Improving roadside surveys for a better knowledge of road freight transport

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Abstract

This paper is focused on improving the observation and knowledge of interurban road freight transport. It investigates some directions for the improvement of a classic French road-side survey protocol, usually employed to gather origin-destination data. To do that, new questions are added to the classic roadside survey form, and the enhanced survey form is tested in the frame of two surveys. The new questions concern currently unobserved variables: the volume occupied by the freight in vehicles; the organizations (double crew, relays) set by motor carriers; the existence of specific logistic imperatives; and the breaks drivers have to take. The questions about the volume constraint and the organizations of carriers prove to be the most informative ones; as such, these two questions are two promising directions for improving French roadside surveys. The questions about specific logistic imperatives and about breaks prove less fruitful.

1 Introduction

Theoretical models, simulation models, as well as all kind of quantitative and qualitative analyses of freight transport are based on databases, which describe the activity of the freight transport system in various ways. Among these databases, one type is particularly interesting to study the activity, organization and costs of road freight transport: those obtained by roadside surveys. The objective of this paper is to present some directions for improvements of roadside surveys, in order to acquire better information on the practices and constraints of road freight carriers.

Before detailing why and how roadside surveys should be improved, let us discuss a bit the scientific importance of such efforts. In many models, and, more generally, in many representations of road freight transport, the technology of carrier is represented in a simple manner: the cost of transporting a given amount of tons on an origin-destination pair is assumed proportional to that amount, and the length of the trip, up to a per ton and per kilometer cost coefficient. While this assumption can prove sufficient in many situations, there are cases where a better understanding of the structure of road transport costs is desirable, especially when addressing such complicated questions as modal choice. However, when trying to examine in detail the structure of costs of road freight transport, a number of difficulties arises (for an indicative list of these difficulties, see e.g. [1], pp. 433–434). Some of them are briefly discussed below.

The complexity of the structure of road transport costs stems first from the network structure of the production of freight transport services. For example, on an origin-destination pair, main haul and back haul freight rates are closely related [2]; these spatial interdependencies become increasingly complex when more sophisticated network structures are considered [3].

Second, road freight transport operations take place in a logistic context, which is an issue because the microeconomic drivers of logistic decisions are yet only partially understood. In particular, the choice by shippers of shipment sizes and of transport modes is closely dependent on transport prices and particularly on the relationship between shipment size freight rates, relationship which is in reality more complicated than a simple linear relationship. Furthermore, freight rates are influenced by the choices of shipment sizes made by shippers. For a discussion of the microeconomics and econometrics of the choice of shipment size, and more generally of the introduction of logistic principles in freight transport modeling, see e.g. [4], and [5].

Third, if shipment sizes are represented, then it is necessary to account for the fact that carriers consolidate shipments in vehicles, and that this consolidation is limited by the capacity of the vehicles. This is known to be a complex problem of operation research, namely the bin-packing problem, and it has a complicated influence on the prices of freight transport [6, 7]. Besides, the capacity of vehicles is an important lever of freight transport policies and, as such, has been the object of econometric investigations (see e.g. [8, 9]).

A better understanding of the road freight transport technology is thus desirable; and this encompasses not only theoretical refinements, but also metrological and econometrical advances. This paper is purported to present such metrological improvements. It is mainly focused on interurban road freight transport; urban road freight transport call for specific observation approaches [10].

Let us now present briefly the principles of roadside surveys, then discuss to what extent they can be improved. Basically, roadside surveys are data collection operations, where vehicles are stopped in the course of their trips, and drivers asked some questions. In the case of road freight transport in France, roadside surveys are mainly purported to build OD matrices per commodity type, transport mode and conditioning. However, they may be improved in order to yield useful information about other aspects of freight transport, without increasing much their cost. The objective of this paper is to investigate how this can be done, and to identify which type of information can be obtained.

Four directions for improvements are investigated. First, we investigate whether the volume capacity constraint of vehicles can be measured. Second, we try to obtain more details on the way road carriers organize freight transport operations. Third, we assess the possibility to observe the specific constraints set by shippers on carriers, with respect to the transport operations. Finally, the places and durations of the breaks drivers take are observed.

These four directions for improvement are comprehensively tested in the frame of a specific pretest survey, which will thereafter be referred to as the RN10 survey, according to the geographic area where this survey took place. A subset of these questions, which where identified to yield useful information, where tested again in the frame of a confirmation survey, referred to as the A10-A20 survey.

The outline of this study is the following one: the classic French roadside survey protocol and survey form are first presented in Section 2. Next, Section 3 presents the design of the pretest survey form, and the results of the RN10 pretest survey. Third, the outcome of the confirmation A10-A20 survey is presented in Section 4, before some conclusions are discussed in Section 5. All survey forms are available from the authors, or in the appendices of [4].

2 The classic roadside survey protocol for freight transport

The purpose of a roadside survey is, among others, to observe the origin and destination of trips made by vehicles passing through a given road. They consist in stopping vehicles on that road to ask them some questions. These questions typically concern the origin and destination of the trip, its length, motive, the number of passengers for passenger transport, and, in the case of freight transport, the type and amount of commodity transported.

Technically, the roadside survey consists concretely in diverting momentarily a number of vehicle from the road, so that interviewers can administer them a survey form. The operation's presence is indicated by traffic cones and mobile signs. The trucks are diverted by policemen, who alone are authorized to operate inside the traffic (the availability and willingness of the police to participate to the survey is thus absolutely necessary, and sometimes not enthusiastic). They are directed to an available area on the side of the road to be interviewed (typically a service area for highways), after which they resume their trips. There can be several interviewers, so that several drivers can be interviewed simultaneously.

Roadside surveys are used extensively in France to gather data on the origins and destinations of passengers and freight vehicle trips. One of their uses is to yield information on local transport practices. Another one is to be combined with traffic data to build origin destination matrices at the regional and national levels. They usually last 2 to 6 days, and 100 to 150 vehicles can be surveyed each day. Their locations are usually chosen so that all the roads getting in and out of a relatively big city are surveyed, which is necessary to build OD matrices. Broadly speaking, the cost of roadside surveys is about 10€ per observation.

The contents of the survey form can vary, but the questions asked to truck drivers are generally the following ones.

- *Number of axles.* Observed by the interviewer, the answer is generally comprised between 2 and 5.
- *Type of vehicle.* Also observed by the interviewer. In case of a semi-trailer, the interviewer must fill in the semi-trailer type. The types distinguished are usually: container, box (rigid sider), tanker (for liquid and gas), reefer (equipped with a heating/cooling unit), dry bulk (for dry powder materials), flatbed (a load floor with removable side rails), tautliner (curtain sider), other.
- *Origin of the trip.* The driver is asked his last compulsory stop, whether is was to load or unload freight, or to take the vehicle. Note that the two possibilities are distinguished when asking the question, because the origin of the freight's trip can be different from the origin of the driver's trip.
- *Destination of the trip.* The driver is asked his next compulsory stop, whether is is to load or unload freight, or to take the vehicle.
- *Length of the trip.* The interviewer asks the trip length. The driver's answer is sometimes approximate.
- *Empty or loaded.* The interviewer asks whether the vehicle contains freight or not.

- *Commodity type*. In case there is freight in the vehicle, the interviewer asks its nature. Note that when the semi-trailer holds a container, the commodity type is generally unknown to the driver. In other cases, the driver generally holds documents which describe the freight, the pickup and delivery times, as well as the route.
- *Freight amount*. The driver is asked how many tons of freight he is carrying. This data is also available on the documents accompanying the freight.
- *Hazardous materials*. Some questions can concern specifically hazardous materials.

This list of questions may vary with the circumstances. An example of a classic French roadside survey survey form is provided, translated, in Appendix A.1 of [4].

On the whole, this list of questions reaches the objective of providing OD information. There is, anyway, a strong limitation. It is for example sometimes impossible to follow the route of the freight, if there is a transshipment on a cross-docking platform, or to another transport mode, etc. The transport chain, *i.e.*, the number of operations involved by the transport of a given shipment, cannot be observed using roadside surveys. Roadside surveys do not necessarily provide vehicle OD data either, as the drivers can change in the course of a given trip. As a consequence, there is no certitude as to whether OD matrices obtained using these surveys are vehicle OD or freight OD data [11].

However, roadside surveys provide valuable data on freight flows, and on the productivity of carriers. In the next section, we examine how they can be improved to yield even more information.

3 Design of the new survey form, and pretest survey

Truck drivers are not managers, and they are not necessarily fully aware of the potentially complex processes which determine which trip they have to do and when. However, they know more about freight transport operations than what they are asked about in classic surveys. In order to identify the directions in which roadside surveys can be improved to yield more information about road freight transport, a new survey form, addressing various topics, was tested. The results are presented here.

This survey form is based on the classic roadside survey form. General statements about the survey are first provided in Section 3.1. Then, the four new topics specifically addressed by the survey form: freight volume, transport organisation, specific schedule imperatives, location and duration of breaks, are presented respectively in Sections 3.2 to 3.5. The survey form itself is provided in Appendix A.2 of [4].

3.1 The RN10 survey

The survey took place between the 4th december and the 12th december 2007 at 50 kms of Bordeaux, France, on the RN10 main road, which is part of one of the main routes between Bordeaux and Paris. Both traffic directions were surveyed. Due to the unavailability of police force, the roadside protocol presented in the previous section could not be applied rigorously. As a consequence, the drivers were interviewed on a nearby service area, during their breaks. For this reason, there may be a series of bias in the results presented below. 693 truck drivers were interviewed, 686 of these interviews yielded workable data.

Before getting into the detailed description of the original questions, the sample is briefly described. Some general remarks on interurban freight transport by road are made. 89.8% of the vehicles in the sample have 5 axles. The survey is located on a main road between two big cities, and on a major route of international freight traffic, notably between France and the Iberian peninsula, so that large vehicles, adapted to interurban transport, are expected to prevail. For the same reason, the nationalities of the vehicles is not surprising: 45.5% of the vehicles are French, 24.6% Spanish and 20.4% Portuguese. With respect to their origins and destinations, 42% of the trips are national, 58% international. 56.9% of the international trips are transit trips.

The vehicle types depend strongly on the number of axles. The trucks with 2 axles are mainly reefers or tautliners, the 3 and 4 axles are mainly flatbeds or dry bulk. About a half of the 5 axle vehicles are tautliners. The other types are by and large equally distributed, except for the containers, which are rare. Tautliner vehicles can be considered as general purpose vehicles, while the other vehicles are used for commodities with specific constraints (handling, temperature, safety, etc.). The use of specific equipments in road freight transport is thus significant. The distribution of vehicle types is relatively similar in both directions.

The commodity type is encoded along the French commodity type nomenclature called NST(*Nomenclature Statistique Transport*, Transport Statistics Nomenclature). The commodity type is observed for 86% of the loaded vehicles. Interestingly enough, while commodity flows appear to be symmetric when commodity types are examined at the least detailed level (10 categories in the NST), this symmetry is broken when considering commodity types at the most detailed level (176 categories in the NST).

10.8% of the vehicles interviewed were running empty. However, this percentage depends strongly on the type of vehicle. Some transport techniques, such as tautliners, are quite versatile, and present low empty running factors, below 10%. More specialised trailers, such as tankers and dry bulks, show much higher empty running factors, more than 20%. This can be explained by the higher difficulty to find backhaul freight for a specialised vehicle type, compared to a versatile one.

The average trip length is 1176 km, its median 1103 km and its standard deviation 864 km. It varies a lot with the commodity type, number of axles, and vehicle type. The average trip length by commodity type ranges from 406 km for the vehicles carrying building materials to 1480 km for the vehicles carrying manufactured goods. Similarly, dry bulk vehicles cover on average 310 km, against 1550 km for reefers.

It would be possible to proceed to a myriad of analyses of this kind. However, this is not the objective of this work, so this won't be done here. The points specifically addressed by the novel survey form will now be examined. To ensure a minimal homogeneity of the transport operations analysed, the following discussion is limited to the 5 axle vehicles, which represent about 90% of the sample.

3.2 The volume constraint

The weight capacity is a major technological constraint of freight transport. The ability of carriers to fill their vehicles up to their capacity is a critical driver of their productivity. It can be measured by the loading factor, the ratio of the weight of freight carried to the vehicle capacity. This ratio is used in almost all spatialised models to convert commodity flows into vehicle flows, which constitute road traffic (for example, the loading factor has been chosen as one of the key factors of freight transport demand in the REDEFINE European project [12]).

Freight weight can be measured accurately by roadside surveys, because it is indicated on documents drivers have at their disposal. Vehicle capacity is also indicated. Therefore, the average loading factor is easily computed; the influence of the weight constraint on the organization and costs of carriers can be assessed correctly. However, another constraint limits the productivity of carriers: that of the volume constraint. Contrarily to the loading factor, this constraint is usually disregarded in transport statistics. The influence of this constraint on road freight transport costs is thus not well known.

The difficulty with measuring the volume constraint is that freight volume is usually not available. Therefore, this question is absent from the classic roadside survey form. However, even if the drivers are not able to tell the exact volume of their freight in m^3, they are approximately aware of the place the freight takes in their vehicle, and can tell if the vehicle is, say, half empty, or two thirds full. A specific question is thus asked to drivers in the new survey form: if the vehicle is not empty, the interviewer asks the driver if a quarter, a half, three quarters or the totality of the vehicle's volume is used. It appears that, in most cases, drivers understand the question correctly, and are able to answer it.

The question is now to know if the volume and the weight constraint do play the same role. If yes, then asking the two questions is

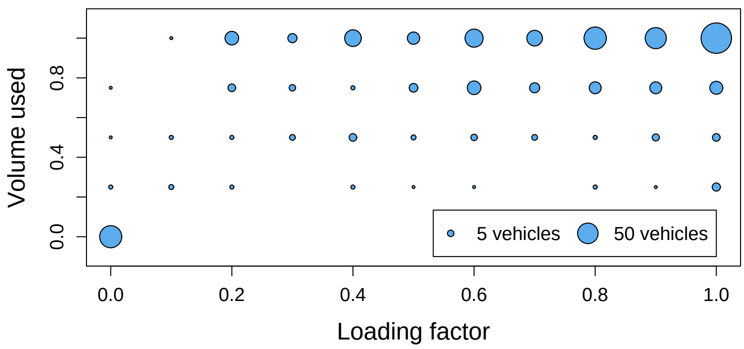
Table 1: Weight and volume constraints, RN10 survey

		Full volume	
		No	Yes
Full weight	No	23.2%	42.0%
	Yes	8.6%	26.1%

not really instructive. If not, then it is important to obtain informations on both dimensions. From the examination of these two variables (Table 1), the two constraints do appear to play the same role; furthermore, it seems that the volume constraint is often more binding than the weight constraint. In particular, increasing the weight limit while leaving the volume limit unchanged would only impact 8.6% of the vehicles in the sample, against 42.0% for a change in the volume limit with a constant weight limit.

The relationship between weight and volume is detailed by Figure 1. This, combined to the correlation between the freight weight and the weight volume for loaded vehicles, which is only 0.16, implies that weight alone is not a complete measure of the productivity of road freight transport.

Figure 1: Loading factor and volume used, RN10 survey



While the figures given in this section should be considered with care, due to the possible bias resulting from the survey protocol, the feasibility of measuring approximately the volume used in the vehicles is clear. Such data can be a useful basis for TS & W (Truck Size and Weight) studies, in which one difficulty is to evaluate the elasticities of road freight transport demand with respect to weight limit and vehicle dimensions. They also explain why increasing the useful volume while keeping the outer dimensions unchanged is as much a major axis of innovation of the trucking industry as reducing the curb weight of vehicles.

3.3 Transport organisation

From a microeconomic perspective, road freight transport is not considered to be a complicated technology. Consider the two inputs that are vehicles and drivers, they are generally assumed to be perfect complements: they must be used in fixed proportions to produce a given amount of transport, measured in vkm. The cost function of road freight transport is thus proportional to the vkm output, and road freight transport's speed is fully determined by the vehicle limit speed and the breaks drivers must take. The complementarity of drivers and vehicles is confirmed econometrically. For example, [13] found by fitting a CES production function which takes the number of vehicles and drivers as its arguments, that the elasticity of substitution between these two factors is 0.2, which is low.

However, motor carriers can, in some cases, organise themselves so as to decrease the travel time on a given origin destination pair. If two drivers are present in a vehicle (double crew), one of them can drive while the other one sleeps, so that the truck does not have to stop due to the regulatory breaks. A more complex organisation, in relay, is also possible: the idea is to organise the trips of several drivers and vehicles so that each vehicle is always driven and each driver drives the time he is supposed to drive. The characteristic of an organisation in relay is that the driver and the freight do not have the same origins and destinations. In both cases, the vehicle is always running, so that its average speed is increased. For long distances, the carrier is thus able to reduce the travel time, provided the shipper agrees to pay the extra cost.

Roadside surveys can measure these practices. This is done with the survey form presented here. The interviewer asks “How many drivers are there on board?”, and “Are you doing the same trip as the freight?”, as well as, if it is a relay, the origin, destination, and length, of the part of the trip done by the current driver (questions Q11 to Q15).

Except for two cases, all the double crews and relays are observed for 5 axle vehicles. Their frequencies are given in Table 2, as well as the corresponding average distances and speeds. These frequencies are low: it seems double crew and relay organisations are a minority. However, they should be taken with extreme care. Indeed, the objective of relay and double crew organisation is to avoid breaks, so that the pretest survey, which was made on a rest area, most probably underestimates them. The average trip length and speed corresponding to each organisation are also indicated in Table 2. The double crew and relay organisation, which are more expensive than the simple crew organisation, also allow for a higher speed. They are used on longer trips. From an economic standpoint, double crew and relay are expected to be used on long distances and for high value of time or high depreciation cost goods, such as agricultural products and foodstuff. This is seems to be confirmed by the comparison (not detailed here) of commodity types with transport organisations.

Table 2: Organisation of transport operations, RN10 survey

Organisation	Freq.	Dist. (km)	Speed (km/h)
Simple crew	93.1%	1182	33.9
Double crew	5.4%	2143	40.6
Relay	1.5%	1606	50.8

All these statements require confirmation from in-depth econometric analyses and more numerous data. However, the capacity of roadside surveys to yield detailed information on which such studies could be based is demonstrated.

3.4 Logistic imperatives

The increasing role of logistic imperatives imposed by shippers to carriers in the recent evolution of freight transport markets has been much discussed. The notion of logistic imperative is however not precisely defined, and seems to consist of several aspects. One may quote, among others, the greater importance of the preferences of customers in the logistic organizations of the shippers, the closer integration of logistic decisions and production or marketing decisions, or the rationalization of logistic and transport operations.

A first approach of the latter point has been attempted with the present survey form. Indeed, the interviewers asked the drivers both their expected arrival times, and imperative arrival times, making a clear distinction between these two (questions Q18 and Q19 of the survey form). The existence of a specific logistic constraint, distinct from a classical expected arrival time, is thus investigated.

The answers are quite instructive, but not fully as expected. Indeed, for the 5 axle vehicles, most drivers (77.0%) answered they had no imperative arrival time. 6.9% answered they had an imperative arrival time, which was in fact their expected arrival time. By the way, the question was ill received by many drivers, who considered it questioned their autonomy. It seems that in the end, the notion of imperative arrival time is mainly a matter of perception of drivers. Eventually, 16.2% drivers announced an imperative arrival time clearly distinct from the expected arrival time. For these drivers, the margin between the expected and imperative arrival time increases with the trip's length.

On the whole, the existence and definition of logistic imperatives for motor carriers is not really striking. The large amount of drivers for whom there is no imperative, or no clear distinction between the expected arrival time and the imperative arrival time, can be interpreted as the result of a correct reliability of road freight transport. Motor carriers commonly give drivers a margin just large enough for the delivery to be done on time in case of an unexpected delay, thus ensuring the delivery time reliability. However, maybe roadside surveys can prove useful observing trends with respect to imperative arrival times.

3.5 Location and duration of breaks

For drivers to keep watchful and drive safely, breaks are enforced by regulation. This regulation describes precisely when the breaks have to be taken, and how long they have to last. Subsequently, drivers have little choice but to respect closely this regulation.

Two important issues of transport policy, at least, are closely related to the regulation of breaks. One of them is the effective speed of road freight transport, and its productivity. Besides, as already discussed in Section 3.3: motor carriers can introduce specific organizations to increase the effective speed of trucks while respecting the regulation.

Another one is the congestion of service areas on highways and major roads. Breaks being compulsory, the drivers who don't find room on a service area will park somewhere else, which entails road safety issues as well as increased robbery risks. Drivers can also reconsider their route choice, due to these issues. As such, it is both an important question for infrastructure operators and from a road infrastructure planning perspective.

The usefulness of roadside surveys in investigating these effects has been tested with the present survey form, where drivers are asked the number of breaks they have taken since their departure, the location and duration of their longest break, and its motive (questions Q20 to Q23). Unfortunately, their answers yield little useful information, which will subsequently not be presented here. Indeed, apart from choosing the place where they can park, the drivers have little initiative on their breaks. The data only illustrates the rules they follow. A geographical approach, where the route and parking choices of drivers would be analyzed together with the occupancy of rest areas. This is not possible using roadside surveys alone.

4 Final survey form, and confirmation survey

The survey form tested in the frame of the RN10 survey yields much more information about freight transport than the classic survey form. However, the RN10 survey disregarded some constraints that usual classic roadside must respect. In particular, the survey form used in the RN10 survey is much too long to be used as is in regular roadside surveys. It it thus necessary to reduce this survey form. According to the previous section, the most useful results concern the volume constraint and the organisation of carriers. These questions are thus kept and applied in the frame of a new roadside survey, with the objective to confirm their interest and to obtain unbiased results.

Table 3: Weight and volume constraints, A10-A20 survey

		Full volume	
		No	Yes
Full weight	No	28.0%	34.4%
	Yes	11.8%	25.7%

Table 4: Organisation of transport operations, A10-A20 survey

Organisation	Freq.	Dist. (km)
Simple crew	92.7%	572
Double crew	1.9%	829
Relay	5.3%	735

This survey took place between May the 14th and May the 20th 2008, on a number of roads between the cities of Limoges and Poitiers, in France, including the A20 highway passing near Limoges and oriented North-South, and the parallel A10 highway, located between 100km and 200km to the West. The survey form that was applied consisted of the classic roadside survey form, as presented in Section 2, plus the following questions:

- How much of the vehicle's volume is used?
- How many drivers are there on board?
- Is the driver making the same trip as the freight?

The sample obtained by this survey consists of 630 vehicles. 75% of them are 5 axle vehicles, the average trip length is 514km, and 21.9% vehicles are running empty. This sample is thus not directly comparable to the previous one: the survey has obviously targeted a much more local and diffuse freight transport.

Despite these dissimilarities, the respective roles of the weight and volume constraint seem to be relatively stable. The figures of Table 3, which correspond to the 5 axle loaded vehicles, are by and large consistent with those of Table 1. However, it seems the weight constraint is a bit more important in this survey than in the RN10 survey. However, the quality of data is limited: the volume is only an estimation of the driver, not an accurate measure of the actual volume of the freight.

Similarly, double crew and relay organizations are identified. The results are given in Table 4. We find again that double crew and relays are relatively rare, and that the average distance is greater with double crew or relay organizations. However, the ranks are inversed: double crews are much less frequent in this sample than in the RN10 sample; this can be both due to the distinct survey protocol, and to the fact that the traffics differ in nature.

On the whole, the A10-A20 survey confirms the potential of the new survey form. To a marginal cost, roadside survey forms can be enhanced to yield useful information on interurban road freight transport.

5 Conclusion

The classic French roadside survey form is generally used to obtain origin destination data. In the case of freight transport, vehicles are diverted from the traffic, and their drivers are asked their trip's origin, destination, length, the nature and amount of the commodities they carry. Although truck drivers are not motor carrier managers, a possibility remains that the classic roadside survey form does not make the most of what they know. The objective of this paper is to investigate this possibility.

In order to determine how roadside surveys can be enhanced, an original, comprehensive survey form has been developed and tested. Apart from the classic questions, four additional subjects are addressed by this survey form: the freight volume, the transport organization, the presence of specific logistic imperatives, and the breaks. The conclusions derived from this pretest survey have been confirmed by another survey, using a reduced survey form.

Generally, drivers can tell precisely how many tons of freight they carry, because they bear documents on which this information is written. This is not the case for the freight's volume. However, they are able to tell approximately how much of their vehicle's volume is occupied by the freight they carry. The role of the volume constraint can thus be measured, although imperfectly: it even seems to be at least as important in determining road freight transport's productivity as the weight constraint.

If some aspects of road freight transport operation are complex, the ratio of one driver per vehicle is generally assumed fixed and universally valid. In fact, carriers sometime use other organizations, such as double crews or relays. Roadside surveys can yield useful data on these practices, on which studies could be based to investigate when and why such organizations are chosen by motor carriers.

Investigating logistic imperatives is more complicated. Drivers have been asked whether they have an imperative arrival time distinct from the expected arrival time. Most answered that they had no imperative, a fraction answered that their expected arrival time was imperative, and about a sixth had both an expected and an imperative arrival time. However, it has been difficult to discern any relation between this answer and the other variables of the model.

Similarly, drivers have been asked a series of questions about their breaks. Although the choice of the place the drivers park for their breaks, and the related problems of safety, theft, and service area congestion are important, the answers of the drivers mainly reflect the regulation in force. It seems roadside surveys can provide little information on this question, if they are not combined with other information sources, such as, for example, service area occupancy levels.

Finally, it should be noted that the surveys presented in this paper have a major shortcoming. Indeed, the distinction has not been made between public and private carriers. It is certainly possible to ask drivers this question, and highly relevant, insofar as public and private road freight transport are clearly distinct sectors or road freight transport. This is a recommended extension to this work.

As explained before, the objective of this paper was not to proceed to econometric analyses, but to investigate the possibility to enhance roadside surveys, so that they provide useful additional information on freight transport. This possibility appears to be significant. Roadside surveys prove efficient in measuring the role of the volume constraint, even if the approach is approximate, and this role appears to be quite important. They also prove efficient in observing specific road freight transport organizations, such as double crews and relays, two questions on which depends closely the productivity of road freight transport. If these questions were asked systematically, given the number of roadside surveys done in France each year, abundant data would be quickly available to analyze these questions in more depth, to a small extra cost.

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