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COLLECTING DATA BY INTERNET ON STATED PREFERENCE FOR TRANSPORT SUPPLY: THREE CASE STUDIES ON SURVEY MODE COMPARISON

Åse Nossum [a]***, Knut Veisten*** [b]

[a] *Institute of Transport Economics*
Gaustadalleen 21, NO-0349 Oslo, Norway
Analyse & Strategi AS Postboks 12 Skøyen, NO-0212 Oslo, Norway (present address)

[b] *Institute of Transport Economics*
Gaustadalleen 21, NO-0349 Oslo, Norway
Corresponding author: kve@toi.no

Internet-based data has become an important source for market research in the developed world, following the rapidly improving technology and increase in Internet access and use. Given the existence of an acceptable and accessible sampling frame, sampling by the Internet is much cheaper than any other sampling method. A main issue is to which extent use of different survey modes, particularly the Internet, will affect survey results, and if differences are due to different representation of genders, age groups, etc., or due to the survey mode itself.

This paper presents recent experiences from the use of Internet-based stated-preference surveys combined with other survey modes, particularly postal mail sampling. Preferences were stated as sequential pair-wise choices between transport options. Comparing models with and without weighting with respect to gender, age and unemployment, we show that there is a significant survey-mode effect on a large share of attribute parameters.

Keywords: pair-wise choices, public transport, sampling bias, time savings

1. Introduction

Internet-based surveys (web surveys) have become an important source for market research in the developed world, following the rapidly improving technology and increase in Internet access and use [1]. Given the existence of an acceptable and accessible sampling frame, sampling by the Internet is much cheaper than any other sampling method [2], [3], [4]. That is, if the respondent can be sampled by the Internet, for example by sending a hyperlink to the person's e-mail address, there is no additional shipment or dispatch costs of sampling. Even if the recruitment is to be carried out by telephone or ordinal mail, there will be a cost reduction compared to other sampling methods since the respondent plots and returns the data with no additional costs for the survey administrator. Data collection by Internet has also similar advantages as other computerized interviewing methods, enabling interactive and customized questionnaires [5]. Tailor-made questions for different individuals is also considered advantageous in stated preference surveys, for example, enabling questions and choices to be pivoted from the individuals' actual behaviour and making logical specifications following previous responses [6], [7].

Stated preference (SP) methods are survey-based methods for eliciting values of either new product attributes or (components of) public services [8]. The application of these methods are hampered by the cost of gathering survey data, when considering strict requirements of probability sampling and data quality. Thus, it becomes particularily relevant in the application of stated preference methodology to assess if there are adverse effects from use of Internet that may counterbalance the cost savings and other advantages. A main potential disadvantage of using Internet is related to the still limited accessibility to Internet for some population segments. Also in Scandinavia, where Internet access and use are most extended, there is relatively lower access among elderly and social security recipients, and, in general, lower access/use among women than men (www.ssb.no, www.scb.se). Thus, the characteristics of the respondents to an Internet survey may differ from what obtained by other sampling methods, and, most importantly, differ from the affected (theoretical) population [1]. There is still limited knowledge on how the use of Internet will affect valuations based on stated preference studies [9].

This paper presents experience from use of Internet-based surveying in three different SP studies applied to public transport. Internet was combined with either mail-based questionnaires or computer-aided personal interviews, such that our data enable testing of the Internet mode effect. We can assess if use of Internet influences on value estimates from SP surveys. To our knowledge, quite few studies have presented tests of the Internet effect on SP based values. We also describe differences in respondent characteristics between modes. The remainder of the paper is arranged as the following. The next section lists potential advantages and disadvantages of Internet-based surveys compared to alternative survey methods. The third section provides a description of the stated preference studies investigated. The fourth section presents the findings, and these are discussed and concluded in the last section.

2. Advantages and Disadvantages of Web Surveys

2.1. Growth of Internet access and use enabling cost savings in data collection

During the last decade the use and access to Internet has increased considerably in Norway and Sweden. According to the International Telecommunication Union, ca 77% of the Swedish population had access to the Internet in 2007 (www.itu.int). For the Norwegian population the access rate was 83%; most of these had broadband connection, and they spent on average approximately 1 hour on the Internet per day [10]. The accessibility/usage rate of Internet in Scandinavia is among the highest in the World.[1]

Data collection by traditional computerised methods, as home interviews using portable computer, has become very expensive. Currently a home interview (either face-to-face interview or assisted survey by a laptop computer) will cost approximately NOK1,000 (about €120). There is hardly any economics of scale when increasing the number of respondents up to 500 or 1000, such that 500 interviews will cost around NOK500,000 (€60,000) and 1000 interviews NOK1 million (€120,000). Looking only at the part of answering the questionnaire, the cost of self-administered Internet surveys does not increase linearly according to the number of respondents. The average interview cost per interviewee will decrease as the number of respondents rise. Thus, the greater the sample, the more savings can be made by carrying out self-administered Internet surveys compared to home interviews. The web method has been found significantly cheaper than the mail method when the number of subjects is more than 200 [2]. For a given budget the Internet survey offers much larger sample size than, e.g., the conventional mail survey [4].[2]

Furthermore, an average response time has been estimated to approximately six days in Internet surveys, compared to approximately 16 days in a mail survey [2]. Thus, the speed in Internet-based data collection is approximately four times faster. However, these comparisons are based on the existence of an e-mail register for the Internet-based data collection. If the invitation to participate has to be based on postal mail or phone, inviting the persons to connect to a web address (where the survey is placed) or provide an e-mail address, the speed gain will be less. When e-mail registers are available, the minimum time required from e-mailing the invitation to participate in the survey to receiving a response from the respondent, is the time it takes for the respondent to read the e-mail, click the link to the web-based questionnaire, fill in the questionnaire, and press the submit button.

2.2. Limited access for some segments and lack of public e-mail registers

Access to Internet still differs between population groups in Norway. Among the elderly the access rate is lowest, and those who have access do not use Internet as much as younger people [12]. In general, people with low income and/or only basic education do not use Internet as much as those with higher education and/or high income. Furthermore, more men than women use the Internet (www.ssb.no; www.scb.se). In addition to access and computer know-how, respondents must also have compatible hardware and software in order to successfully complete an Internet survey [3]. When Internet access/use differs between segments, problems concerning sample coverage and sample representativeness may be expected – at least for surveys covering the overall adult population [11]. It poses a much lesser problem if the target population is a subpopulation with very high Internet usage, e.g. university students or government agency staff [13].

[1] http://www.internetworldstats.com/stats4.htm#europe.

[2] Studies comparing the cost of mail surveys to the cost of internet surveys have found that the former are 20 to 600 percent more costly [2], [11].

A main disadvantage of using Internet sampling and surveying, at least currently, is the lack of extended registers with e-mail addresses, something parallel to telephone number and postal address registers. Thus, if disregarding commercial Internet panels, the first part of the sampling will in most cases have to be based on postal mail or phone, inviting the persons to connect to a web address (where the survey is placed) or provide an e-mail address. Thus, if such a first phase is phone/mail based, also the particular disadvantages of these mediums will apply. This raises costs compared to addressing a register of e-mails, and it reduces the response rate compared to the direct sampling using e-mails. Some potential respondents pay for their Internet access, and will then also have to pay an amount of money to be able to answer a survey. Such costs for the respondents may give an undesirable effect and influence the response rate. Most individuals in Norway access Internet free of charge at work, at school, at the public library, or they have an access at home with a fixed rate and zero marginal costs (not dependent on use). Yet, no e-mail register for the general population exists.

2.3. Potential effects from using Internet-based stated preference (SP) surveys

SP surveys are surveys that include some questions that enable valuation of either new product attributes or (components of) public services [8]. Typically, a SP sequence will involve: i) an introduction to a particular context – a choice/valuation scenario; ii) description of some attribute(s) that may be introduced/improved at some cost; iii) a set of pair-wise choices (or other format for valuation); iv) probe questions related to stated choices (to validate/explain choices and comprehension); and v) individual characteristics (to explain choices and assess representativeness). Generally, there is a demand for high sample quality and, normally, that this should be representative for an identifiable population (e.g., the overall adult population). Also the survey mode should ensure comprehension and incite truthful/ considerate responses.

Relatively few studies involving stated preference (SP) have compared survey mode effects on response rates; and those reported involve contingent valuation rather than choice-based SP [9]. In a contingent valuation study carried out in Portugal, a much lower response rate was obtained in the web-based survey than in in-person interviews, respectively 5% against 84% [14]. This topic of the study was valuation of environmental improvements. However, in a test of Internet against face-to-face interviews, applied to contingent valuation of biodiversity protection in Norway, the null hypothesis of equal valuations between survey modes could not be rejected at the 10% significance level [9]. In another SP study concerning preferences for protecting nature areas in motorway planning in Denmark, pair-wise choices were applied [11]. Similar (and high) response rates were obtained both for Internet-based survey mode and (postal) mail survey mode, respectively 63.6% and 60.3%. Possibly these differences between results in Portugal and Denmark are, to a large extent, caused by national differences – in Internet access/usage as well as other particularities.[3] In another study involving choice-based SP it was observed significant differences in attribute preferences between sub-samples facing different survey modes, and it was concluded that the Internet-based data collection method was judged superior to a traditional pen-and-paper survey mode on the basis of internal consistency and predictive validity [17]. Taken together, the literature shows quite mixed results regarding the survey-mode effect from Internet.

2.4. Tests of survey-mode effects in stated preference (SP) surveys

Our primary interest is to test if use of web-based surveying affects estimated economic values, compared to other survey modes. Thus the main null hypothesis is that there are equal attribute values from web-based samples and samples from other survey modes, i.e., (postal) mail. We will also test formally if some population segments (age group or gender) are less represented when using Internet. Again, the null hypothesis is no difference. Our data will not enable clean tests of overall response rates, since we do not have split samples. However, we will report how many of the recruited respondents choose responding via Internet versus an alternative survey-mode.

[3] Another national comparative artefact from Scandinavia is the relatively higher response rates in Sweden than in Norway experienced in SP studies with sampling in both countries [15], [16].

If no survey mode effects are found, it will yield some support to the use of Internet or mixed modes in a survey. It may be regarded as a test of convergent validity [18]. If mode effects do exist, our results based on three independent surveys will yield some indication of directions. If patterns are clear, there may be ways of counteracting bias, e.g., by weighting procedures based on the distribution of registered individual characteristics (age, gender, etc.) that can be compared to distributions in the overall population.

3. Material: Three Recent Internet-Based Stated-Preference Surveys

3.1. Valuation of safe public transport – the "Sweden survey"

The first reported Internet-based SP survey was carried out among the adult population in Sweden (in the cities of Gothenburg and Jönköping). The purpose of the study was to value specific public measures to increase accessibility to safe (secure) public transport [15]. Recruitment of the whole sample was done by postal mail. A random sample was chosen from the National Population Register and a letter with an Internet address for the survey and a personal user name and password was sent to this sample by postal mail. The web survey was supplemented with paper forms, i.e., a traditional mail survey (ensuring that everybody could reply and enabling mode testing).

The survey contained two SP choice sequences; one for attributes at the bus stop and one for attributes on board the bus. The attributes in the first choice sequence were safety, bus stop design and fares. The second sequence contained attributes such as information, safety, fares and driver contact. Since the opportunities for customised design with paper forms are limited, the choices in the SP sequence in the paper format were simpler than in the Internet format.

3.2. Valuation of time savings in public transport – the "Oslo survey"

The second reported Internet-based SP survey was carried out among the adult population in Oslo region (the city of Oslo and the county Akershus), in 2002. The purpose was to analyse people's preferences and evaluations of the quality of public transport services [16]. All respondents were recruited in the same way as in the "Sweden survey", by postal mail. The web surveying was also supplemented with a similar pen-and-paper questionnaire, though the web survey was tailor made to a greater extent than the pen-and-paper version.

The survey contained four choice sequences. In three public transport choice sequences the attributes were fares, walking time to bus stop, headway, travel time, interchange, comfort and delays. An additional public transport versus car SP sequence, the attributes were price, travel time and headway. In the Internet format the respondent was given questions that were linked to a familiar journey. This was done in order to make the trade off as realistic as possible, using this in the construction of hypothetical choices [7]. This is not possible on paper in a mail format, and therefore the respondents to the paper mode had to use some average imaginary journey.

3.3. Valuation of time savings in transport – the "Tønsberg survey"

The third reported Internet-based SP survey was carried out among the adult population in the city of Tønsberg (southeast of Oslo), in 2003. The purpose of the study was to develop concrete proposals for changes in public transport services. In order to describe the optimal public transport provision, an SP analysis was carried out to find passengers' preferences for different quality aspects of journeys by bus, car and bicycle [19].

Recruitment was carried out by telephone instead of mail in this survey. Respondents could choose either a self-administered Internet questionnaire or a computer-aided personal interview (CAPI) at home. Those who choose the self-administered web survey received a hyperlink to a website and a personal password/user name by e-mail. The CAPI was carried out using a laptop computer connected to the Internet via a mobile telephone. Different sub-samples received different SP questions, based on their

main transport mode. Bus passengers chose primarily between different bus journeys, while the other transport mode users (car, cycle) received both within-mode choices and between-mode choices against public transportation. The pair-wise choices included attributes such as the cost of the journey, travel time, delays, transfer, walking time to the bus stop, as well as parking for cars and separated bicycle lanes.

4. Results

4.1. Characteristics of respondents and survey mode

The shares choosing to respond by Internet vs. other survey mode are fairly similar between the three surveys, and the share for Internet is consistently somewhat higher (Table 4.1).

Table 4.1. Response rates in three different web based SP-survey

Survey	Web self-administered	Web home interview	Paper	Total
Sweden survey	24%	n.a.	21%	44%
Oslo survey	16%	n.a.	14%	30%
Tønsberg survey	19%	13%	n.a.	32%

The proportion of men was significantly higher in the sub-samples answering with respect to self-administered Internet, in all three surveys. However, the difference was quite limited in absolute terms. The average age among those who responded through Internet was significantly lower than among those who responded by paper or by CAPI. The age difference is stronger than the gender difference. The proportion of those in employment was significantly larger in the sample which replied using the Internet, in all three surveys. This difference was even stronger than the age difference (Table 4.2).

Table 4.2. Gender, average age, and employment; by survey and survey mode

	"Sweden survey"		"Oslo survey"		"Tønsberg survey"	
	Web	**Paper**	**Web**	**Paper**	**Web**	**Home**
Men	52%	41%	54%	46%	53%	42%
Women	48%	52%	46%	54%	47%	58%
n	1406	1232	561	593	582	352
Age	37.8	53.9	36.8	50.7	40.3	49.1
n	1406	1204	561	632	599	354
Employed/student (inc. part time workers)	93%	58%	95%	67%	92%	64%
Not employed (on benefits, pensioners)	7%	42%	5%	34%	8%	36%
n	1339	1243	521	591	563	339

Thus, particularly employment and age, and, to a lesser extent, gender, are characteristics that covariate with individual choice of SP survey mode.

4.2. Formally testing the survey mode effect

Formal tests were carried out with standard binary logit models, assuming linear utility functions, and these were estimated by use of ALOGIT [20]:

$$\Pr(Y_i = 1) = \frac{e^{V_{iA}}}{e^{V_{iA}} + e^{V_{iB}}} = \frac{1}{1 + e^{-(V_{iA} - V_{iB})}} \quad (1)$$

where Y_i is individual i's choice between the two alternatives, A,B (and A is set equal to 1 and B is set equal to 0).

In order to test whether the survey mode has an independent effect on the results, we have added survey mode dummy variables to all separate parameters. The dummy takes value one if self-administered Internet was the survey mode, and is zero otherwise. The parameter, γ_m ($m = 1,\ldots M$ attributes), for

the dummy, D_m, then expresses the isolated effect that the choice of Internet mode, compared to an alternative survey mode, has on the respective attribute (X_m); e.g.:

$$V = \beta_0 + \beta_1 \cdot X_1 + \gamma_1 \cdot D_1 \cdot X_1 + \beta_2 \cdot X_2 + \gamma_2 \cdot D_2 \cdot X_2 \ldots \quad (2)$$

The estimated Internet use dummy parameters are presented, together with common parameter estimates ($\boldsymbol{\beta} = \beta_0, \beta_1, \ldots, \beta_M$) from pooled data (data from both survey modes included in estimation), in Table 4.3.

Table 4.3. The survey mode effect, measured for each attribute including an Internet dummy

Choice sequence	Attributes (**X**)	Parameters (**β**) – pooled sample	Parameters (**γ**) – Internet mode
"Sweden survey"			
1	Security: security guard at bus stop	0.13	0.409
1	Security: surveillance camera at bus stop	0.06	0.083
1	Bus stop with building/lightning/heating	1.90*	-0.672*
1	Bus stop with penthouse/lightning	1.99*	-0.552*
1	Bus stop with penthouse (no lightning)	0.64*	-0.095
1	Fare, bus	-0.04	-0.020
2	Possible to contact the driver	1.16*	-1.28*
2	Security: surveillance camera and security guard	0.71*	0.567*
2	Security: security guard	1.09*	0.108
2	Security: surveillance camera	0.82*	-0.16
2	Real-time display on board and at bus stop	1.11*	-0.535
2	Real-time display at bus stop	1.16*	-0.769
2	Information at bus stop if delayed	1.55*	-1.18
2	Fare, bus	-0.12*	0.008
"Oslo survey"			
1	Headway	-0.04*	-0.13*
1	Access time	0.02	-0.102*
1	Fare	-0.10*	-0.023*
2	Interchange 10 min	-2.69*	1.02*
2	Interchange 5 min	-1.50*	0.494*
2	Interchange 0 min	-0.36*	-0.012
2	In vehicle time, bus	-0.10*	-0.005
2	Cost, bus	-0.15*	0.045*
3	Delay3	-1.73*	0.791*
3	Delay2	-0.83*	0.262
3	Delay1	-0.24	-0.102
3	In-vehicle time, standing, bus	-0.10*	0.017
3	In-vehicle time, sitting, bus	-0.03*	-0.02*
3	Fare, bus	-0.07*	-0.003
"Tønsberg survey"			
A1	Headway	-0.04*	-0.011
A1	Access time	-0.08*	0.070*
A1	Fare, bus	-0.23*	0.074*
A2	Interchange 10 min	-2.65*	0.357
A2	Interchange 5 min	-1.87*	0.526*
A2	Interchange 0 min	-0.61*	0.213
A2	In-vehicle time, bus	-0.02	-0.058*
A2	Fare, bus	-0.13*	-0.017
B1	Parking bicycle, outside	-0.22	0.287
B1	Parking bicycle, bicycle shed	-0.46*	0.294
B1	Parking bicycle, lockers	-0.89*	0.332
B1	Separated cycle/walking path	2.76*	-0.89*
B1	Cycle lane (in street)	1.51*	-0.084
B1	Cycling on pavement	1.26*	-0.091
B1	Travel time, bicycle	-0.06*	0.033
C1	Time from car park	-0.20*	0.086*
C1	In-vehicle time, car	0.01	-0.060*
C1	Parking charge	-0.07*	0.005

* Significantly different from zero, 95% t-test.

In the "Sweden survey" and the "Oslo survey", combining web and pen-and-paper, approximately half of the parameters are significantly affected by survey mode. The use of Internet has yielded both higher parameter (β_m) estimates (γ_m significantly positive) and lower parameter (β_m) estimates

(γ_m significantly negative). In the case of the "Tønsberg survey", combining self-administered web and CAPI, the survey mode effect is significant for fewer parameters than in the other two surveys.[4]

Based on the findings that gender, age and employment differ significantly between those choosing the self-administered Internet versus other survey modes, we assess the effect of weighting procedures on the web dummy parameters (γ_m). That is, we weigh the the Internet-based sub-sample on the under-representative individual characteristics, that is, females, elderly, and unemployed (up to the level of the sub-sample responding by paper). We limit the comparison to the "Oslo survey" and the "Tønsberg survey", concentrating on the comparable within-mode stated pairwise choice sequences for public transport. Table 4.4 shows Internet dummy parameters for the unweighted case (taken from Table 4.3) and for the cases where the Internet-based sub-samples are weighted with respect to individual characteristics.

Table 4.4. The survey mode effect when weighting the Internet-based sub-sample on under-representative individual characteristics

	γ – non-weighted Internet-based sub-sample		γ – weighted Internet-based sub-sample – age and sex		γ – weighted Internet-based sub-sample – unemployment, age and sex	
	"Oslo survey"	"Tønsberg survey"	"Oslo survey"	"Tønsberg survey"	"Oslo survey"	"Tønsberg survey"
Headway	-0.13*	-0.01	-0.00	-0.01	0.02*	0.01
Access time	-0.10*	0.07*	-0.09*	0.04	-0.06*	0.02
Cost (sequence 1)	-0.02*	0.07*	0.02*	0.05	0.42*	0.08*
Interchange, 10 min waiting time	1.02*	0.36	1.17*	0.11	1.32*	-0.07
Interchange, 5 min waiting time	0.50*	0.53*	0.64*	0.23	0.84*	-0.07
Interchange, no waiting time	-0.01	0.21	0.27	-0.03	0.73*	-0.23
In vehicle time (travel time)	-0.01	-0.09*	0.02	-0.04	0.04*	-0.06*
Cost (sequence 2)	0.05*	-0.02	0.09*	-0.02	0.09*	-0.05

* Significantly different from zero, 95% t-test

For both the "Oslo survey" and the "Tønsberg survey", the weighting with respect to age and sex decreases the survey-mode effect (the strength of the dummy parameters, γ). However, the survey-mode effect increases, even beyond the non-weighted case, if the Internet-based sub-samples additionally are weighted with respect to non-employment. At least, this is the case for the "Oslo survey".

Discussion and Conclusions

Compared to other survey modes, Internet surveys have competitive advantages in terms of speed and costs. It also allows for a more efficient way of dealing with respondents. As other computer-based methods, surveys on Internet derive advantage from skip patterns, randomisation of questions and customized design. Customized design is crucial in SP analyses; it makes the attribute levels more familiar to respondents and provides higher variation in the observations. We have assessed a potential disadvantage of using self-administered Internet surveying, the lack of access to the Internet in certain groups of the population which may yield survey mode biases in SP parameter estimates.

We have shown that there is a significant survey-mode effect on a large share of attribute parameters, in three SP surveys focussing public transport attributes. The direction of change in estimated public transport attribute preferences, when applying self-administered Internet surveying instead of postal mail or CAPI, is not clear in our data.[5] What is indicated, though, is that weighting the Internet-based sample with respect to age and sex, to compensate for too low representativeness of these characteristics, will

[4] If we, alternatively, run split estimations with respect to survey mode, and then compare non-pooled parameters (betas), we find that there are no significant parameter differences in the "Tønsberg survey", comparing self-administered internet and CAPI. Differences remain in the comparison between self-administered internet and ordinary mail in the other two surveys. However, the cost (fare) parameters were significantly different in only one of three sequences in the "Oslo survey", and not in any sequences in the "Sweden survey". Reduced access time and reduced headway obtained significantly higher parameter values for those responding by internet, in the "Oslo survey". For the other public transport quality parameters, differing significantly with respect to survey mode (interchange and delay in the "Oslo survey", bus stop comfort, driver contact and real-time display / information in the Sweden survey), the estimated values were higher for those responding by postal mail.

[5] However, there might be a pattern of increased size/strength of time and headway parameters in the internet case, while comfort and information parameters are decreased.

decrease but not eliminate the survey mode effect on estimated parameters. When we included weighting with respect to non-employment, the survey-mode effect increased (even beyond the non-weighted case, in one of our studies). Other studies have found more characteristics differing between an Internet sample and a postal mail sample, e.g., civil status and health status [12]. Thus, in our cases there might be some unregistered differences in individual characteristics that drive our results to some extent.

There is stronger survey mode difference when comparing self-administered Internet versus postal mail than when comparing self-administered Internet versus CAPI. This is so, even if the latter comparison is similar in terms of registered individual characteristic differences between Internet and the alternative survey mode. Thus, more than just an issue of sampling and representativeness, it is the way of responding *per se* which drives part of the observed survey mode difference. CAPI, in contrast to the pen-and-paper format, resembled very closely the response situation in the self-administered Internet. The pen-and-paper formats were less customized, and it is just another response situation, ticking off choices on a paper questionnaire rather than clicking around on the screen. When comes to the quality of Internet-based data, as such, several authors indicate that it might be equal or even superior to data from mail questionnaires [17], [21].

In the three surveys we report, a small majority of the recruited chose self-administered Internet survey over postal (paper) survey and computer-based home interview, in contrast to findings from other studies enabling respondents to choose survey mode [22], [23]. Nonetheless, the possibility for improving response rates and reducing non-response and coverage errors are such that the use of mixed-mode surveys are likely to increase in the near future [1]. When comparing our results to those few reported from contingent valuation studies, indicating no significant value differences [9], [11], one must bear in mind that a choice-based SP generally provides more value estimates per respondents than contingent valuation. Thus, the differentiated attribute focus in choice-based SP, compared to the composite good focus in contingent valuation, may by itself increase the probability of observing survey-mode differences in choice-based SP. More studies are needed to assess the Internet effect for SP, both with respect to representativeness, data quality and impact on economic valuations using SP methods.

References

1. Dillman, D. A., Smyth, J. D. and L. M. Christian. *Internet, Mail, and Mixed-Mode Surveys: The Tailored Design Method (3rd ed.)*. Hoboken, NJ: John Wiley & Sons, Inc., 2008. 512 p.
2. Cobanoglu, C., Warde, B. and P. J. Moreo. A comparison of mail, fax, and web-based survey methods, *International Journal of Market Research*, Vol. 43, No 4, 2001, pp. 441–452.
3. Schonlau, M., Fricker, Jr. R. D. and M. N. Elliot. *Conducting Research Surveys via E-Mail and the Web*. Santa Monica, CA: Rand, 2002. 142 p.
4. Berrens, R. P., Jenkins-Smith, H., Silva, C. and D. L. Weimer. The advent of Internet surveys for political research: a comparison of telephone and Internet samples, *Political Analysis*, Vol. 11, 2003, pp. 1–22.
5. Johnson, R. M., Orme, B. K., Huber, J. and J. Pinnell. Testing adaptive choice-based conjoint designs. In: *Research Paper Series*. Sequim, WA: Sawtooth Software, Inc., 2005. 14 p.
6. Bradley, M. and A. Daly. Use of logit scaling approach to test for rank-order and fatigue effects in stated preference data, *Transportation*, Vol. 21, No 2, 1994, pp. 167–184.
7. Train, K. and W. W. Wilson. Estimation on stated-preference experiments constructed from revealed-preference choices, *Transportation Research Part B*, Vol. 42, No 3, 2008, pp. 191–203.
8. Bateman, I. J., Carson, R. T., Day, B., Hanemann, W. M., Hanley, N., Hett, T., Jones-Lee, M. W., Loomes, G., Mourato, S., Özdemerioglu, E., Pearce, D. W., Sugden, R. and J. Swanson. *Economic Valuation with Stated Preference Techniques: A Manual*. Cheltenham, UK: Edward Elgar, 2002. 480 p.
9. Lindhjem, H. and S. Navrud. Internet CV surveys – a cheap, fast way to get large samples of biased values? Ås, Norway: Department of Economics and Resource Management (IØR), Norwegian University of Life Sciences (UMB), April 2008. 58 p. Unpublished manuscript
10. Vaage, O. F. *Norsk mediebarometer 2007*. Oslo, Norway: Statistics Norway (SSB), Statistical Analyses 96, 2008. 92 p. (In Norwegian)
11. Olsen, S. B. Internet versus mail: are stated preferences affected by the mode of sampling a choice experiment? *Environmental and Resource Economics*, Vol. 44, No 4, 2009, pp. 591–610.
12. Bech, M. and M. B. Kristensen. Differential response rates in postal and web-based surveys among older respondents, *Survey Research Methods*, Vol. 3, No 1, 2009, pp. 1–6.

13. Kaplowitz, M. D., Hadlock, T. D. and R. Levine. A comparison of web and mail survey response rates, *Public Opinion Quarterly*, Vol. 68, No 1, 2004, pp. 94–101.
14. Marta-Pedroso, C., Freitas, H. and T. Domingos. Testing for the survey mode effect on contingent valuation data quality: a case study of web based versus in-person interviews, *Ecological Economics*, Vol. 62, 2007, pp. 388–398.
15. Stangeby, I. and Å. Nossum. *Trygg kollektivtransport: trafikanters opplevelse av kollektivreiser og tiltak for å øke tryggheten – Dokumentasjonsrapport*. Oslo, Norway: Institute of Transport Economics (TØI), TØI Report 704a/2004, 135 p. (In Norwegian)
16. Nossum, Å. *Kollektivtilbudet i Osloregionen. Trafikantenes verdsetting av tid.* Oslo, Norway: Institute of Transport Economics (TØI), TØI Report 633/2003, 31 p.
17. Sethuraman, R., Kerin, R. A. and W. L. Cron. A field study comparing online and offline data collection methods for identifying product attributes preferences using conjoint analysis, *Journal of Business Research*, Vol. 58, 2005, pp. 602–610.
18. Carmines, E. G. and R. A. Zeller. Reliability and Validity Assessment. In: *Sage University Paper series on Quantitative Applications in Social Sciences, series No 07–017.* Thousand Oaks, CA: Sage Publications Inc., 1979. 73 p.
19. Vibe, N., Kjørstad, K. N., Nossum, Å. and A. Ruud. *Kollektivalternativene i Tønsbergpakken: TØIs bidrag til konsekvensutredningen.* Oslo, Norway: Institute of Transport Economics (TØI), TØI Report 698/2004, 258 p. (In Norwegian)
20. Daly, A. J. *ALOGIT 3.2 Users Manual*. The Hague, Netherlands: Hague Consulting Group, 1992.
21. Ritter, P., Lorig, K., Lauren, D. and K. Matthews. Internet versus mailed questionnaires: a randomized comparison, *Journal of Medical Internet Research*, Vol. 6, No 3, 2004. e29.
22. Leece, P., Bhandari, M., Sprague, S., Swinomtkowski, M. F., Schemithsch, E. H., Tornetta, P., Devereaux, P. J. and G. H. Guyatt. Internet versus mailed questionnaires: a randomized comparison, *Journal of Medical Internet Research*, Vol. 6, No 3, 2004. e30.
23. Manfreda, K. L., Bosnjak, M., Berzelak, J., Haas, I. and V. Vehovar. Web surveys versus other survey modes: a meta-analysis comparing response rates, *International Journal of Market Research*, Vol. 50, No 1, 2008, pp. 79–104.

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