$) | Hired (%) ($N = 192$) | OO (%) ($N = 64$) |
|---|---|---|---|
| Pay calculation method | | | |
| Book miles | 47 | 48 | 38 |
| Actual miles | 12 | 14 | 6 |
| Hours | 12 | 15 | 3 |
| Others | 29 | 23 | 53 |
| Bearer of fuel costs | | | |
| Company | 69 | 92 | 5 |
| Driver—partially | 15 | 2 | 54 |
| Driver | 16 | 7 | 41 |
| Bearer of toll costs | | | |
| Company | 74 | 89 | 24 |
| Driver—partially | 2 | 68 | 50 |
| Driver | 16 | 5 | 14 |
| Other or no answer | 8 | 3 | 56 |
| Electronic toll tag | | | |
| With tag | 65 | 68 | 50 |
| Without tag | 35 | 32 | 50 |

**TABLE 4 Planning and En Route Routing Decision Making by Driver and Shipment Type**

| Routing Decision | Overall (%) (*N* = 153) | Driver Type | | Shipment Type | |
|---|---|---|---|---|---|
| | | Hired (%) (*N* = 114) | OO (%) (*N* = 39) | TL (%) (*N* = 119) | LTL (%) (*N* = 16) |
| Planning | | | | | |
| Assigned—must follow | 16 | 20 | 5 | 16 | 25 |
| Assigned—approval | 2 | 3 | 0 | 1 | 6 |
| Assigned—freely | 8 | 11 | 0 | 9 | 13 |
| Choose—alternatives | 7 | 10 | 0 | 7 | 6 |
| Choose—approval | 2 | 3 | 0 | 2 | 0 |
| Choose—freely | 65 | 54 | 95 | 65 | 50 |
| En route | | | | | |
| Not allowed | 3 | 3 | 0 | 1 | 6 |
| Reassigned | 1 | 1 | 0 | 1 | 0 |
| Approval | 12 | 16 | 0 | 13 | 19 |
| Freely | 85 | 80 | 100 | 85 | 75 |

## Routing Decision Maker

In identifying the routing decision makers, a distinction was made between pretrip route planning and en route adjustments. In the route planning phase, drivers may be assigned a route or choose one on their own. An assigned route may be mandatory or it may be a recommended route, allowing drivers to ask for approval to change or freely choose another. Drivers who choose their routes may be required to do so from a set of preapproved alternatives, may be required to have their chosen route approved, or may be able to make their own choice. En route drivers may not be allowed to change routes at all, may have to ask for and be assigned a new route, or may change their route on their own freely or after obtaining approval for the change. Table 4 shows the distribution of responses for planning and en route decision making for the overall sample and various segments in it.

Most drivers reported they were responsible for routing decisions. At the planning stage 65% of drivers were free to choose their own routes. Only 16% were assigned a route they had to follow. While en route, drivers had even more flexibility to change their routes; 85% reported they could change their routes freely. Only 2% could not change at all or would be reassigned a route by their company. This result indicates that drivers had substantial responsibility in managing their routes. OOs almost always decided their own routes at the planning stage and en route. In contrast, only 54% of the hired drivers freely chose their own routes. The rest experienced different levels of supervision, with 20% following the required routes assigned to them. Still, 96% of hired drivers could change their routes while driving, either freely (80%) or after obtaining approval. Drivers carrying an LTL shipment played lesser roles in deciding routes. Only 50% of LTL drivers chose their own route freely, compared with 65% of TL drivers. At the other extreme, 25% of LTL drivers were required to follow an assigned route, as opposed to only 16% of TL drivers. The sample size for LTL is rather small, but these patterns are consistent in all decision-making options. Similarly, 85% of TL drivers may change their route freely while driving, compared with only 75% of LTL drivers.

Table 5 shows the routing decision makers for various driver segments in relation to the bearer of fuel and toll costs and the method of calculating pay. Drivers may be fully, partially, or not at all responsible for the cost of fuel and tolls. Drivers who were fully or partially (e.g., receive surcharges) responsible for fuel costs overwhelmingly had the right to choose routes on their own. Drivers who were not responsible for fuel costs at all were more restricted in their routing:

**TABLE 5 Planning and En Route Routing Decision Making by Employment Terms**

| Routing Decision | Driver Bears Fuel Cost | | | Driver Bears Tolls | | | Pay Calculation Method | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No (%) (*N* =118) | Partly (%) (*N* = 23) | Yes (%) (*N* = 18) | No (%) (*N* = 32) | Partly (%) (*N* = 4) | Yes (%) (*N* = 24) | Book Miles (%) (*N* = 66) | Actual Miles (%) (*N* = 20) | Hours (%) (*N* = 17) | Others (%) (*N* = 53) |
| Planning | | | | | | | | | | |
| Assigned—must follow | 20 | 9 | 6 | 12 | 0 | 8 | 21 | 20 | 23 | 9 |
| Assigned—approval | 3 | 0 | 0 | 3 | 0 | 0 | 1 | 0 | 12 | 0 |
| Assigned—freely | 12 | 0 | 0 | 16 | 0 | 4 | 18 | 5 | 6 | 0 |
| Choose—alternatives | 9 | 0 | 0 | 6 | 0 | 0 | 5 | 15 | 12 | 6 |
| Choose—approval | 3 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 4 |
| Choose—freely | 53 | 91 | 94 | 63 | 100 | 88 | 53 | 60 | 47 | 81 |
| En route | | | | | | | | | | |
| Not allowed | 3 | 0 | 0 | 3 | 0 | 0 | 2 | 5 | 6 | 2 |
| Reassigned | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| Approval | 15 | 4 | 0 | 9 | 0 | 0 | 14 | 10 | 23 | 7 |
| Freely | 81 | 96 | 100 | 88 | 100 | 100 | 83 | 85 | 71 | 91 |

**TABLE 6 Routing Decision Making by Special Service Characteristics**

| Routing Decision | Hazmat (%) ($N = 7$) | Temperature Controlled (%) ($N = 22$) | None (%) ($N = 100$) |
|---|---|---|---|
| Planning | | | |
| Assigned—must follow | 0 | 14 | 19 |
| Assigned—approval | 14 | 5 | 1 |
| Assigned—freely | 14 | 9 | 7 |
| Choose—alternatives | 0 | 0 | 9 |
| Choose—approval | 14 | 5 | 2 |
| Choose—freely | 57 | 68 | 62 |
| En route | | | |
| Not allowed | 0 | 0 | 3 |
| Reassigned | 0 | 5 | 0 |
| Approved | 29 | 14 | 12 |
| Freely | 71 | 82 | 85 |

only 53% chose their routes freely; 20% were assigned routes that they had to follow; 81% could change their route while driving. A similar pattern was observed for toll costs: 90% of drivers who were fully or partially responsible for tolls selected their own routes, and 100% could freely change their routes while driving. In contrast, when drivers were not responsible for tolls, only 63% of drivers in pretrip and 88% en route chose routes freely. As for drivers' payment method, the category that combined payment options that were unrelated to routing (i.e., fixed amounts or depending on the load weight, value, or the freight charges) had the highest level of freedom in choosing routes (81% pretrip and 91% en route). Drivers paid by their hours, whose pay depends the most on the routing decision, had the least flexibility in making decisions (47% and 71% for pretrip and en route, respectively).

Table 6 shows routing decision making for shipments with and without special services: hazmats and temperature control. The distributions for temperature-controlled shipments were not substantially different from those of other TL shipments. With hazmats, the fractions of drivers that could choose their routes freely were lower: 57% pretrip and 71% en route. However, these figures are still surprisingly high, as hazmat shipping regulations required that routes be preapproved or follow designated routes. However, these results were based on a very small sample of only seven drivers.

## Sources of Information

Information about the sources of information that drivers use when planning their routes and the way they learn about delays on their routes while driving was also collected. Drivers were asked to rate the frequency at which they use various information sources on a 5-point scale. The results are presented in Table 7. Drivers base routing choice mainly on their own previous experience. All drivers indicated that they relied on it at least half the time. Maps and navigation systems are also useful sources (62% and 65%, respectively, use it at least half the time). En route, other drivers are the most frequent source of information (72% use that source at least half of the time). The company is not perceived as a significant source of information at any stage. Only 27% and 18% receive information from it at least half of the time, pretrip and en route, respectively.

## Factors That Affect Route Choices

Respondents were also asked about the frequency with which several factors affect their routing decisions. Four factors were considered: travel time predictability, availability of parking locations, fuel stations that the driver can use, and the effect on fuel consumption. The results are presented in Table 8. Drivers were most concerned with having fuel stations that they could use (88% at least half the time), followed by having predictable travel times (84%) and by being able to find truck parking (81%). In contrast, the effect of the route on fuel consumption did not factor in their responses. None of the respondents stated that they considered it usually or always.

## Electronic Toll Collection Tags

Finally, the questionnaires also collected information on the availability of ETC tags in the truck, which is expected to affect the use of toll roads. The results are presented in Table 9.

Overall, 64% of trucks were equipped with an ETC tag. As can be expected, penetration rates were lower for OOs, who often need to cover the costs themselves. Surprisingly, they were also lower for LTL shipments. This result may reflect shorter haul trips or more regular service areas, which may allow drivers better familiarity

**TABLE 7 Sources of Information Used in Making Routing Decisions**

| Routing Decision | Never 1 (%) | Seldom 2 (%) | Half 3 (%) | Usually 4 (%) | Always 5 (%) | Avg. | Std. |
|---|---|---|---|---|---|---|---|
| Planning | | | | | | | |
| Prior experience ($N = 11$) | 0 | 0 | 9 | 73 | 18 | 4.1 | 0.5 |
| Navigation ($N = 58$) | 26 | 9 | 20 | 21 | 24 | 3.1 | 1.5 |
| Map ($N = 58$) | 29 | 9 | 17 | 21 | 24 | 3.0 | 1.6 |
| Other drivers ($N = 11$) | 18 | 46 | 9 | 27 | 0 | 2.5 | 1.1 |
| Company ($N = 11$) | 37 | 36 | 18 | 0 | 9 | 2.1 | 1.2 |
| En route | | | | | | | |
| Navigation ($N = 146$) | 53 | 7 | 6 | 13 | 21 | 2.4 | 1.7 |
| Highway radio ($N = 146$) | 40 | 8 | 15 | 20 | 17 | 2.7 | 1.6 |
| Other drivers ($N = 148$) | 21 | 7 | 16 | 28 | 28 | 3.3 | 1.5 |
| Company ($N = 149$) | 67 | 15 | 8 | 6 | 4 | 1.7 | 1.1 |
| No information ($N = 149$) | 21 | 21 | 23 | 22 | 13 | 2.9 | 1.3 |

NOTE: Avg. = average; std. = standard.

**TABLE 8 Factors That Affect Routing Decisions**

| Factor | Never 1 (%) | Seldom 2 (%) | Half 3 (%) | Usually 4 (%) | Always 5 (%) | Avg. | Std. |
|---|---|---|---|---|---|---|---|
| Predictable travel time ($N = 57$) | 9 | 7 | 9 | 24 | 51 | 4.0 | 1.3 |
| Parking ($N = 58$) | 12 | 7 | 17 | 17 | 47 | 3.8 | 1.4 |
| Fuel stations ($N = 58$) | 7 | 5 | 10 | 16 | 62 | 4.2 | 1.2 |
| Fuel consumption ($N = 11$) | 46 | 27 | 27 | 0 | 0 | 1.8 | 0.8 |

with nontoll alternatives. In regard to toll bearers, the ETC penetration rate is highest (75%) when the company bears the toll cost either directly or through reimbursement. It is lowest (33%) when the driver is responsible for the toll cost. The sample sizes for the cases that the driver is partially reimbursed or for other arrangements are very low and therefore the sample penetration rates for these are not meaningful. They are reported only for completeness. Nevertheless, the low sample sizes do indicate that these are uncommon employment terms.

## CONCLUSION

This research studies the characteristics and considerations involved in truckers' routing decision making. By using data collected in intercept interviews with truck drivers, the identity of routing decision makers was investigated. Results show that in most cases the driver has the power to choose routes. That is especially the case for OOs and for drivers who are responsible, even if partly, for the cost of fuel and tolls. Furthermore, the sources of information that drivers consult in making routing decisions are limited. They receive little support from their companies. The results also show that drivers consider additional factors beyond travel time and travel cost in deciding their routes. In the survey, drivers mentioned travel time predictability and the availability of parking and fuel stations as relevant considerations.

These findings suggest that simple VOT studies that have been used as a basis to predict truck route choices and flows, and in particular in the context of toll roads, may not be adequate. This survey included SP data that may be used to develop models for routing choices and to quantify the effects of the factors that explain those choices.

**TABLE 9 ETC Penetration Rates for Various Segments in Sample**

| Group | ETC Tag Penetration Rate (%) | Sample Size ($N$) |
|---|---|---|
| Driver type | | |
| All sample | 64 | 160 |
| Hired drivers | 68 | 120 |
| OO | 50 | 40 |
| Shipment type | | |
| TL | 71 | 120 |
| LTL | 44 | 16 |
| Toll bearer | | |
| Company | 75 | 123 |
| Driver—partially | 50 | 4 |
| Driver | 33 | 24 |
| Others | 50 | 6 |

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