Transport analysis

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Memorandum
Report 2015:10

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Content

1 Over-reporting of vehicles with “no-activity” in the road freight survey

1.1 Introduction

The Swedish road freight survey reports the domestic and foreign operations of heavy vehicles registered in Sweden. The population consists of vehicles registered in Sweden with a load capacity of 3.5 tonnes or more and the journeys made by such vehicles.

The population totals some 60,000 vehicles. The sample size is roughly 3 000 vehicles per quarter, i.e., about 12,000 per year. The sampling method consists of unrestricted random sampling within 52 predefined strata. Data for a specific measurement week must be provided for each sampled vehicle. The data are provided by the current vehicle owner at the specified time. The form contains information such as the place of loading and unloading, kilometres driven, weight of goods, and type of goods, tonnes, countries crossed in transit, degree of loading, type of transport and type of journey. The data are gathered by postal questionnaires, telephone or by the web, with two written reminders and telephone reminders. Data gathering is performed continuously every week of the year.

The statistics are published quarterly, with annual statistics published after the end of each year. The most important parameters to be estimated comprise the transported cargo volume, number of shipments made, mileage (measured as the number of kilometres driven), and transport performance (measured in tonne/kilometres), nationally and internationally. Key reporting groups consist of national and international transports, goods type, loading and unloading area, and the number of axles load capacity and maximum permissible weight.

A quality declaration for the survey is also published in conjunction with the publication of the statistics to provide more details of the survey. The statistics and quality declaration are available on the Transport Analysis website.[1]

The response rate for the survey is roughly 70%, and has been consistently so in recent years.

[1] See www.trafa.se/sv/Statistik/Vagtrafik/Lastbilstrafik

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Transport Analysis is the agency responsible for the survey, while Statisticon AB has been producing the survey at the request of Transport Analysis since 2008. Statisticon engages the firm EVRY for the data gathering.

The remaining presentation in this memo is intended to outline the EU regulations pertaining to the survey. The target population, sample design, estimation process, and measurements will then be described in separate chapters. The "no-activity" problem will be discussed and, finally, a number of development projects carried out in recent years will be described.

The aim of this memo is to provide, in balanced fashion, details (e.g., mathematical expressions) and more theoretical descriptions, in the hope that they will be comprehensible to a broad spectrum of users. Footnotes are used to reference additional details/facts and to clarify a number of statistical terms.

1.2 EU regulations

The road freight survey is subject to Regulation no. 70/2012 of the European Council of 18 January 2012 on statistical returns in respect of the carriage of goods by road. There are also a handful of other applicable regulations, but Regulation no. 70/2012 is the primary one. One important EU requirement that affects the sample size pertains to the precision requirements to which the survey is subject. The requirement states that the percentage standard error (95% confidence) for the annual estimates of the total tonnes, tonne-kilometres, and kilometres driven for the survey in total and the national level should not exceed ±5%.

To concretise this somewhat, it may be noted that, in the 2013 statistics,[2] the estimated number of kilometres driven was 2417 ± 86 million. The percentage standard error was thus 86/2417 = 3.6%.

The precision requirement for the parameter "number of kilometres driven" was thus fulfilled. However, there are some parameters for which the precision requirements are not fully met. The sample size strikes a balance between the precision requirements set by the EU and the workload imposed on the data providers.

Microdata gathered and processed in the survey are sent to the EU. It may be noted in brief that the three databases delivered to Eurostat are:

- A1 – with vehicle-related data
- A2 – Journey-related data
- A3 – Goods-related variables (in the basic transport operation)

[2] The 2014 statistics are not yet published.

Each row in the vehicle-related data database (A1) represents one vehicle. Roughly ten variables pertaining to the vehicle are sought, such as the axle configuration, total weight, load capacity, Swedish Standard Industrial Classification (SNI) code for the company owning the vehicle, and the total number of kilometres driven during the measurement week. The journey-related data (A2) reports all journeys made by the vehicle during the measurement week. A vehicle that has made 26 journeys during the measurement week will thus be accounted for using 26 rows of data. So-called "empty journeys" are included as well. Examples of reported variables include cargo weight, kilometres driven, tonne/kilometres, loading and unloading sites (as per NUTS3 codes[3]), load type, and transit countries. Database A3 regarding goods-related variables contains information about the goods, such as the type of goods and whether they are hazardous.

Because the EU demands detailed data, this establishes the framework for how the "no-activity" problem can be addressed. We will return to this issue below.

1.3 Target population and sampling frame

The key element sought in the study, and that serves as the basis for the statistics generated, journeys with goods. The journey begins when loading commences and ends when the vehicle has been unloaded and is once again empty.[4] Empty journeys are included as well. The target population may be said to consist of all journeys carried out by vehicles that meet the demarcation criteria during the reference period.

The *survey element* thus consists of journeys, while the *sampling unit* consists of vehicles (see chapter 2, "EU regulations"). The journeys that are of interest in the survey are based on the following demarcations regarding vehicle:

- Vehicles registered in Sweden
- Load capacity of 3.5 tonnes or more
- The vehicle must be in service, i.e., it must not be deregistered
- Certain chassis codes are excluded, such as fire trucks, recovery vehicles, police vehicles, and mobile cranes
- Model year must be younger than 30
- Vehicle owners must be entered in the Statistics Sweden company register

The sampling frame is based on the Swedish Transport Agency's vehicle register, which is received roughly 1.5 months before each quarter. The number of vehicles falling within the sampling frame is roughly 60,000.

[3] NUTS is a European system of geographical division. In Sweden, the NUTS3 codes correspond to the Swedish counties. There are eight regions at the NUTS2 level and three at the NUTS1 level. There are equivalents in other countries.
[4] The survey distinguishes between a shipment and a journey, but this division is not needed to conduct the seminar.

The sampling frame for vehicles is stratified into 52 strata.[5] The purpose of the stratification is to improve the precision of the estimates. Stratification is first performed with respect to domestic and foreign strata; if the vehicle owner has a license for professional international operation, then the vehicle is assigned to a foreign stratum, otherwise to a domestic one. There are 35 domestic strata and 17 foreign strata. The following stratification variables are then applied[6]:

Domestic strata

- Geographical classification
- Age
- Mileage (10s of kilometres)
- Load capacity (kg)

Foreign strata

- Geographical classification
- Chassis
- Mileage (10s of kilometres)
- Load capacity (kg)

The stratification process was modified twice in the 2000s, in 2003 and in 2012. The justifications for and technical aspects associated with these changes are documented in two reports: Eriksson et al. (2003) regarding the 2003 survey, and Transport Analysis PM 2011:14 regarding the 2012 survey. One general aspect common to both changes is that they were implemented with a view to making the estimates as precise as possible.

Sample design and estimation

The initial sample size is 2 800 vehicles per quarter. These vehicles are allocated across the 52 strata so that 1 600 vehicles are spread over the 35 domestic strata and 1 200 over the foreign strata. The principle of Neyman allocation7 is applied within each portion with respect to the variable “transported cargo volume” (tonnes) based on data from the two most recent available quarters. One requirement is that a stratum must comprise at least 15 vehicles. If the initial sample size as per the allocation is fewer than 15 vehicles in a given stratum, then the sample size (the definitive sample size) is set at 15. For this reason, the definitive sample size is somewhat larger than the initial sample size. Thus, just over 3 000 vehicles are sampled each quarter.

In a second step, each vehicle is assigned a specific week. The sampled vehicles are distributed uniformly over the 13 weeks in the quarter. From a sampling theory perspective,

[5] A stratum is a sample group.
[6] Appendix 1 presents a table of all strata.
[7] This means that a larger sample is collected in strata exhibiting large variation in the measured variable, here the loaded cargo volume, than in strata with little variation.

this week constitutes a cluster of journeys. This week is viewed as the primary sampling unit (cluster of journeys), and all elements (journeys) are measured for a sampled vehicle week. The sampling method used for vehicle weeks consists of simple random sample within each stratum. Note that from a theoretical perspective, one option is to view the sample as a two-stage sample, with vehicles as the primary sampling units and the week as a secondary sampling unit. In this case, the number of sampled vehicles for different measurement weeks would have varied. This is not the case; rather, the number of vehicles is spread uniformly over the measurement weeks in the quarter. This method resembles a stratified simple random sample of the vehicle weeks so closely that point and variance estimates can be made under this assumption. The assumption was tested and shown to be valid by Rosén and Zamani (1993).

Another aspect of the sampling should be mentioned. A sampled vehicle is exempt from future sampling for one year, after which the vehicle can again be selected in the sampling process. This is done to reduce the workload of the individual data provider. This process has been used for many years in the survey, and has been theoretically justified by Rosén and Zamani (1993), who refer to the method as “disjunct” sampling. The new stratification process introduced in 2012 has not altered this principle.

A more technical description of the estimation process follows below. This section can be skipped without reducing the comprehensibility of the chapters that follow.

Let N designate the number of journeys during the reference period in the population, U (the universe). Let y designate a survey variable, such as the number of kilometres driven, and y_k its value for journeys $k = 1,2,\cdots,N$. All parameters of interest in the survey are totals, which can be written as

$$t = \sum_{U} y_k \qquad (1)$$

The designation $\sum_{U}$ refers to $\sum_{k \in U}$ in order to abbreviate the notation. The number of vehicles is designated N_I , and the quantity of all vehicles is designated $U_I = (1,2,\cdots,i,\cdots,N_I)$. Subindex *I* (Roman numeral one) directs our attention to *primary* sampling units (clusters i.e. vehicles).

The population of vehicle weeks is consequently given by $N_I^* = 13 \times N_I$. The population of vehicles is stratified into $H = 52$ strata, $h = 1,2,\cdots,H$. A sample, s_{Ih} , of n_{Ih} vehicles (vehicle weeks) is derived from h based on the simple random sample principle. The entire sample of vehicle weeks is designated s_I , i.e., $s_I = \bigcup_{h=1}^{H} s_{Ih}$ of size $n_I = \sum_{h=1}^{H} n_{Ih}$.

$$t_i = \sum_{U_i} y_k$$

Furthermore, let designate the total for a vehicle, i , for example, the total number of kilometres driven during the measurement week. If responses were to be obtained from all vehicles, the parameter (1) would be estimated using

$$\hat{t} = \sum_{h=1}^{H} \frac{N_{Ih}^*}{n_{Ih}} \sum_{S_{Ih}} t_i \qquad (2)$$

However, responses are not obtained from all sampled vehicles, but rather a quantity of responses, r_I , is obtained consisting of m_I vehicles. The estimator for non-responses is

$$\hat{t} = \sum_{h=1}^{H} \frac{N_{Ih}^*}{m_{Ih}} \sum_{r_{Ih}} t_i \qquad (3)$$

The method used to compensate for the non-response is thus straight-line upward adjustment within the strata.

The variance of (3) is estimated using

$$\hat{V}(\hat{t}) = \sum_{h=1}^{H} N_{Ih}^{*2} \frac{1 - \frac{m_{Ih}}{N_{Ih}^*}}{m_{Ih}} S_{tr_{Ih}}^2 \qquad (4)$$

where

$$S_{tr_{Ih}}^2 = \frac{1}{m_{Ih} - 1} \left(\sum_{r_{Ih}} t_i^2 - \frac{1}{m_{Ih}} \left(\sum_{r_{Ih}} t_i \right)^2 \right) \qquad (5)$$

is the variance of the cluster totals, t_i , within stratum h .

The foregoing expressions are used to obtain estimates for a reporting group, such as domestic journeys, but with the difference that y_k is set to 0 if the journeys does not belong to the reporting group.

The foregoing describes parameters and estimators per quarter; the annual results are obtained via a natural extrapolation of the results. Add a subindex so that t_{kv1} designates parameter (1) for quarter 1; the parameter per year is then given by

$$t_{år} = t_{kv1} + t_{kv2} + t_{kv3} + t_{kv4} \quad (6)$$

where the parameter for each respective quarter is estimated using (3), which yields the estimator

$$\hat{t}_{år} = \hat{t}_{kv1} + \hat{t}_{kv2} + \hat{t}_{kv3} + \hat{t}_{kv4} \quad (7)$$

If the samples and quarters were derived entirely independently of one another, then the variance of $\hat{t}_{år}$ would be derived by adding the variances for each respective quarter. However, the samples are not entirely independent of one another, since they are derived as disjunct samples, as described above. However, it has been determined that this dependency plays such a small role that the variance of the annual estimation is estimated as though the quarterly estimates were independent of one another. The variance estimator for the annual estimation is therefore given by

$$\hat{V}(\hat{t}_{år}) = \hat{V}(\hat{t}_{kv1}) + \hat{V}(\hat{t}_{kv2}) + \hat{V}(\hat{t}_{kv3}) + \hat{V}(\hat{t}_{kv4}) \quad (8)$$

where the variance estimator for each individual quarter is given by (4).

1.4 Measurement

The data are gathered via postal questionnaires sent to the owners whose vehicles are included in the sample.[8] The survey entails an obligation to provide data. The questionnaires are sent out once a week, two weeks before the start of the measurement week. Just over one week after the end of the measurement week, a written reminder is sent out if no response has been received. If no response has been received after yet another week, then another written reminder is sent out, this time with a new survey form.

Each vehicle owner is asked to respond regarding all journeys made during the measurement week. However, a vehicle may not have been used during the measurement week. There can be various reasons for this, such as the absence of any hauling jobs, holidays, servicing, etc. The circumstance of a vehicle not being used during the measurement week is referred to as ”no-activity”, and the vehicle owner must so indicate. There is no “checkbox” on the form for ”no-activity”; rather, the vehicle owner must, in response to the question, indicate the days of the measurement week on which the vehicle was **not** active.

If all seven days are marked, this is coded as ”no-activity”. This question formerly appeared on the first page of the form, but has been on the second page spread since the first quarter of 2015.

[8] The vehicle owners will be able to respond via an web questionnaire as of Q3 2015.

The ”no-activity” problem mainly concerns this issue. If the vehicle really has been idle and not in use, then it is correct to code it as ”no-activity”. However, there are clear indications that some vehicle owners tick off all seven days in the form even though they have made journeys.

This is very likely done as a simple means of avoiding having to fill out the questionnaire with a number of details while still fulfilling the prescribed “obligation” to respond. It is partly these *false ”no-activity”* reports that are causing problems in the survey.

1.5 The ”no-activity” problem

When a vehicle owner answers ”no-activity” on false grounds, a problem arises if parameters such as the total number of kilometres driven are to be estimated. The problem can be described quite simply: too many reports of ”no-activity” are present among the respondents. When estimating a parameter, we proceed, in simple terms, based on the assumption that the share of “not in use” instances among the population is the same as it is among the respondents. If there is a substantial proportion of false ”no-activity” responses, the estimated levels will be too low. The actual/real levels will be underestimated.

The problem can be described in more technical terms as follows: Table 1 shows a typical breakdown of the sampled vehicles into various status groups during a quarter. Population weightings are determined based on the number of respondents (the first two rows). In the example, there are 1 150 + 719 = 1 869 respondents out of the sample of 2 920. The weighting obviously depends on the stratum to which the vehicle belongs, but to keep this description simple, we will overlook this aspect for the present. Given that these 1 860 vehicles are to be extrapolated to the population of 60,000 vehicles, the weighting will be 60,000 / 1 869 ≈ 32. The data provided by a vehicle owner for a vehicle must therefore be multiplied by a factor of 32 to “scale” the estimate to the real/actual levels of the parameter.

Table 1. Example of categorisation of sampled vehicles into different status groups during a quarter

Status	Number
Respondents with journey data	1 150
Respondents with no journey data:	719
- of which ”no-activity” code: 634	
- of which work code: 85	
Non-response	918
Over-coverage (temporarily deregistered, deregistered)	133
Total	**2 920**

If the results from the 1 150 respondents who provided journey data are extrapolated by a factor of 32 for all respondents, we obtain an estimate of, for example, the number of kilometres driven. If there are any *false ”no-activity”* instances among the respondents, this upward extrapolation will be too low, i.e., we will underestimate the real/actual levels.

Allow us to illustrate: Assume that among the 634 who answered ”no-activity” there are 200 (ca. 30%) *false ”no-activity”* instances, and that we can identify which ones they are. We could then code them as non-response (since we have no journey data for them). The number of respondents would then be 1 869 – 200 = 1 669 and the weighting would be 60,000 / 1 669 ≈ 36. Using this weighting, the 1 150 respondents would be extrapolated up to a higher level, one that better accords with the actual levels.

Attempting to identify which responses constitute *false ”no-activity”* instances offers a number of conceivable ways to address this problem.

1.6 The ”no-activity” survey

Since 2012, Transport Analysis has been conducting a survey in parallel (auxiliary) to the road freight survey. This help survey is called the ”no-activity” survey. The ”no-activity” survey derives a stratified random sample comprising a total of 500 lorries each quarter. The stratification is based on company properties rather than vehicle properties. The sample size in each stratum is 50 vehicles. Appendix 2 describes the stratification process in greater detail. The 500 vehicles are spread uniformly over the 13 weeks of the quarter. If a vehicle is sampled in the road freight survey, it is exempted from the help survey. The vehicle owners sampled in the help survey are contacted by telephone, and only one (or two) question is asked:

Did your company use this particular vehicle for goods transportation last week?

The possible answers are:
Yes,
No
Don´t know or the vehicle is sold.

- If yes, which days of the week was the vehicle used?

Because only one (or two) question is asked, the interview goes quickly. There is no reason for the vehicle owner to respond with a *false ”no-activity”* in this survey. However, the survey does, like all surveys, have sources of uncertainty, and the non-response rate is 40–50%. The main reason for non-response is that no contact could be established with the vehicle owner.

Data are obtained based on the help-survey results that make it possible to adjust the estimates in the road freight survey. The underlying idea is that, based on the help survey, we can derive the *estimated true share*[9] of vehicle weeks with journeys. From the road freight survey we obtain the *reported* share of vehicle weeks with journeys. Table 2 presents the results from Q2 2014.

[9] The term “estimated *true* share” is used to emphasise the contrast with the reported share obtained via the road freigth survey.

Table 2. Estimated true and reported shares of vehicle weeks with journeys plus inflation factor for Q2 2014

	Estimated share of vehicle weeks with journeys based on		
Stratum, g	"No-activity"(estimated *true* share)	Road freight survey (*reported* share)	Inflation factor,[10] w_g
000	0.602	0.602	1.000
111	0.864	0.570	1.515
112	0.875	0.587	1.491
113	0.870	0.796	1.092
121	0.760	0.280	2.713
122	0.640	0.444	1.442
123	0.625	0.547	1.143
211	0.810	0.604	1.341
212	0.815	0.656	1.243
213	0.829	0.753	1.100
220	0.692	0.534	1.296

For example, stratum 211 is the reported share of vehicle weeks with journeys, estimated at 60.4% based on road freight surveys. Based on no-activity help survey, the *true share* is estimated at 81.0%. The ratio between these is 0.810 / 0.604 = 1.341, i.e., the (estimated) *true share* of vehicle weeks with journeys is 34% higher than what was reported.

This factor (1.341) can be used as an inflation factor in the estimation expression (3).[11] If we ignore the fact that there are different inflation factors in different strata, we can say, in simplified fashion, that the old weighting of 32 has now been adjusted to become 32 × 1.341 ≈ 43. The estimates are thus "scaled" by 34%.

Appendix 2 shows that the strata that end in a 1 comprise small companies, while a terminal digit of 3 indicates large companies. It is clear that the biggest difference between the estimated true share and the reported share of "no-activity" instances occurs in strata comprising small companies. In other words, the largest share of false "no-activity" instances is found in these strata.

Parallel unpublished estimates have been calculated in this way since Q1 2012. However, the problem in general has been described in both quarterly and annual reports. The 2013 annual report described, for the first time, the degree of underestimation (as calculated using the "no-activity" help survey). These data will be presented in the following sections.

Figure 1 below shows inflation factors for all strata per quarter for the years 2012–2013. The image is rather cluttered at first glance, but it is still evident that the inflation factors vary

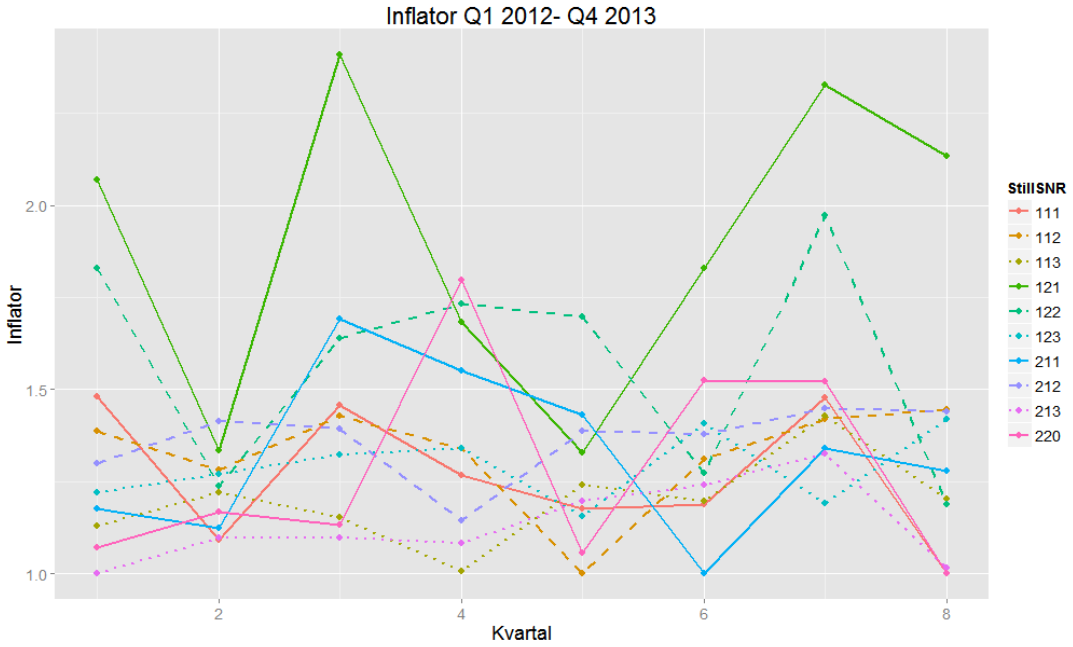
[10] The inflation factor is the ratio between the "no-activity" help survey and the road freight survey results. The inflation factor in stratum 000 is set to 1.000. See Appendix 2 for clarification.

[11] The estimator is as follows:

$$\hat{t}_w = \sum_{h=1}^{H} \frac{13N_{Ih}}{m_{Ih}} \sum_{i \in r_{Ih}} w_g t_i$$

dramatically in nearly all strata. Bear in mind that the sample size per stratum is 50 vehicles and that non response does occur. The presence of major variations is consequently not surprising.

Figure 1. Inflation factors in various strata, 2012–2013 **(the quarters on the *x*-axis are interpreted as follows: 1 = Q1 2012, 2 = Q2 2012, … 8 = Q4 2013)**



Key: Kvartal = Quarter StillSNR = Number of ”no-activity” instances

1.7 Estimating the degree of underestimation

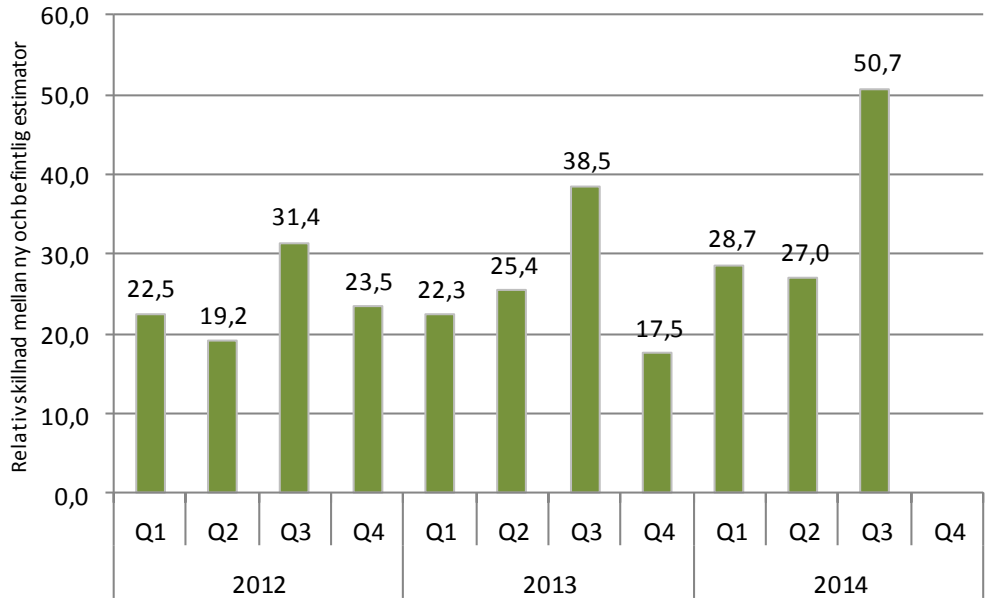
Table 3 shows the estimates of key parameters in the 2012 and 2013 surveys, plus the level increase obtained if an alternative estimation method were used that takes the inflation factors in the help survey into account. The results indicate that the underestimation is considerable.

Table 3. Estimates of parameters for 2012 and 2013 plus level increase using alternative estimation method based on inflation factors from the "no-activity" help survey.

Parameter	Published estimate, 2012	Level increase, 2012 (%)	Published estimate, 2013	Level increase, 2013 (%)
Number of journeys in thousands	29,878	30	27,850	30
Kilometres driven in thousands	2,445,152	25	2,417,711	25
Loaded cargo volume in thousands of tonnes	294,925	30	281,129	30
Transport performance in millions of tonne/kilometres	33,477	20	33,521	25

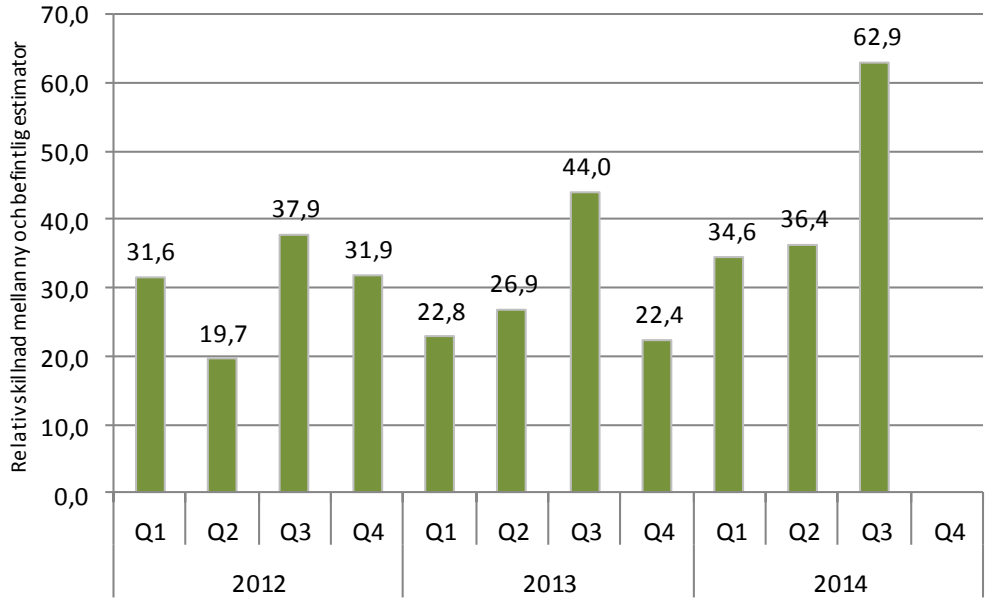
A degree of variation occurs in the level estimates between the quarters when estimates based on an alternative estimation method that takes the inflation factors in the help survey into account are compared with the published estimates. Figures 2–4 show the relative differences between the two estimates per quarter. Major quarterly differences are evident. There was a very large difference in Q3 2014. One difference in that quarter was that the discrepancy between the reported and estimated true ”no-activity” instances was large in strata comprising large companies. Table 2 shows that the inflation factor in strata ending in code 3 (large companies) was roughly 10%. However, it was higher in Q3 2013, which affects the entire estimation, as shown in Figures 2–4, though the reason for this is unknown.

Figure 2. Relative difference in level using an alternative estimation method that takes the "no-activity" help survey inflation factors into account in relation to published estimates, kilometres driven (total)



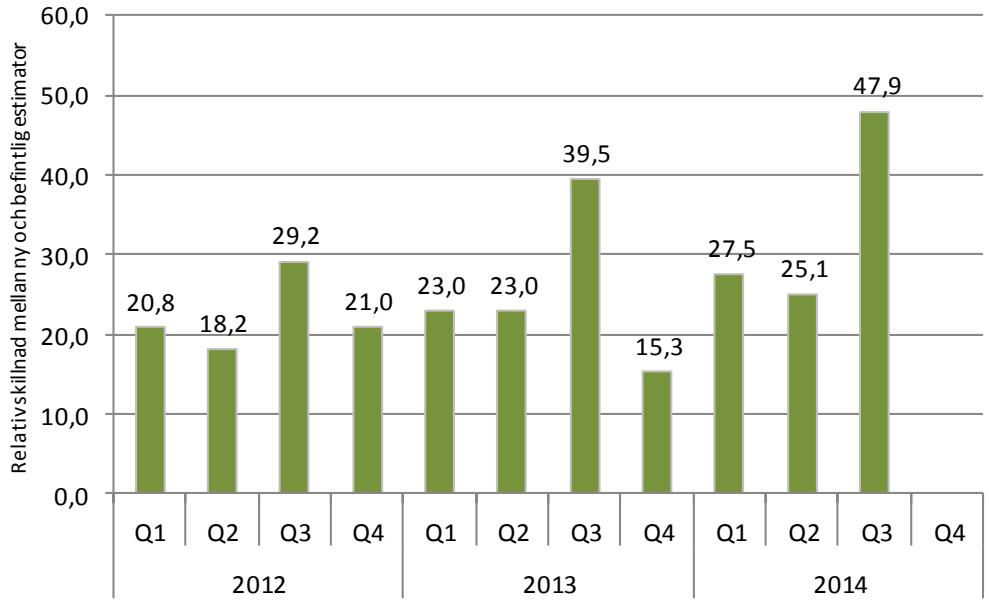
Left margin text: Relative difference between new and existing estimators
(Commas = decimal points)

Figure 3. Relative difference in level using an alternative estimation method that takes the "no-activity" help survey inflation factors into account in relation to published estimates, loaded cargo volume (total)



Left margin text: Relative difference between new and existing estimators
(Commas = decimal points)

Figure 4. Relative difference in level using an alternative estimation method that takes the "No-activity" help survey inflation factors into account in relation to published estimates, transport performance (total)



Left margin text: Relative difference between new and existing estimator
(Commas = decimal points)

1.8 Alternative ways of addressing the ”no-activity” problem

The ”no-activity” survey offers one means of adjusting for erroneously reported ”no-activity” instances. It is the only method that has been implemented at full scale and that is ready to use. However, it is not the only method available. Two alternative methods are delineated below. It should be noted that all three of these methods “relieve the symptoms” but do not solve the fundamental problem of erroneously reported “no-activity” instances. The section below discusses how we could come to grips with this fundamental problem.

Code those who respond erroneously as non-response

One alternative to the help-survey method is to attempt to code those who respond erroneously as non-response. If we succeed in identifying those who respond with a false ”no-activity” and code them as non-response, the inflation factors will become higher, and will extrapolate up to the correct level in the population. The problem is how to identify which respondents are responding truthfully, and which are reporting a false ”no-activity”. Tables 4–6 offer some perspective. The tables were generated in an analysis of 2012. All three tables show companies with three or more sampled vehicles, where the vehicle owner reported ”no-activity” for all of them. For example, we see in Table 4, which pertains to Q2 2012, that company A has six sampled lorries, and that all six were reported as ”no-activity”.12 In Table 5 for Q1 2012, this same company A has three sampled vehicles, and all three were also reported as ”no-activity”. In Table 6 for Q4 2011, company A again had six sampled vehicles, all of which were reported as ”no-activity”. A corresponding pattern can be discerned for other companies, such as company B in Tables 4 and 5. Conversely, companies C and D appear only in Table 4, company E occurs in both Tables 5 and 6, and so on.

Table 4. Companies that in Q2 2012 had three or more sampled vehicles, all of which were reported as ”no-activity”. The company names are coded A, B, C, and so on.

2012, Q2	Number		
Company	Sampled	”no-activity”	Proportion ”no-activity”, %
A	6	6	100
B	3	3	100
C	3	3	100
D	3	3	100

[12] Company A owns roughly 50 lorries.

Table 5. Companies that in Q1 2012 had three or more sampled vehicles, all of which were reported as ”no-activity”. The company names are coded A, B, C, and so on.

2012, Q1	Number		
Company	Sampled	”no-activity”	Proportion ”no-activity”, %
A	3	3	100
E	4	4	100
B	3	3	100
F	4	4	100

Table 6. Companies that in Q4 2011 had three or more sampled vehicles, all of which were reported as ”no-activity”. The company names are coded A, B, C, and so on.

2011, Q4	Number		
Company	Sampled	”no-activity”	Proportion ”no-activity”, %
A	6	6	100
E	7	7	100
F	7	7	100

In these cases, it is very likely that all (or most) of the ”no-activity” reports constitute *false ”no-activity”* instances.

A corresponding analysis can be performed for those companies that have at least two sampled vehicles per quarter. If all, or nearly all, of the sampled vehicles are ”no-activity” over an extended period of time, they likely represent *false ”no-activity”* instances.

The greatest share of ”no-activity” instances is not attributable to major companies with many sampled vehicles, but rather to minor and small companies. If a single-vehicle company has a vehicle sampled in a given quarter, years may pass before that same vehicle is sampled again. In the case of small companies, it is consequently difficult to determine whether a reported ”no-activity” instance is true or false.

However, it may be possible to make further progress by taking this approach. For example, we might attempt to model whether a reported ”no-activity” instance is true or false. Such a model has not been studied in detail, but could involve some form of logistic regression (with dichotomous outcomes, i.e., ”activity” vs. ”no-activity”). and, based on the estimated probability of “no-activity”, we could attempt to classify certain lorries as false ”no-activity” instances and view them as non-responses.

One disadvantage of this method is that the results would need to be analysed carefully every quarter, which would entail extra work. Furthermore, the results would be model dependent in some sense, which is usually best avoided in sample surveys.

Calibrate against known auxiliary data

If robust auxiliary data are available, they could be used in the estimation process. One such potential variable would be mileage data obtained from vehicle inspections. Transport Analysis administers the mileage database (MDB), in which annual mileages from a given year are available for most vehicles. MDB data are currently used in the road freight survey stratification process. In theory, it should be possible to calibrate against mileage data in the estimation process. If the MDB mileages constituted the true annual mileages, it would be possible, via calibration, to estimate mileages in the road freight survey that would be error free. However, the reality is not quite so simple, and several aspects need to be studied, such as:

Not all vehicles within the sampling frame of the road freight survey can be assigned a register-based mileage figure from MDB. This pertains mainly to newer vehicles that have not yet undergone inspection. These vehicles are not found in MDB. Roughly 5% of the vehicles within the sampling frame of the road freight survey are not found in MDB. Furthermore, there are a few vehicles (several hundred within the sampling frame) that are in MDB but have an annual mileage value of 0. This could be because the vehicle was deregistered during the year to which the mileage data pertain, but has now been re-registered and included within the sampling frame of the road freight survey.

The final sentence in the preceding item points to another aspect that plays a role, namely, that the MDB mileage data do not pertain to the relevant survey year, but rather are subject to a certain time lag.

The MDB mileages are annual mileages. The annual mileage is indeed estimated in the road freight survey, but based on four quarterly estimates. It would be necessary to convert the annual mileage data in MDB to quarterly mileages. How this conversion should take place has not been fully clarified.

These aspects, and possibly others, would need to be studied if the method of calibrating against mileage data were used to adjust for erroneously reported ”no-activity” instances.

It may be noted that the method involving such calibration appears to be the one used in Norway to adjust for the same problem (see Ødegård et al. 2007, pp. 56–57). In Norway, it appears that the auxiliary mileage data are used by creating six groups, based on vehicle age (three groups) and professional commercial vs. company vehicle mileage (two groups). Total mileage data from the mileage database are calibrated against in each of these groups.

1.9 Ethics

One important consideration in this context is ethical in nature, and has to do with trust. Data gathering is predicated upon more or less pronounced trust between the data gatherers and the data providers. It is hoped that the data providers trust those requesting the information

and believe that it is important to respond to surveys included in, for example, Sweden's official statistics. For their part, the data gatherers trust that the data providers will do their best to respond to the surveys, even if it does increase their workload.

As the ”no-activity” problem has come to light, Transport Analysis has perceived that there are some vehicle owners who obviously respond inaccurately. How should this be information be imparted and dealt with? The 2013 annual report presented, for the first time, data indicating the degree of underestimation. Before that the problem had been mentioned only in the quality declaration. Being transparent and pointing out the problems that exist in a survey is certainly more reasonable than the opposite approach, i.e., concealing the problems. However, bringing this problem to light has created stress in terms of trust on several levels. One dimension is user confidence in the survey and its results. Another has to do with how vehicle owners perceive being “accused” of answering incorrectly. The vast majority of vehicle owners certainly respond as truthfully as they can. How will data providers as a group respond when Transport Analysis points out in its annual report that some vehicle owners are answering incorrectly? If the solution to the problem is to conduct a separate survey (the ”no-activity” survey) and then adjust the estimates, will there be a risk of backlash from some vehicle owners?

“It doesn't matter how I answer – Transport Analysis is just going to convert my answers anyway”.

The above hypothetical quotation may be somewhat exaggerated, but it is not completely unrealistic to suppose that some vehicle owners would have less trust in Transport Analysis were they to learn that a special adjustment method had to be used to take their false ”no-activity” reports into account. It may be noted that this ethical aspect does not appear to be discussed in the Norwegian report (Ødegård et al. 2007). Generally, the Norwegian survey does not appear to be as transparent as the Swedish one in terms of publications regarding its methodology and approach. For instance, the most recent methodological publication appeared in 2007. Perhaps the ethical aspect elucidated in this section becomes less important in the absence of transparency regarding methodology and problems. However, this ethical issue is of the utmost importance, given the Transport Analysis tradition of providing transparent methodological documentation.

1.10 How to come to grips with the fundamental problem?

The adjustment methods discussed above can result in level estimates that accord better with the real/actual values. However, they do not solve the fundamental problem, but rather “relieve the symptoms”. If the ethical dimension is important, both non-responses and the ”no-activity” problem could increase if the vehicle owners were to lose trust and the willingness to respond. One question is then that of how to solve the fundamental problem, i.e., reduce or eliminate the false ”no-activity” responses. This is easier said than done, though we do have some ideas about a conceivable strategy to achieve this.

At the present juncture, it is *easy* to answer ”no-activity”. The underlying idea of our strategy is to make it significantly more difficult to answer ”no-activity”. The reason for the false ”no-activity” responses is that it is easy to respond that way while fulfilling the obligation to respond. If it becomes (significantly) more difficult to answer ”no-activity”, then those who used to take the easy way out and report a *false ”no-activity”* will presumably not bother to respond to the survey at all. The hope is of course that they will take the time to fill out the questionnaire, and perhaps even provide run data. But if they do not respond to the survey, they will be categorised as non-responses, which is better than receiving a *false ”no-activity”* response. Those vehicle owners who have true ”no-activity” instances and are willing to fulfil their obligation will presumably continue to respond to the survey even if it becomes more difficult to answer ”no-activity”.

How can we make it more difficult to answer ”no-activity”? A web questionnaire will be introduced in the road freight survey in Q3 2015. One option in an online questionnaire is to start by eliminating the general question concerning what days the vehicle was used (see the related graphic in Chapter 5, “Measurement”). If the vehicle has not been in use, the questionnaire must still be completed in the same way as if there had been journeys. Vehicle owners who report their transport activities on Monday as ”no-activity” must then answer a follow-up question about the reason for this. The vehicle owner must then proceed and do the same thing for every day from Tuesday to Sunday. Reporting ”no-activity” for all seven days of the week would then be almost as time consuming as responding with run data for each day. How such a solution is to be adapted to the hardcopy form needs to be studied.

The disadvantage of this approach is that data providers who have true ”no-activity” instances to report will have a heavier workload. This may be something that is necessary in order to come to grips with the fundamental problem.

Cut-off sampling?

Another possible means of coming to grips with the fundamental problem to a certain extent would be to use different population demarcations. *False ”no-activity”* reports are more common among small companies. One option is to use some type of cut-off when defining the population. We could, for example, exclude all companies that own one or two vehicles. However, such companies account for a large part of the population. There are some 60,000 vehicles within the sampling frame of the survey, some 20% of which are owned by single-vehicle companies (ca. 12–13,000 vehicles), while another 10% are owned by two-vehicle companies. In 2013, the single-vehicle companies accounted for about 15% of the estimated total loaded cargo volume in Sweden, and for 10% of the transport performance and kilometres driven (mileage). If we include the two-vehicle companies, then the single- and two-vehicle companies together account for just over 30% of the loaded cargo volume and just over 20% of the transport performance and mileage. Excluding such a large share of the population would have major consequences. Whether such an approach is possible under EU regulations needs to be studied.

One possibility is to let these companies be included, but to examine them less frequently. This could be done in a number of different ways. One is to let them be included in the population in, for example, Q1 but not Q2–4. The results obtained in Q1 would then be used in

Q2–4 as well. Either the statistical contribution from these groups could quite simply be “brought forward” or a more sophisticated method involving some type of model estimation could be used, i.e., some sort of forecast for Q2–4 based on the results from Q1.

2 Workshop on the ”no-activity” problem

During the spring of 2015, Transport Analysis arranged a workshop to which participants from affected industry organisations and academics in the field of official statistics were invited. The purpose of the workshop was to discuss the ”no-activity” problem from a number of perspectives, including time series breaks, data-provider ethics, suitable methods, and backward error correction.

The group discussions led to the following recommendations being made to Transport Analysis:

- Examine the actual importance of the “no-activity” problem by studying the heavy non-responses in the supplemental survey, and its effect.
- Estimate the magnitude of the false “no-activity” problem using a suitable method, correct the estimates as soon as possible, and report the results in an informative (but not accusatory) manner.
- Transport Analysis should also develop a suitable method for correcting estimates using a more advanced calibration method.
- Transport Analysis should then implement the formulated calibration method when feasible.
- Strive to minimise the workload on data providers, but do not offer easy shortcuts (e.g., as in the current ”no-activity” model).

2.1 The workshop discussion

In the discussion, arguments were made as to whether it was the level estimation that was most important, or whether it was the change estimates. The ”no-activity” problem can be addressed in slightly different ways, depending upon which view pertains. However, it is clear that the level estimates cannot be overlooked, as they are used by multiple statistics users, particularly in the context of transport policy decisions, road maintenance, etc. It emerged in the discussion that the participants agreed that Transport Analysis should adjust the estimates to take the ”no-activity” problem into account. One of the participants put it this way: “We’ll just have to bite the bullet and make adjustments”.

The participants also agreed (with one exception) that the results of the ”no-activity” survey should serve as the basis for the adjustments. The alternative method of calibrating against known register totals, such as mileage from the mileage database, was deemed interesting,

but one that should be studied before potentially being implemented. That would take at least a year, and an adjustment should be made as soon as possible.

There was discussion as to whether the non-responses in the ”no-activity” survey constitutes a problem per se. One participant argued that Transport Analysis should examine whether or not the non-response in the ”no-activity” survey is skewed before deciding whether to use its results to adjust the estimates in the road freight survey. Given that the survey is encumbered by not-insubstantial non-responses (40–50%), this participant opined that we should first assess and analyse the ”no-activity” survey more carefully. The other participants did not fully agree with this conclusion, but rather recommended an adjustment using the existing basis.

Because results of the ”no-activity” surveys as of 2012 are available, we have a good means of “bridging” the time series problem.

In future quarterly estimates, it would be a good idea to use not only the ”no-activity” inflation factors for the current quarter, but also to perform some type of integration using the current quarter and the corresponding quarter from the year before, and possibly the year before that.

During the workshop there was also discussion of the following question: is it too easy to report “no-activity”? The participants found it a bit remarkable that the operators reported ”no-activity”, and one alternative could be to proceed based on tachograph data. The operators must keep these data on hand for at least two months before they are deleted. This period may be even longer for newer vehicles. Transport Analysis should look into this possibility.

Transport Analysis was offered help in formulating the cover letter and instructions so that they are better tailored to the data providers. However, it was pointed out that we must not be overconfident regarding what a cover letter and/or instructions can accomplish. A cover letter must naturally be well written, but it does not offer a practicable path to increasing the share of respondents or eliminating the ”no-activity” problem. It was noted that Transport Analysis needs to emphasise the benefits and usefulness of the survey in a clear way (e.g., by noting that the survey serves as a basis for road maintenance decisions). Relating the survey to the EU, as is currently the practice, was considered more likely to be counterproductive than helpful in the present case (and even for surveys in general).

It was noted that small operators with one or a few vehicles account for much of the “no-activity” problem. Unfortunately, these operators also account for a significant share of transport performance, with the result that it would be neither reasonable nor appropriate to use a cut-off limit to exclude them from participating in the road freight survey. One idea that emerged was that of studying whether so-called “vehicle terminals” could provide Transport Analysis with basic documentation regarding ordered journeys and therefore a way to get a sense of false “not in use” reports. After all, an ordered and completed run can hardly be reported as a ”no-activity” instance.

One suggestion was that Transport Analysis should try adding incentives to the survey, which could increase participation in the regular road freight survey. Research indicates that the greater the incentive, the greater the cooperation. Research further indicates that incentives need to be distributed to all potential respondents regardless of whether or not they respond, i.e., not be sent to respondents after the fact.

The group did not consider the ethical aspects to pose a major problem. The point is to describe the adjustment methods in an informative but non-accusatory manner. Nor did the group consider time series breaks to be particularly problematic, all the more so because it is possible to calculate back over two years, thanks to the parallel ”no-activity” surveys conducted.

If Transport Analysis adjusts the estimates with ”no-activity” inflation factors incorporated, then the time series will be broken. However, the group was pragmatic in its attitude toward time series breaks, even though Transport Analysis might find it reasonable, in a few years, to make adjustments using some other method, such as calibrating against the mileage database, which could produce yet another time series break. The group did not consider this to be a major problem: One must sometimes accept that breaks will occur, and most users will accept this as long as it is clearly stated why the steps were taken and what benefits they yielded.

Using a cut-off to limit single-vehicle owners was not viewed as a solution. Time did not allow the group to discuss any aspects of making it substantially more difficult to report ”no-activity”, although the group did indicate that it would be better for the operators not to respond at all (with permission) than to report ”no-activity”.

3 Development projects carried out in the road freight survey

Several development projects have been carried out in recent years within the framework of the road freight survey. These are described briefly below.

3.1 New stratification

A review of the stratification process was conducted before 2012. The results led to a revision of the stratification variables, and the number of strata was reduced from 57 to 52. The effect of the new stratification was positive, i.e., improved precision for all parameters. As a result, the sample size was reduced by 200 vehicles per quarter as of statistical year 2013.

3.2 Form revisions

Numerous relatively extensive form revisions have been carried out. In one revision, the question that serves as the basis for ”no-activity” was moved farther back in the form, rather than appearing on the first page. This was done in Q1 2015, which means that it is too soon to say whether this has had any impact on the ”no-activity” problem.

3.3 No-response analysis

A more in-depth non-response analysis was conducted in the 2014 road freight survey. The results of the analysis indicate that no skewness occurs as a result of non-response in the case of some variables (load capacity, geographical region, and vehicle age), while skewness is present with respect to the variable “register-based mileage”. Register-based mileage is obtained from the mileage database, which is in turn based on vehicle inspection data. This variable is used in the stratification process. The non-response analyses show that vehicles in the non-response group have higher average daily (registered-based) mileage than do the respondents. Because there is a correlation between register-based mileage and actual mileage during the measurement week, this entails a risk of skewness in terms of mileage.

Company size measured as the number of vehicles the company owns was another variable that was skewed between the respondents and the non-response group. The analysis shows that the bigger companies are more inclined to respond to the survey than are smaller companies. This skewness need not, in and of itself, pose a problem if this variable is not in turn correlated with a survey variable. However, as noted above, there probably is a link between the tendency to report *false ”no-activity”* instances and company size.

3.4 Shorter reference period?

The reference period for the vehicle owners is one week – or “measurement week”, which is the term used in the form. However, it is possible, within the framework of the EU regulations, to have both longer and shorter reference periods. The vast majority of EU countries do, however, use one week as their reference period. Germany, which uses a three-day reference period, is an exception. A study was conducted during the fall of 2014 in which some 500 sampled vehicles were given a shorter reference period. Half of the sample were to report journeys Monday to Wednesday, the other half Thursday to Sunday. The understanding was that using a shorter reference period would lighten the workload on the data providers. One important issue was whether the precision of the estimates would be degraded if a shorter reference period were used. The study also included in-depth interviews with ten vehicle owners.

Regarding precision, the results show that it is *not* degraded by a shorter reference period. Regarding the workload for the data providers, it does not generally matter to large companies whether they respond for an entire week or just part of a week. However, small companies found a shorter reference period to be less burdensome. The question of whether letting bigger companies respond for an entire week and smaller companies for just part of a week offers an alternative has not been studied further, nor have the statistical implications of such an approach been considered.

3.5 Web questionnaire

In Q3 2015 it will be possible to complete the survey via an online questionnaire rather than a hardcopy one. This represents in part an effort to make things easier for the vehicle owners by giving them the opportunity to choose the method they use to respond. Some countries, including Denmark, have recently gone so far as to eliminate the hardcopy form of their survey entirely, the only means of responding being via the web questionnaire.

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Appendix 1 – Strata in The Road freight survey

Tabell 7. Stratification of the population of vehicles for the domestic strata.

Nr	SNR[13]	Geographical division	Age	Distance (thousand kilometres)	Load capacity (Kilo)
1	110101	SE11, SE12	0–-5 year	alla	0–13 000
2	110112		0–5 year	0–10 000	13 001–16 000
3	110113		0–5 year	0–10 000	16 001+
4	110122		0–5 year	10 001+	13 001+
5	110201		6+ year	alla	0–13 000
6	110212		6+ year	0–10 000	13 001–16 000
7	110213		6+ year	0–10 000	16 001+
8	110222		6+ year	10 001+	13 001+
9	120101	SE21 exkl. Gotland, SE23	0–5 year	alla	0–13 000
10	120112		0–5 year	0–10 000	13 001–16 000
11	120113		0–5 year	0–10 000	16 001+
12	120122		0–5 year	10 001+	13 001+
13	120201		6+ year	alla	0–13 000
14	120212		6+ year	0–10 000	13 001–16 000
15	120213		6+ year	0–10 000	16 001+
16	120222		6+ year	10 001+	13 001+
17	130101	SE22	0–5 year	alla	0–13 000
18	130112		0–5 year	0–10 000	13 001–16 000
19	130113		0–5 year	0–10 000	16 001+
20	130122		0–5 year	10 001+	13 001+
21	130201		6+ year	alla	0–13 000
22	130212		6+ year	0–10 000	13 001–16 000
23	130213		6+ year	0–10 000	16 001+
24	130222		6+ year	10 001+	13 001+
25	140101	SE31, SE32, SE33	0–5 year	alla	0–13 000
26	140112		0–5 year	0–10 000	13 001–16 000
27	140113		0–5 year	0–10 000	16 001+
28	140122		0–5 year	10001+	13 001–16 000
29	140123		0–5 year	10 001+	16 001+
30	140201		6+ year	alla	0–13 000
31	140212		6+ year	0–10 000	13 001–16 000
32	140213		6+ year	0–10 000	16 001+
33	140222		6+ year	10 001+	13 001+
34	150001	Gotland	all	all	0–13 000
35	150002		all	all	13 001+

[13] SNR is the stratum classification.

Tabell 8. Stratification of the population of the lorries with respect to foreign strata.

Nr	SNR[14]	Geographical division indelning	Carrossery	Distance (thousand kilometres)	Load capacity (kilo)(Kilo)
36	200000				
37	211000	SE11, SE12 och SE21	Road tractors not belong	All	All
38	212011	SE11, SE12 och SE21	Others	0–10 000	0–10 000
39	212012	SE11, SE12 och SE21	Others	0–10 000	10 001+
40	212020	SE11, SE12 och SE21	Others	10 001+	All
41	221000	SE22	Road tractors not belong	All	All
42	222011	SE22	Others	0–10 000	0–10 000
43	222012	SE22	Others	0–10 000	10001+
44	222020	SE22	Others	10 001+	All
45	231000	SE23	Road tractors not belong	All	All
46	232011	SE23	Others	0–10 000	0–10 000
47	232012	SE23	Others	0–10 000	10 001+
48	232020	SE23	Others	10 001+	All
49	241000	SE31, SE32 och SE33	Road tractors	All	All
50	242011	SE31, SE32 och SE33	Others	0–10 000	0–10 000
51	242012	SE31, SE32 och SE33	Others	0–10 000	10 001+
52	242020	SE31, SE32 och SE33	Others	10 001+	All

[14] SNR is the stratum classification.

Appendix 2 – Strata in the ”no activity” survey

Tabel 9. Description of strata in the “no-activity” survey

Stratum	National/ international	Bransch	Number of vehicles owned by the company
111	National	Transport of goods, SNI 49410	1-4 lorries
112	National	Transport of goods, SNI 49410	5-10 lorries
113	National	Transport of goods, SNI 49410	11+ lorries
121	National	Other	1 lorry
122	National	Other	2-4 lorries
123	National	Other	5+ lorries
211	International	Transport of goods, SNI 49410	1-4 lorries
212	International	Transport of goods, SNI 49410	5-15 lorries
213	International	Transport of goods, SNI 49410	16+ lorries
220	International	Other	All
000		Specialstratum, see information below	

The breakdown into national and international strata is based on whether the company has a license for international operations. With respect to the breakdown by industry, we employ the Swedish Standard Industrial Classification (SNI) as a variable within the framework of the road freight survey. The number of vehicles owned by the company is a derived variable within the framework of the road freight survey. Stratum 000 is a special stratum for vehicles that meet the following conditions:

- Their owners do not take the legal form of a sole trader, partnership, or other type of limited liability company.
- Owned by a company that belongs to the industry designated “postal deliveries”, i.e., SNI 53100.
- Owned by one of eight specific large companies. For reasons of confidentiality, the names of those companies are not disclosed.
- Vehicles that meet any of these conditions are assigned stratum number 000. However, no samples are drawn from this stratum. The ”no-activity” reporting that occurs in the road freight survey is viewed as being true. As a result, the inflation factor for this stratum is set at 1.0.

All 11 strata are roughly equal in size as measured in terms of numbers of vehicles. The smallest contains just over 3 000 vehicles, while the largest contains roughly 9 000 vehicles.

Transport analysis

Transport Analysis is a Swedish agency for transport policy analysis. We analyse and evaluate proposed and implemented measures within the sphere of transport policy. We are also responsible for official statistics in the transport and communication sectors. Transport Analysis was established in April 2010 with its head office in Stockholm and a branch office in Östersund.

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