

POSSIBLE EXPLANATIONS FOR AN INCREASING SHARE OF NO-TRIP RESPONDENTS

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Abstract

This paper discusses changes in the methodology of The Danish National Travel Survey (DNTS) that could explain some puzzling survey results, such as a 60% increase in the zero trip rate. The DNTS was a continuous survey conducted in the period 1992-2003. In 1998 an unexpected drop in kilometres and number of trips per person was observed, and further discrepancies emerged in the following years until the beginning of 2002.

The paper presents an analysis of the changes in the zero trip rate over two periods, from 1997 to 1998 and from 1998 to 2001. For both periods, the explanation is sought in the data collection methodology and not in the changed behaviour of the respondents.

The paper shows how sensitive continuous travel surveys are to even minor changes in methodology. It pinpoints the importance of maintaining strictly consistent calling times throughout the week and day. The analysis of the possible explanations for the substantial increase in the zero trip rate shows that the main reason is related to interviewer performance. The importance of keeping a continuous check on interview quality and results cannot be emphasised strongly enough. Furthermore the paper illustrates how the zero trip rate depends on soft refusals and making interviews on cell phones.

Purpose

This paper reports on some puzzling findings from the Danish National Travel Survey (DNTS). The DNTS was a continuous CATI survey conducted in the period 1992-2003 with 14-16,000 computer-assisted telephone interviews annually.

A continuous travel survey provides important information about changes in travel behaviour. Surprisingly, a decline in transport kilometres was observed in the DNTS in 1998 and an even sharper drop in 2001. The decline was registered for all transport means. Furthermore, the trip rate declined by 12% from 1995 to 2001. This trend in overall transport kilometres and trip rates is not found in other traffic observations. For instance, according to traffic counts collected by the Road Directorate, transport kilometres had in fact increased for many years until 2000 when they stabilised for a couple of years (Road Directorate, 2003). The DNTS changes are unlikely to derive from actual behavioural changes and are most probably explained by changes in the data collection methodology.

The paper focuses on the zero trip rate as it appears to be the most obvious reason for the unexpected drops in transport kilometres from 1997 to 1998 and afterwards up to 2001. Over the period the zero trip rate increased by 60%, from 16 to 25% (Figure 1). In reality, the zero trip rate should change only slightly per year in line with changes in participation in the labour market or as a result of a generation effect as shown by Madre et al. (2004).

The objective of the paper is twofold:

- to show how sensitive continuous surveys can be to small changes in data collection methodology, and
- to find explanations for the observed changes in the DNTS to illustrate the effect of changed methodology.

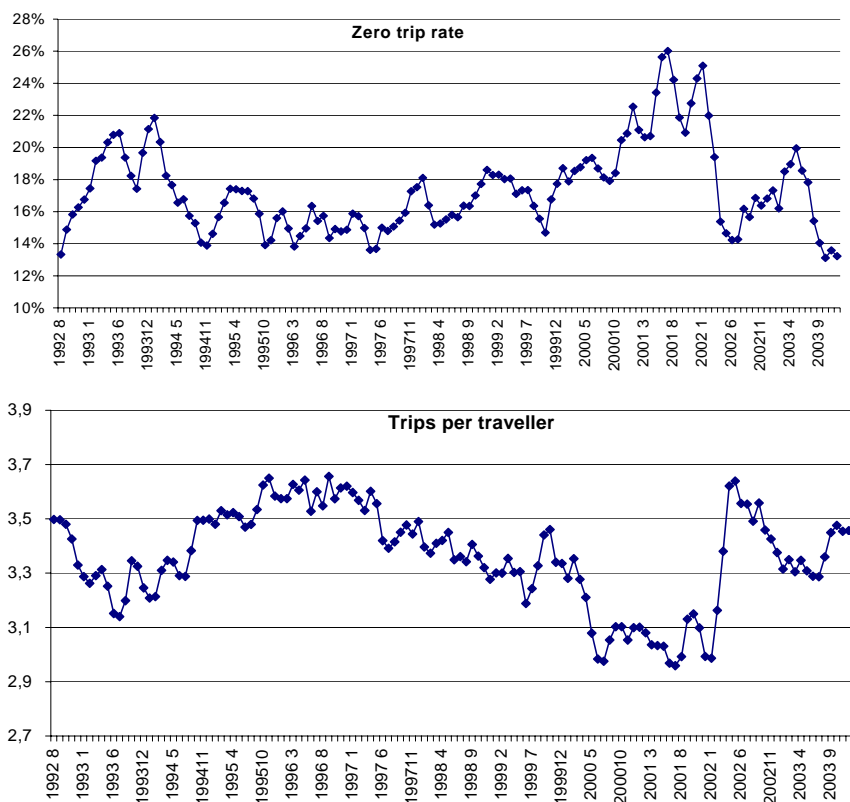


Figure 1: 1) Monthly mean of zero trip rate and 2) the mean trip rate for people travelling from August 1992 to December 2003. 16–74 year age group

In 'Danish National Travel Survey' the methodology of the DNTS is described. In 'Possible Explanations' different explanations for changes in the zero trip rate is discussed.

'Methodology and Results' the results of the regression analysis are presented. Both the general results and the explanations for the changes in the DNTS are illustrated. At last in 'Conclusions and Recommendations' the conclusions and recommendations of interest to other national travel surveys are discussed.

The Danish National Travel Survey

The DNTS was conducted by Statistics Denmark. Contrary to most other national travel surveys, it was based on a random sample of persons rather than of families. Respondents were selected from the Civil Register of all the inhabitants of Denmark. An introductory letter was sent to respondents in advance to explain the survey. As only people with listed telephone numbers were called, the letter requested non-listed telephone numbers. Only a few respondents complied with this request.

Respondents in the DNTS were not dedicated to a fixed day. They were sampled for a month, and when an attempt to contact them was successful, they were interviewed about the day prior to the calling day. The calling time was normally from 11 a.m. to 9 p.m. on weekdays and from 9 a.m. to 2 p.m. at weekends.

In order to avoid over-sampling certain weekdays, exactly the same number of respondents had to be interviewed every day. It was sometimes impossible to get enough contacts, e.g. on a summer Sunday. On such occasions, interviews related to this day were resumed on the following day. By the end of the month, it was some-

times impossible to get enough interviews, and interviews related to the last days of month were resumed on subsequent days.

Over the years, the data collection methodology changed several times. These changes are expected to influence both the zero trip rate and the trip rate per traveller. From 1997 to 1998 the data collection period was changed from one week each month to the whole month. The monthly number of respondents interviewed was the same before and after the change - except that some interviews were added because the group of respondents was expanded from the age range 16-74 to 11-84.

In the period 1998-2001, the only known change in data collection methodology was inclusion of cell phone numbers in the stock of called numbers, because all telephone numbers from 2000 were listed on a joint list.

Possible Explanations

This chapter identifies focal changes in data collection methodology.

Effect of Time of Interview

First, the zero trip rate is expected to depend on the day of the reported behaviour. If the distribution of interviews over the week or the year changes, the zero trip rate would change. The calling time of the day might also be important. For instance, 60% of respondents were not at home at 11 a.m. on a normal weekday whereas at 6 p.m., the figure was 20%. The distribution of calls over the day is unimportant if everyone in the sample is interviewed. However, if some are not interviewed because of insufficient efforts to contact them, people at home much of the time are over-represented. If many calls take place during daytime hours, the bias is greater than for a situation in which evening calls are over-represented.

The random calling method can create a bias in which person is contacted, e.g. on weekdays and at weekends. The distribution of respondents over the week is therefore dependent on the calling time of day. For instance, if many interviews are conducted during the daytime on weekdays, people outside the labour market are over-represented on weekdays, while respondents in active employment will be more concentrated at the weekend, reporting Friday and Saturday activities. Both biases generate a higher zero trip rate.

Contact Pattern

The change in the number of daily calls and the duration of the interview period from 1997 to 1998 might change the contact pattern and thus result in a different group of respondents with a different zero trip rate. Various methodologies have been used to highlight these changes, and the best variables are presented in 'Methodology and Results'.

Cell Phone Numbers

According to Figure 2, non-contacts and the share of unlisted telephone numbers changed substantially during the period 1997-2001. The number of people impossible to contact halved from 1997 to 1998, a decrease due to the longer calling period that enabled contact to be established with people returning home from journeys later in the month. However, the figure started to rise again from 2000, and by 2003 non-contact was 50% higher than in 1997. De Leeuw & de Heer (2002) reported an inter-

national trend with an increase in non-contact of 0.2% per year. The increase in the DNTS is much higher.

The percentage of sampled persons without a known telephone number gradually increased from 1997 until the end of 2000 as a result of an increase in the number of mobile telephones and telephone companies. From the end of 2000 when registration of cell phone numbers started, the percentage without a known telephone number dropped to half the level in 1999.

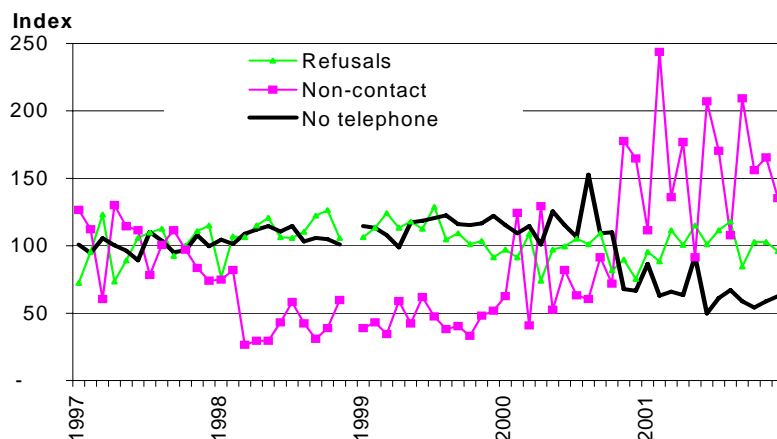


Figure 2: Changes in number of respondents and non-respondents in the age range 16–74. The mean number in 1997 is taken as index=100

These two developments are clearly interrelated. When cell phone numbers were included and more respondents were called, the number of people difficult to contact increased. The explanation seems to be that many cell phones are still registered even though they have been scrapped or switched off. In reality, a large proportion of the extra telephone numbers are of no use to interviewers but are merely time consuming.

The emergence of cell phones as an interview medium might also explain some of the increase in the zero trip rate. It is difficult to interview people via cell phone when they are away from home. In these circumstances, the respondent may not be fully concentrated and the interview short.

Soft Refusal

An additional explanation for the changing zero trip rate could be the theory of soft refusal. Madre et al. (2004) suggested that a disproportionately high percentage of zero trippers is produced by ‘soft’ refusals and concluded that the expected level of zero trippers in a one-day weekday diary survey should be 10-15%. In the event of a higher range, they suggest that ‘something in the interaction between the survey, the survey protocol, and the field work firm invites the respondents ... to use the soft refusal’ and thus avoid reporting their travel activities (page 28). The DNTS is carried out as a one-day diary but as part of a whole-week survey. Hence, a higher percentage of zero trippers at the weekend makes a 15-20% range of zero trippers realistic. The zero trip rate of 25% in 2001 is accordingly too high.

De Leeuw & de Heer (2002) showed that refusal rates increase in most countries by around 0.3% per year but the size of increase differs from survey to survey and from country to country. According to Figure 2, the refusal rate actually increased from 1998 through 1999. However, from the end of 1999 the refusal rate declined again and stabilised at the 1997 level in mid-2000. An explanation for this decline could be extra efforts to get a sufficient number of interviews when non-contact increases. The result of such efforts could be an increase in soft refusals instead. Reluctant respondents who try to avoid an interview by saying ‘I never go out’ could, for in-

stance, be persuaded to take part by answering 'oh, then I won't need to take much of your time'. The result might be no trips reported.

A higher share of non-contact in 2001 could be another indication of soft refusal. Chapleau (2003) reported a much higher level of non-response from people who were called numerous times. Lynn et al. (2002) do not find a higher non-response rate if people were called many times without contact being made. Stopher et al. (2004) mentioned that a repeated number of appointments before agreeing to participate in an interview is an indicator of a soft refusal. They suggested that respondents who make more than a certain number of appointments should be excluded.

Interviewer Effect

In all kinds of personal interviews, irrespective of whether they are conducted as part of a CAPI survey or, like the DNTS, a CATI survey, interviewers act differently and achieve different results according to, e.g. unit non-response and item non-response (many references to interviewer effects can be found in Groves et al., 2002). This can result in a decreasing trip rate or even an increasing zero trip rate. Battellino & Peachman (2003) points to the problem with some kind of tiredness after conducting many interviews. They offer recommendations for addressing this problem.

Interviewer experience might also result in better results. Both Chapleau (2003) and Pahkinen & Pastinen (2001) reported lower refusal rates with experience. On the other hand, persistent attempts to reduce potential refusals by persuading respondents to participate could result in a higher percentage of soft refusals.

As the interviewers' salary depended on the number of interviews achieved, interviewers had a financial incentive to reduce interview time. An easy way to reduce interview time is to be less eager to record a maximum number of trips, which results in a reduced trip rate. This could also explain the high zero trip rate recorded by some interviewers.

Interviewers did not interview on the same days, which naturally influenced their zero trip rates, as interview time of day and week is very important for the resulting zero trip rate. Therefore the interaction between interviewer and time of interview had to be included in the analyses.

Information about age and gender is available to the interviewer when he decides to call a respondent. Thus, the interviewer may tend to call people aged over 60 during daytime hours on weekdays and younger people in the evenings and at the weekend. Therefore the interaction between interviewer, time of interview, and age of the respondent had to be included in the analyses.

Methodology and Results

The data analysis was carried out as a logistic regression on a disaggregated dataset with each respondent as an observation. The dataset is based on an interview-logfile supplemented by information on the number of trips reported by the respondents. Eighty-one thousand observations are available from 1997 to 2001. The analysis used a binary logit model to compute the probability of the zero trip rate being zero.

The purpose of the methodology applied was to identify variables or groups of variables that may explain differences between years. The influence of a variable can change either because the combination of the values of a variable changes, e.g. if the

share of interviews reporting Sunday activity increases, or because the influence of a variable on the zero trip rate changes, e.g. if some of the interviewers are less eager to get all information about trips made by the respondent.

Year dummies were included in the regression as independent variables to describe changes in behaviour year by year. The year dummy was also included in interaction with the significant variables. A significant change in this interaction in some years indicates that the influence of the variable with which the year dummy interacts has changed in the given years.

The independent variables describing the data collection methodology should normally be supplemented by socio-economic variables to control for bias. The analysis presented in this paper only takes age and gender into account. This approach has been selected in order to highlight the influence of the data collection methodology on results.

Two analyses were carried out, one for the period 1998-2001 for the age range 11-84 and one for 1997-1998 for the age range 16-74.

Overall Results

Table 1: The Chi-square statistics of the logistic regression for the period 1998 to 2001

Source	DF	Chi-Square	Pr>ChiSq
Year 2001	1	10.9737	0.0009
Age	1	97.8600	<.0001
Age ²	1	325.2386	<.0001
Time of call and interview day	7	133.8521	<.0001
Age * Time	7	19.9703	0.0056
Age ² * Time	7	19.1101	0.0078
Month	3	59.6437	<.0001
Interviewer	8	107.3402	<.0001
Interviewer experience	6	18.8651	0.0044
Interviewer * experience	30	58.3029	0.0015
Year 2001 * Interviewer	6	13.4271	0.0367
Interviewer * Time	23	52.3245	0.0005
Contact pattern	3	123.3585	<.0001
After end of month	1	11.6610	0.0006
Number of non-contacts	7	28.3647	0.0002
Number of appointments	3	13.9770	0.0029
Mobil telephones	1	5.0994	0.0239

The result of the logistic regression from the period 1998-2001 is presented in Table 2. Only the significant variables are listed. Some of the presented effects are not significant, but are included because their second-order interactions are significant.

The result of the regression from the 1998-2001 period is that the year dummy of 2001 is significant, but none of the other year dummies are. This means the model does not fully explain changes over the year. 2001 still shows an inexplicable increase in zero trip rate.

The logistic regression from the period 1997-1998 includes most of the same variables but

fewer interactions thanks to the smaller number of interviews - 28.000. The year dummy is insignificant and the changes are fully explained.

Effect of Time of Interview

As expected, Table 2 shows that the zero trip rate depends on the day of reported behaviour. The zero trip rate is higher at weekends than on weekdays and higher on Sundays than on Saturdays.

The zero trip rate also depends on the time of day the call was conducted. According to Table 2, the zero trip rate on Saturdays for respondents interviewed after 11 a.m. on Sundays is fairly high related to contacting earlier on Sundays or on Mondays. As more than two-thirds of the Sunday respondents are contacted after 11 a.m., the reported zero trip rate on Saturdays seems to be biased. A Sunday evening interview period might change the zero trip rate, with respondents reporting more travelling activities on Saturdays.

Table 2: Estimated zero trip rates 1998-2001 depending on calling time and the day the interview relates to

Calling time	Interview relates to	Zero trip rate
Day	Weekday	19 %
Evening	Weekday	14 %
Saturday	Weekday	12 %
Sunday morning	Saturday	17 %
Sunday after 11	Saturday	20 %
Monday	Saturday	16 %
Monday	Sunday	29 %
Holiday	Sunday / Public holiday	32 %

The intention was to keep the distribution of the interviews over the day and week the same. However from 1998, far less interviewers were active each day than previously, which made it more difficult to allocate the right number of interviewers to each period of the day. This resulted in more respondents with high zero trip rates being interviewed during weekday daytime hours and fewer interviewed in the evenings. Even

though, changes in calling time only contribute little to the increase in zero trip rate in both periods.

Age and Gender

Age is significant in both first and second order, whereas gender is not. The zero trip rate increases significantly with the age of the respondent. The difference between elderly and young is slightly smaller at weekends than during the rest of the week (Figure 3).

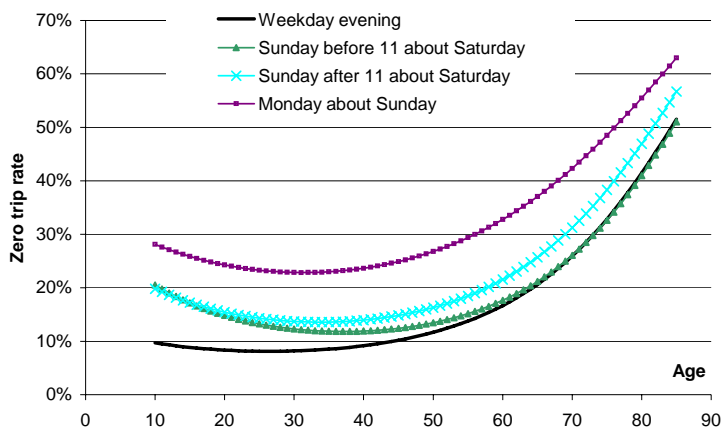


Figure 3: The estimated zero trip rate in 1998-2001 depending on age and calling time

Since the composition of the age groups did not change much from 1997 to 1998, the large difference in zero trip rate between age groups cannot explain any change in the zero trip rate. However, in interaction with calling time, age contributes to the increase in zero trip rate from 1997 to 1998. About half of the increase is explained by change in calling time and the impact this has on the age distribution over days of the week. The influence on

the zero trip rate from 1998 to 2001 is only marginal.

Contact Pattern

A variable indicating the time span between the successful call and a prior call is significant in the regression model. As shown in Figure 4, a person contacted the day

after a day on which he was called without contact has a slightly lower probability of reporting no trips on the previous day. This is a natural outcome because the behaviour on the day the interview concerns is dependent on the day of the earlier call. If the respondent is contacted later on the first calling day, he is also less likely to be a zero tripper. This is typical for a person on the job market who can only be contacted in the evening. He is rarely a zero tripper. On the other hand, the zero trip rate for a respondent contacted at the first call does not differ significantly from that for a respondent contacted more than one day after a prior call.

To conclude, if a person is not contacted on the first calling day, the timing of the next call is not important provided it is not the following day. If contact is not established at the first call on a certain day, it is important to call the person again later on the same day to try to get contact. If this contact pattern is followed, it does not matter that the respondents are not sampled on a fixed day. However, the survey did not follow this rule. In 1997 respondents were more often contacted the day after an earlier call than later on, resulting in a slightly lower zero trip rate in 1997. Furthermore, they were more frequently called several times each day, which slightly reduced the zero trip rate. This difference explains only a small part of the change in the zero trip rate from 1997 to 1998 and none from 1998 to 2001.

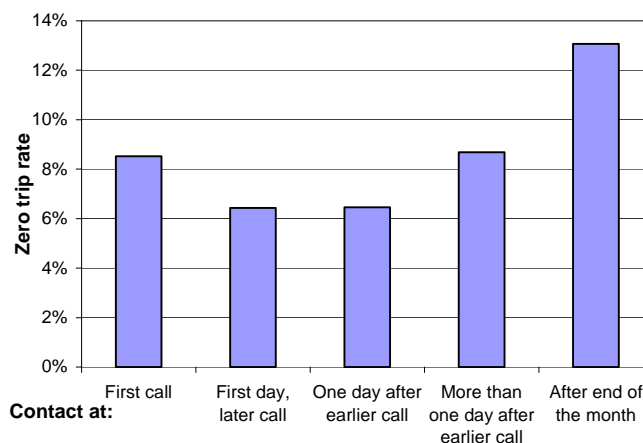


Figure 4: The estimated zero trip rate in 1998-2001 depending on the time span between the successful call and a prior call; and on calling after end of the month

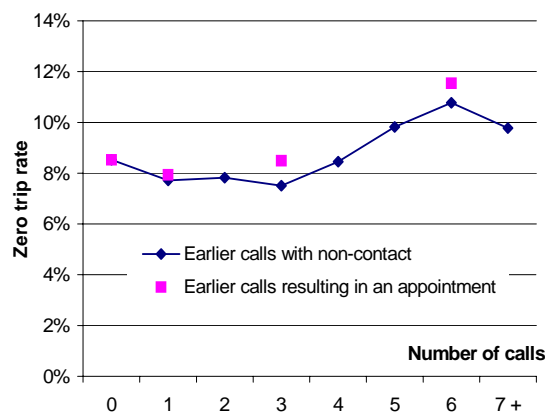


Figure 5: The estimated zero trip rate in 1998-2001 depending on the number of calls resulting in appointments or non-contact before the successful call

Soft Refusal

The most surprising result from the analyses of the contact pattern is a 50% higher zero trip rate for respondents contacted one or more days after the end of the month (Figure 4). These respondents had been called several times earlier without an interview being achieved and would be expected to have a very low zero trip rate. Two explanations are possible: one is the possibility of soft refusal and the other is that respondents have forgotten some trips, primarily the short ones. The zero trip rate for respondents reporting an activity more than one day ago but not at the end of the month is not significantly different from that for everyone else. This indicates that the discrepancy is not caused by difficulty remembering trips.

In 1997, a higher share of respondents was contacted after the end of the month than in the following years. The longer period with fewer calls per day makes it easier to complete interviewing within the period. The effect from calls after the end of the

month cancels out the effect from more calls only one day after a prior call. This means that changes in contact pattern do not explain the increasing zero trip rate from 1997 to 1998, nor after 1998.

The monthly mean share of refusals is not significant. The analysis therefore does not support the possibility of a change from refusal to soft refusal.

The number of calls with non-contact and the number of appointments before making contact are both significant. As expected, the zero trip rate decreases if more than one call is necessary to get contact, but only up to a certain number (Figure 5). If the respondent is contacted more than four times without contact the zero trip rate is higher. The rate reaches a maximum 25% above the level without any non-contact calls if six non-contact calls are necessary. The zero trip rate decreases slightly again if the number is even higher, perhaps because some people have been away from home for a longer period and have now returned to their normal activities at home. If more than four appointments are made, the estimated level of the zero trip rate is one third higher than without earlier appointments.

Both variables show that it is problematic to continue attempting to make contact after many calls. The risk of a soft refusal interview increases. We agree with Stopher et al. (2004) that attempts to establish contact must stop after four appointments. An interview after many non-contacts is not a good solution either. As persistence to call might result in contact with respondents who have been away on long distance travel many non-contact calls are more acceptable.

We assess the overall effect on the zero trip rate from soft refusal to be about 0.3% following contact after many fruitless appointments and non-contact calls, and contact made on calling after the end of the month. This is little in relation to the large change in zero trip rate.

Cell Phones

Interviews conducted on a cell phone generate a significantly higher zero trip rate than those conducted on a landline telephone (15% higher). As the cell phone calls in 2001 was few this factor only explains 0.1% of the increase in the zero trip rate from 1998 to 2001. The impact of cell phone interviews might increase in the future.

Interviewer Effect

Some DNTS interviewers reported significantly different behaviour from the other interviewers in terms of both zero tripping and trip rate. The effect was handled by introducing a dummy for each of these interviewers or from two of them together. The rest of the interviewers were divided into three groups: a large middle group, used as reference group; a group reporting a slightly higher zero trip rate; and a group reporting a slightly lower percentage of zero trippers. Each of these groups was included in the regression with a dummy for the group as a whole.

The interviewer effect was very significant. Experience affected performance too (Figure 6). Some interviewers reported an increasing zero trip rate as they conducted more interviews. However, for most of the interviewers, experience did not affect the results after the initial learning period. In other words, it appears that some of the interviewers became more passive, not attempting to encourage respondents to remember their trips.

In the period from 1998 to 2001 the variables with the greatest influence on the mean zero trip rate are the dummies for the interviewers. The estimated zero trip rate increased from 10.5% to 15.7% for the reference respondent at the reference calling time due to differences in interviewer performance from 1998 to 2001. When the interviewer effect is corrected for calling time, the influence from the interviewer is reduced. The explanation for the changes from 1998 to 2001 is almost entirely related to the interviewers.

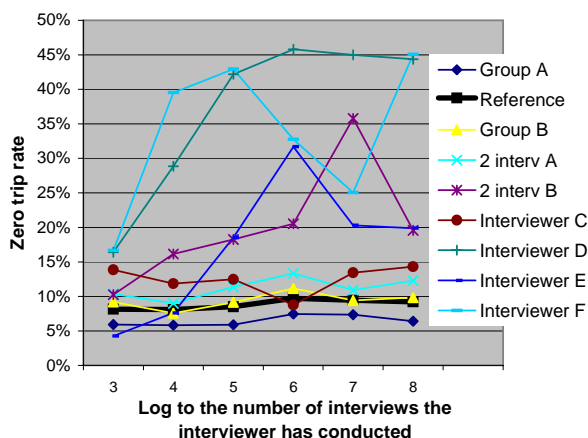


Figure 6: The estimated zero trip rate in 1998-2001 depending on the interviewer effect

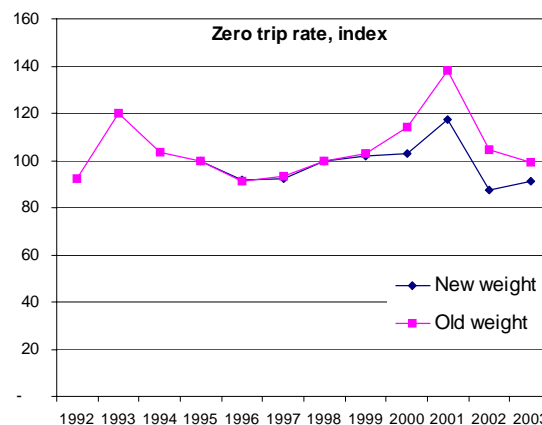


Figure 7: The zero trip rate after a reweighing in which the contribution from two interviewers are left out and a third is 'normalised'

The number of interviews by interviewers who perform poorly increased over the years. In 1998, the reference group of interviewers and the two groups recording a slightly higher or lower zero trip rate accounted for 88% of all interviews. In 2001 these groups accounted for only 69% of the interviews.

The effect of the interviewer in isolation was a small increase in the zero trip rate from 1997 to 1998 but the combined effect of interviewer and time increases the difference. To conclude, changed interviewer performance and calling time of the interviewers account for half of the change in zero trip rate from 1997 to 1998.

In February 2002, Statistics Denmark held an instruction meeting for all interviewers at which they were confronted with the declining trip rate and instructed to exercise more care in registering all trips. According to Figure 1, the trip rate increased from March to a level on a par with 1997-1998.

Figure 7 is illustrating how much the overall transport kilometres is changed with a reweighing of data in which the contribution from the two worst interviewers are left out and the contribution a third is 'normalised'. The zero trip rate in 2002 is extra low because of the general effort to get information about all trips.

Conclusions and Recommendations

At the background of the analyses in this paper it is possible to draw some more general conclusions and make some recommendations for other continuous travel surveys.

The analysis of the possible explanations for the substantial increase in the zero trip rate shows that the main reason is related to interviewer performance. An increasing

number of interviews were conducted by a few interviewers with much higher zero trip rates than the rest. The importance of keeping a continuous check on interview quality and results – percentage of zero tripping, trip rate and km per trip – in relation both to a general trend and to interviewer performance cannot be emphasised strongly enough. This is a particular problem in continuous surveys that are vulnerable to changes in trends due to changed procedures or performance.

Changes in the distribution of calling time over the week will off course change the zero trip rate. More unexpected is that changes in calling time on the calling day can influence which age groups are contacted on the actual day resulting in a changed zero trip rate.

The analysis seems to support the soft refusal theory but only resulting in a small change in zero trip rate. Many calls with non-contacts and many fruitless appointments is one of the reasons. Persistence to get extra interviews at the end of an interview period is another.

The analysis shows that a change from establishing contact exclusively through a landline telephone to including mobile telephones also changes the results. It is far more difficult to contact people with cell phone numbers because they are often switched off or scrapped. This is time consuming and expensive. Furthermore, cell phone contacts increase the resulting zero trip rate because the cell phone is good for short calls but not suitable for calls requiring a great deal of thought. Problems with fewer listed telephone numbers and an increasing number of cell phone will increase in the future.

The DNTS is based on the principle of interviewing about the day prior to the day of contact. It differs in this respect from most other national surveys. The analyses show that the many examples of biased results and variations in the calling day can be related to this method. Interviews about a specific day and intensive calls the following day provide the best results. However, if contact is not successful on this day, the next call can be conducted on a later day but not the day after.

It is often necessary to make an appointment for a new call. If this is the case, the day of the appointment has to be selected randomly and not on the first day the respondent is at home.

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