Rev Agric Food Environ Stud (2017) 98:201–220
https://doi.org/10.1007/s41130-017-0053-6

RESEARCH ARTICLE

Stated preferences: a unique database composed of 1657 recent published articles in journals related to agriculture, environment, or health

Pierre-Alexandre Mahieu[1] · **Henrik Andersson**[2] · **Olivier Beaumais**[3,4] · **Romain Crastes dit Sourd**[5] · **Stephane Hess**[5] · **François-Charles Wolff**[1,6]

Received: 12 May 2016 / Accepted: 11 October 2017 / Published online: 13 November 2017

Abstract Numerous articles dealing with stated preferences are published every year in journals related to agriculture, environment, or health. Hence, it is not easy to find all the relevant articles when performing a benefit transfer, a meta-analysis, or a review of literature. Also, it is not easy to identify trends or common practices in these fields regarding the elicitation method. We have constructed and made available a unique database comprising 1657 choice experiment and/or contingent valuation articles published in journals related to agriculture, environment, or health between 2004 and 2016. We show that the number of choice experiment studies keeps increasing and the single-bounded dichotomous choice format is the most employed question format in contingent valuation studies. We also consider the new nomenclature proposed by Carson and Louviere and we show that the "discrete choice experiment" is more popular than the "matching method," especially in journals related to agriculture.

Keywords Contingent valuation · Choice experiment · Matching method · Incentive compatibility · Meta-analysis · Benefit transfer · Review of literature

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s41130-017-0053-6) contains supplementary material, which is available to authorized users.

✉ Pierre-Alexandre Mahieu
mahieu-pa@univ-nantes.fr

[1] LEMNA, University of Nantes, Chemin de la Censive du Tertre - BP 52231, 44322 Nantes Cedex 3, France

[2] Toulouse School of Economics, University of Toulouse Capitole, Toulouse, France

[3] LISA, University of Corsica Pasquale Paoli, Corte, France

[4] University of Rouen Normandy, Rouen, France

[5] Institute for Transport Studies & Choice Modelling Centre, University of Leeds, Leeds, UK

[6] INED, Paris, France

JEL classification Q18 · Q51 · I10

Introduction

Resources are scarce and policy makers need guidance to secure an efficient resource allocation. A powerful tool to guide allocation is cost-benefit analysis (CBA) according to which the social benefits of policies or investments are compared with their costs. The use of CBA requires a common metric for the benefits and costs, and money acts as this common metric.

However, many non-market goods such as environmental effects and health improvements do not have easily available market prices. For those goods, non-market valuation techniques have to be used. These are usually broadly classified as either revealed (RP) or stated preference (SP) techniques. The former refers to techniques where decisions of individuals in actual markets are used to elicit their preferences for the good being considered. The latter refers to techniques where individuals are asked to state their preferences in hypothetical market situations.

In this review, we mainly focus on two SP techniques, namely, contingent valuation (CV) and choice experiment (CE), where the latter is more widely known as stated choice in fields such as transport research, or mistakenly as conjoint in others (cf. Louviere et al. 2010).[1] CV and CE are the two most well-known approaches in the SP field.[2] CV involves asking respondents for their willingness to pay (WTP) or willingness to accept for a clearly defined good in a direct way, either using an open-ended question such as "what is your maximum WTP?" or a referendum style question such as "would you be willing to pay €X?", where €X takes two different values for each individual if the double-bounded dichotomous choice format (as opposed to the single-bounded dichotomous choice format) is used. CE on the other hand provides the respondents with choice alternatives where the different goods or programs are defined by their attributes, the cost of the good/program being one of them. Information about the WTP of respondents is then derived from choices made, typically by formulating a model grounded in microeconomic theory to explain their choices.[3]

There is a long tradition to use CE in the fields of marketing and transportation. The first CE application is thought to have been conducted by Thurstone (1931) who asked respondents to make choices between coats, hats, and shoes. In transport research, where RP methods dominated until the 1980s, CE has now become the standard approach for many types of applications. This is illustrated, for example, in Abrantes and Wardman (2011). The use of CE in the fields of agriculture, environment, and health is much more recent[4] and it is not clear whether the popularity of CE in marketing and transportation have spread to these fields.

[1] It should of course be noted that these techniques are also very widely used outside a non-market valuation context, such as in many transport and marketing applications.

[2] CE belongs to the family of methods where respondents make a choice between different options, rather than indicating an explicit valuation (Hanley et al. 2001). Other examples include the contingent ranking, contingent rating and best-worst approaches.

[3] For a more comprehensive description of these techniques, see for instance Bateman et al. (2002).

[4] The first CE application in the field of environment was conducted in late 1980s according to Hess and Rose (2009).

In this contribution, we test if CE is becoming more popular than CV in the fields of agriculture, environment, and health. To do so, we employ descriptive and regression tools on a unique database which is composed of 1657 articles that were published between 2004 and 2016. We also consider the new nomenclature proposed by Carson and Louviere (2011) and compare the "discrete choice experiment" (DCE) and the "matching method" (MM). MM elicits WTP in a more direct way than DCE and includes the open-ended question, the bidding game, and payment card.[5] DCE includes CE, single-, and double-bounded dichotomous choice CV formats. Hence, the single-bounded dichotomous choice CV question is viewed as a special case of DCE (Carson and Czajkowski 2014). Finally, we compare the elicitation question in CV surveys. We find that the number of CE keeps increasing and DCE is more popular than MM. Also, the single-bounded format is generally more employed than the other question formats (e.g., double-bounded dichotomous choice format) in journals related to the environment. We make our data and STATA code available online.[6]

Another objective of this study is to complement the bibliography published by Carson (2012) which reports about 7500 references. That bibliography can be very helpful to find published articles, books, and other types of support (e.g., conference papers) written before 2008, but to identify more recent published articles (2008–2016), our database can be of help. However, we extend this objective by also focusing on the trends of non-market valuation techniques, something Carson (2012) did not examine, but which related to the early study by Adamowicz (2004). Hence, we combine the purposes of Carson (2012) and Adamowicz (2004) and the combination of providing an update with published articles and trends in non-market valuation techniques we believe is of interest to both experienced scholars/practitioners and those with limited background in the field. Starting with the latter group, the information provided may help them if they want to use the approach which is the most consensual in the literature and/or use the approach employed by leading authors in the field. Regarding the former group, i.e., those with experience from the field, they can benefit from the bibliography when conducting meta-analyses or when writing a review, or when conducting a benefit transfer.

The remainder of this article is organized as follows. Section 2 provides a brief review of past surveys dealing with non-market valuation. Section 3 describes the database. Section 4 provides some descriptive statistics. Section 5 presents regression results. Finally, a discussion and a conclusion are given in Section 6.

Review studies

Most of the past review studies in agriculture, environment, and health have focused on a given good, bias/anomaly, country, and/or journal. For instance, Lindhjem (2007) reviewed the literature on non-timber forest benefits in three countries (Norway,

[5] Carson and Louviere define the MM and DCE as follows (p. 545): "The first are matching methods (MM), where respondents effectively are asked to provide a number (or numbers) that will make them indifferent in some sense. The second are DCEs that effectively ask respondents to pick their most preferred alternative from a set of options."

[6] Both data and STATA code can be downloaded at the following address: "https://drive.google.com/drive/folders/0B6-aWRdEl74JbzRpbFR1Z2VGY2M?usp=sharing". They are also available in the journal website.

Sweden, and Finland). Laurans et al. (2013) collected studies related to ecosystems. Whitty et al. (2014) analyzed studies on public preferences for healthcare priority setting. Murphy et al. (2005) explored the determinants of hypothetical bias. Mahieu et al. (2015) surveyed valuation studies involving authors affiliated in French institutions. Smith (2000) explored whether the *Journal of Environmental Economics and Management* had an impact on the development and applications of the methods used to estimate economic values for non-marketed environmental resources. Banzhaf (2010) examined whether non-market valuation studies had any impact on land-use plans in the USA. de Bekker-Grob et al. (2012) provided a review of CE in the field of health economics (see also Clark et al. 2014). Lindhjem et al. (2011) focused on mortality risk reductions for environmental, transport, and health risk. Meyerhoff et al. (2014) investigated the sources of protest behavior. Harrison et al. (2014) identified CEs that incorporate a risk attribute. Crastes and Mahieu (2014) collected information on the time for publication acceptance based on articles published in three environmental journals. Özdemir and Johnson (2013) compared the degree of the consensus among active researchers in health and environmental valuation. Bennett and Birol (2010) edited a book which presents best-practice case studies implementing the CE method in developing countries.

To the best of our knowledge, only two studies have attempted to collect a very large number of SP studies involving environmental, agricultural, or health applications.[7] Carson (2012) tried to collect in a book all published articles, book chapters, conference papers, and government reports that were written up to 2007. In total, Carson provided a bibliography of 7500 references. Furthermore, Carson showed the overall trend in the production of CV literature between 1989 and 2007 by using the ISI web of knowledge. However, Carson did not indicate the method used in each of the 7500 studies (CV/CE; MM/DCE). Adamowicz (2004) provided a view of environmental valuation in general and SP methods especially with a special focus on both history and the future. He provided insights into environmental valuation research using a set of ISI articles that were published between 1975 and 2003. The author considered several valuation methods (including CV, CE, travel cost, and hedonic pricing) and found that the number of CE studies was "on the rise" while the number of CV rapidly increased after the occurrence of the Exxon Valdez Oil Spill in 1989.[8]

Construction of the data

We use ISI web of knowledge, like Adamowicz (2004) and Carson (2012), which covers many journals in the fields of agricultural, environmental, and health research. All journals referenced in ISI are classified into "research areas" ("agriculture," "environmental sciences & ecology," or "health care sciences & services"), which facilitates comparison between fields of research. In addition, it includes more journals than SCOPUS and the journals are generally of recognized academic quality, which is not always the case in other search tools.

[7] See also the post written by Whitehead (2011) in a blog: http://www.env-econ.net/2011/06/contingent-valuation-vs-choice-experiments-1989-2011.html.

[8] Alternative surveys of the literature can also be found in Sach et al. (2007), Bateman et al. (2002), and Alberini and Kahn (2009).

Within the ISI web of knowledge, we chose to consider papers published after 2003 for the following two reasons. First, most of the older SP papers have already been included in the various literature surveys mentioned before, e.g., Adamowicz (2004). Second, the use of CE in agriculture, environment, and health is relatively recent.

In July 2017, we used five criteria in the ISI search tool: (1) "topic" = "contingent valuation" or "choice experiment" or "choice modelling,"[9] (2) "document type" = "article," (3) "year published" = "2004–2016," (4) "ISI citation database" = "Science Citation Index" (SCI), "Social Science Citation Index" (SSCI), or "Arts & Humanities Citation Index" (AHCI), and (5) "research area" = "agriculture," "environmental sciences & ecology," or "health care sciences & services." In (1), we selected articles in which the expression "contingent valuation" and/or "choice experiment" and/or "choice modelling" appeared in the title/abstract/authors' keyword. We discarded the "keyword plus"[10] option because most of the automatically generated keywords were irrelevant.

We read the abstracts and removed articles that had nothing or little to do with SP, such as articles dealing with RP. CE applications with no cost attribute were also removed. When there was no reference to "willingness to pay" or "willingness to accept" in the abstract of the CE articles, we checked the manuscript and removed articles that did not include a cost attribute in the empirical application. In some articles, both "contingent valuation" and "choice experiment" expressions were mentioned in the abstract, title, and/or authors' keyword list, although the paper only dealt with one method. Conversely, only one of the two expressions appeared in some papers, although they dealt with both CE and CV approaches. These mismatches were accounted for in the variable constructions.

Also, we browsed all the CV papers and checked if the elicitation question corresponded to one of these five categories: single-bounded dichotomous choice (CV_sbdc), double-bounded dichotomous choice (CV_dbdc), payment card (CV_pc), bidding game (CV_bg), or open-ended (CV_oe) question. We considered another category ("CV_other") for elicitation questions that are neither DCE nor MM (e.g., multiple-bounded uncertainty choice and randomized card sorting). In some cases, the full paper could not be downloaded or the elicitation question was missing. Also, in some applications, a follow-up elicitation task was added to the main task (e.g., a follow-up open-ended question is added to a single-bounded dichotomous choice question). Only the main valuation task was considered.

Overall, our final sample comprises 1657 references, 3279 authors, 223 journals, and 91 country author affiliations. In Table 1, we present the list of the main variables that we have created. A few of them are related to the method. In our data set, 51.2% of the references deal with CV and 51.0% with CE. The total exceeds 100% because there are a few references characterized by the "mixed" dummy variable deal with both CV and CE. Most of them either compare CV and CE or combine them (Adamowicz et al. 2011; Bennett and Balcombe 2012; Bijlenga et al. 2011; Christie and Azevedo 2009; Hynes et al. 2011; Meyerhoff and Liebe 2008; Ryan and Watson 2009).[11] Among the CV articles, the proportion of articles using the single-bounded dichotomous choice, double-bounded dichotomous choice, open-ended, payment card, or bidding game is 33.3, 19.5, 21.7, 18.2, and 4.6%, respectively, which suggests that the single-bounded dichotomous choice format is

[9] We also tried "matching method" in ISI search tool. Out of the 65 results, only one article dealt with SP.
[10] The list of "keywords plus" is generated by ISI to broaden the search. KeyWords Plus reviews the titles of all references and includes keywords that were not listed by the authors.
[11] An interesting example of comparison is the split sample survey conducted by McNair et al. (2011). Participants were faced with a single binary choice set (CV) or several ones (CE).

Table 1 Main variables of the sample

Variables		Description	Mean	St. dev.	*N*
Method	CV	1 if the article is related to contingent valuation; 0 otherwise	0.51	0.50	1657
	CE	1 if the article is related to choice experiment; 0 otherwise	0.51	0.50	1657
	Mixed_CVCE	1 if the article is related to both "choice experiment" and "contingent valuation"; 0 otherwise	0.02	0.15	1657
	MM	1 if the article is related to matching method; 0 otherwise	0.21	0.41	1538
	DCE	1 if the article is related to discrete choice experiment; 0 otherwise	0.81	0.39	1538
	Mixed_MMCE	1 if the article is related to both discrete choice experiment and matching method; 0 otherwise	0.02	0.13	1538
	CV_sbdc	1 if the CV article is related to the single-bounded dichotomous choice; 0 otherwise	0.33	0.47	747
	CV_dbdc	1 if the CV article is related to the double-bounded dichotomous choice; 0 otherwise	0.20	0.40	747
	CV_oe	1 if the CV article is related to the open-ended question; 0 otherwise	0.22	0.41	747
	CV_pc	1 if the CV article is related to the payment card; 0 otherwise	0.18	0.39	747
	CV_bg	1 if the CV article is related to the bidding game; 0 otherwise	0.05	0.21	747
	CV_other	1 if the CV article does not use the single-bounded dichotomous choice, double-bounded dichotomous choice, open-ended question, bidding game, or payment card format; 0 otherwise	0.08	0.28	747
Year of publication	2004	1 if the article is published in 2004; 0 otherwise	0.04	0.20	1657
	2005	1 if the article is published in 2005; 0 otherwise	0.05	0.21	1657
	2006	1 if the article is published in 2006; 0 otherwise	0.05	0.22	1657
	2007	1 if the article is published in 2007; 0 otherwise	0.06	0.24	1657
	2008	1 if the article is published in 2008; 0 otherwise	0.07	0.25	1657
	2009	1 if the article is published in 2009; 0 otherwise	0.09	0.29	1657
	2010	1 if the article is published in 2010; 0 otherwise	0.07	0.26	1657
	2011	1 if the article is published in 2011; 0 otherwise	0.08	0.28	1657
	2012	1 if the article is published in 2012; 0 otherwise	0.08	0.28	1657
	2013	1 if the article is published in 2013; 0 otherwise	0.09	0.28	1657
	2014	1 if the article is published in 2014; 0 otherwise	0.09	0.29	1657
	2015	1 if the article is published in 2015; 0 otherwise	0.09	0.29	1657
	2016	1 if the article is published in 2016; 0 otherwise	0.13	0.34	1657
Research area	Agriculture	1 if the ISI "research areas" include "agriculture"; 0 otherwise	0.20	0.40	1657
	Environment	1 if the ISI "research areas" include "environmental sciences & ecology"; 0 otherwise	0.64	0.48	1657
	Health	1 if the ISI "research areas" include "health care sciences & services"; 0 otherwise	0.16	0.37	1657
Economics		1 if the journal belongs to the ISI "category" "economics"; 0 otherwise	0.50	0.50	1657

Table 1 (continued)

Variables		Description	Mean	St. dev.	*N*
Country of authors	Australia	1 if "Australia" appears in the affiliation address of at least one author; 0 otherwise	0.08	0.28	1657
	Canada	1 if "Canada" appears in the affiliation address of at least one author; 0 otherwise	0.04	0.2	1657
	France	1 if "France" appears in the affiliation address of at least one author; 0 otherwise	0.03	0.17	1657
	Germany	1 if "Germany" appears in the affiliation address of at least one author; 0 otherwise	0.06	0.23	1657
	Netherlands	1 if "Netherlands" appears in the affiliation address of at least one author; 0 otherwise	0.05	0.22	1657
	Spain	1 if "Spain" appears in the affiliation address of at least one author; 0 otherwise	0.10	0.29	1657
	Sweden	1 if "Sweden" appears in the affiliation address of at least one author; 0 otherwise	0.04	0.19	1657
	USA	1 if "USA" appears in the affiliation address of at least one author; 0 otherwise	0.22	0.42	1657
	UK	1 if "UK," "England," "Scotland," or "Northern Ireland" appears in the affiliation address of at least one author; 0 otherwise	0.18	0.39	1657

The database contains 1657 articles. When an author has several affiliations, the one that appears first in ISI web of knowledge is considered

the most employed format in contingent valuation studies. Regarding the new nomenclature proposed by Carson and Louviere (2011), 20.9% of our references deal with MM and 80.7% of the references deal with DCE. Again, the total exceeds 100% because a few references deal with both MM and DCE.

Another set of variables is related to the journals. Our database includes 56 agricultural journals, 130 environmental journals, and 37 health journals. Environmental journals with a special focus on economics ("economics" = 1) include *Ecological Economics*, *Environmental and Resource Economics*, *Journal of Environmental Economics and Management*, *Land Economics*, and *Resource and Energy Economics*, while the other environmental journals ("economics" = 0) include *Energy Policy*, *Global Environmental Change*, *Journal of Environmental Management*, *Journal of Environmental Planning and Management*, *Regional Environmental Change*, *Science of the Total Environment*, and *Water Resources Research*. In total, 19.9, 64.2, and 16.1% of the articles are published in journals related to agriculture, environment, and health, respectively. Some variables relate to authors' academic affiliations; 22.4 and 18.10% of the articles were co-written by someone either working in the USA or the UK, respectively.

Trends in CV/CE and MM/DCE use

In Fig. 1, we report the total number of CV and CE studies published in agricultural, environmental, and health journals between 2004 and 2016. We observe very different

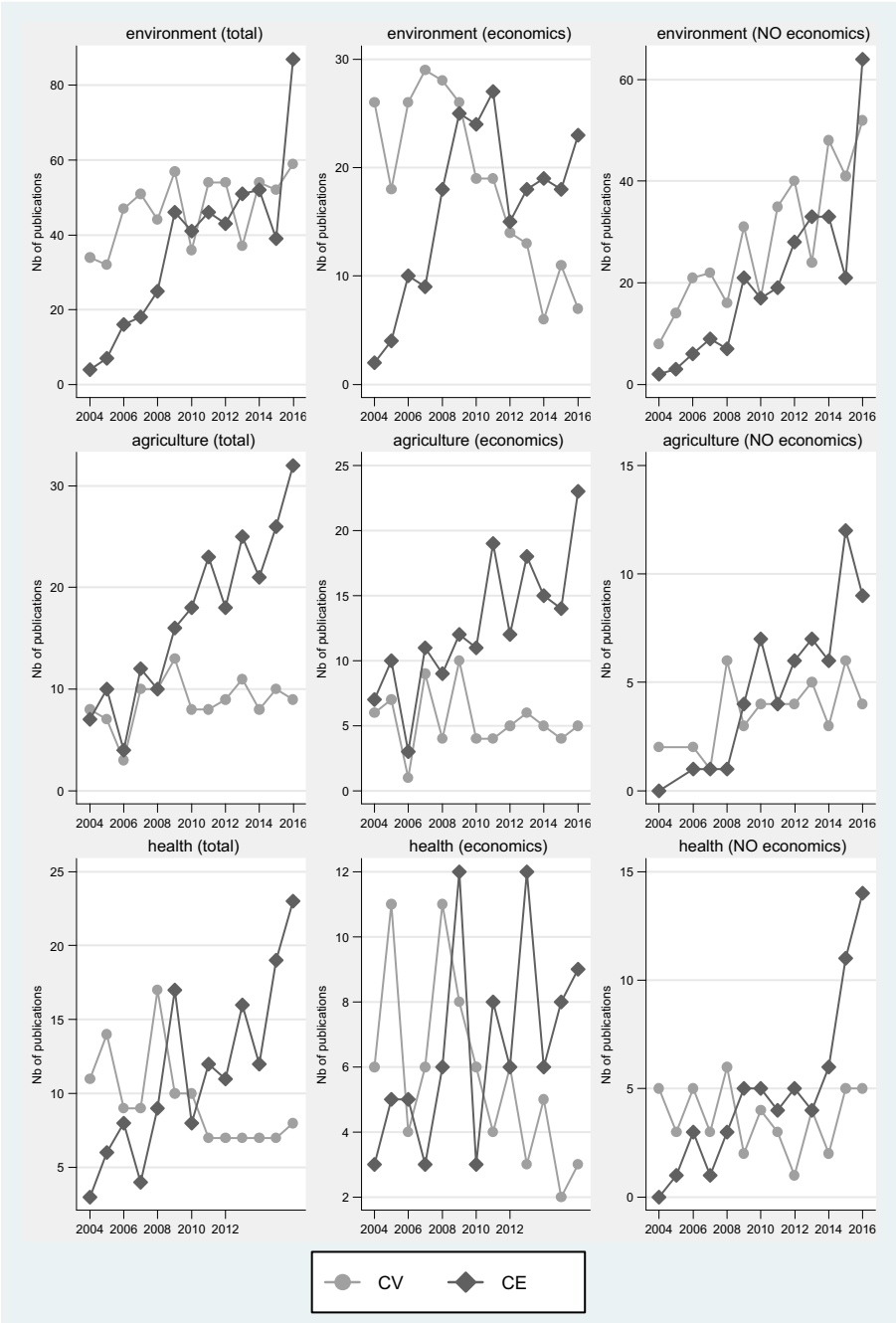

Fig. 1 Number of published CV and CE articles. Note: CV contingent valuation, CE choice experiments

trends for the use of CE and CV. While the number of CV references remains rather flat throughout the period, the number of CE references has increased over the last 13 years.

Furthermore, we observe some differences between economic and non-economic journals. In economic journals related to environment, the number of CV applications has decreased although it has increased in non-economic journals.

The total number of MM and DCE studies published in agricultural, environmental, and health journals between 2004 and 2016 is reported in Fig. 2. We observe similar trends for the three research areas (agriculture, environment, and health): the number of matching articles is relatively stable while the number of DCE articles is rapidly increasing. The proportion of studies using MM is 0.09, 0.24, and 0.24 in journals dealing with agriculture, environment, and health, respectively. A t test proportion comparison indicates that the difference between agriculture and environment (p value = 0.000) is statistically significant at the 5% level, which is also the case between agriculture and health (p value = 0.000). These results hold when restricting our sample to economic or non-economic journals (p value = 0.000 in both cases). Table 4 in the Appendix reports the journals having published the most SP articles. Agricultural journals are clearly DCE oriented.

In Fig. 3, we display the proportion of articles that report a CE study or a CV study that uses the single-bounded dichotomous choice, the double-bounded dichotomous choice, the open-ended question, and the payment card. Bidding game studies are excluded due to the low number of observations. In economic journals related to the environment, the double-bounded dichotomous choice is less employed than the single-bounded dichotomous choice. The null hypothesis of equal proportion between the use of single-bounded dichotomous choice (0.19) and double-bounded dichotomous choice (0.09) is rejected at 5% with a t test (p value = 0.000). Likewise, the same results are observed for economic journals; the null hypothesis is rejected at the 5% level (p value = 0.000).

Econometric analysis

In this section, we perform an econometric analysis to explain the CV versus CE choice. Then, we perform the same analysis for the DCE versus MM choice.

CV versus CE

Our dependent variable is equal to one when an article deals with CE and zero when it deals with CV.[12] For ease of interpretation, we present in Table 2 both the coefficients and marginal effects from Probit models estimated on all types of articles. The selected covariates include year of survey, type of journal, and country-specific dummies for authors.

In a first specification (1), we estimate the Probit regression at the article level. At the sample means, the predicted probability of an article to use CE is equal to 51.19%. This probability has strongly increased over the period under consideration. Compared to 2004, the probability of a CE study was 17.8% higher in 2007, 34.0% in 2009, 40.0% in 2011, and 49.0% in 2016. Our results show substantial differences by type of journals. Compared to papers published in environmental

[12] Mixed articles were removed.

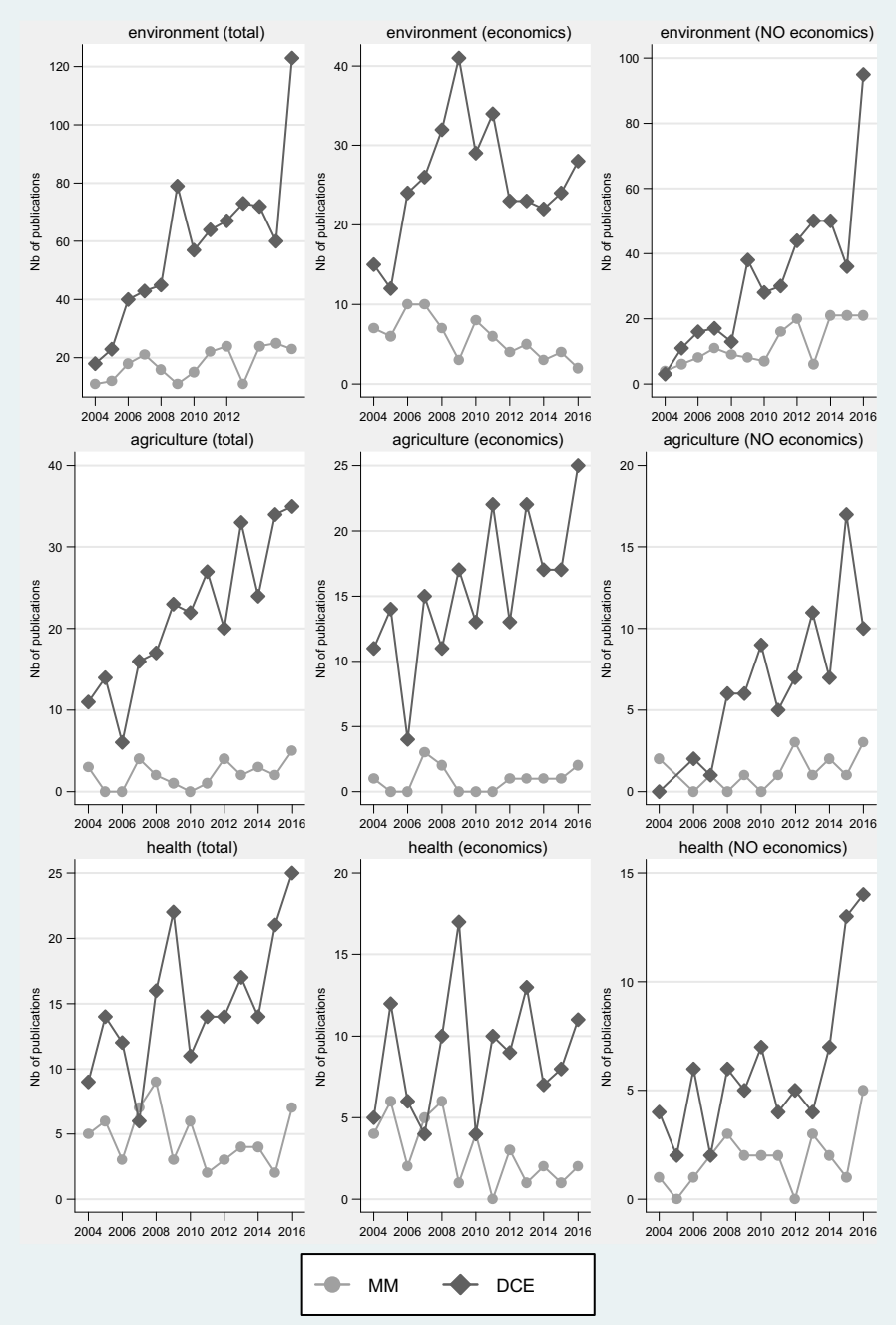

Fig. 2 Number of published MM and CE articles. Note: MM matching method, DCE discrete choice experiment

journals, papers published in agriculture or health are more likely to use the CE method (+ 21.9 and + 9.1%, respectively). Also, articles published in economic

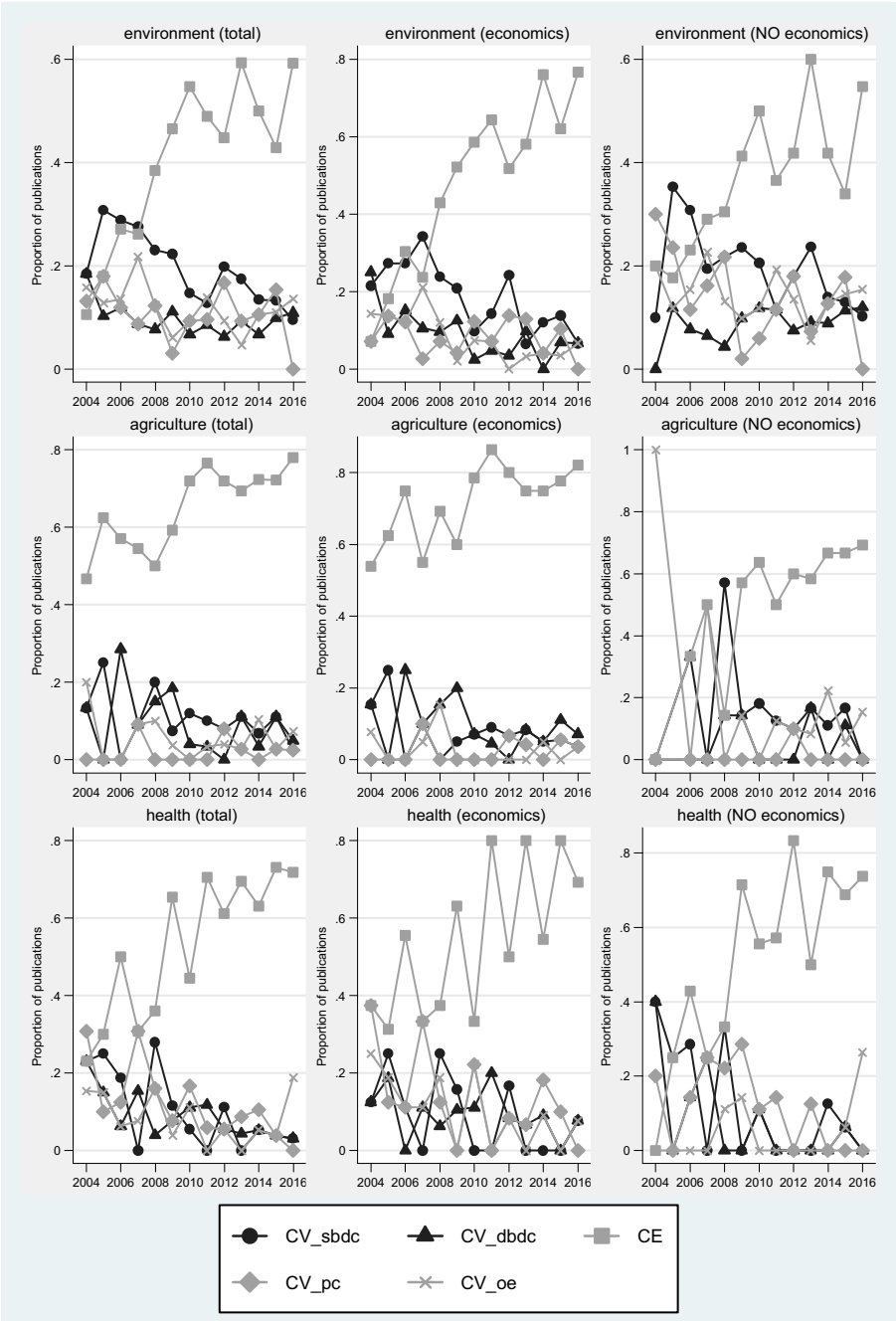

Fig. 3 Proportion of published articles containing a given valuation tasks. Note: CV contingent valuation, CE choice experiments, sbdc single-bounded dichotomous choice, dbdc double-bounded dichotomous choice, pc payment card, oe open-ended

Table 2 Probit estimates explaining the CE choice

Variables		(1) Article level			(2) Author level		
		Coefficient	*t* value	Marginal effect	Coefficient	*t* value	Marginal effect
Constant		− 1.503***	− 7.38		− 1.674***	− 7.73	
Year of publication	2004	Ref.			Ref.		
	2005	0.304	1.23	0.120	0.399	1.55	0.154
	2006	0.479**	1.96	0.185**	0.746***	2.86	0.270***
	2007	0.458**	2.00	0.178**	0.751***	3.04	0.273***
	2008	0.627***	2.77	0.238***	0.798***	3.24	0.287***
	2009	0.947***	4.39	0.340***	1.206***	5.19	0.395***
	2010	1.181***	5.31	0.398***	1.291***	5.35	0.409***
	2011	1.181***	5.36	0.400***	1.340***	5.72	0.422***
	2012	1.090***	4.97	0.378***	1.277***	5.42	0.413***
	2013	1.317***	6.03	0.432***	1.499***	6.31	0.455***
	2014	1.250***	5.72	0.418***	1.524***	6.55	0.464***
	2015	1.258***	5.71	0.421***	1.567***	6.72	0.473***
	2016	1.531***	7.23	0.490***	1.802***	7.94	0.529***
Type of journal	Environment	Ref.			Ref.		
	Health	0.230**	2.44	0.091**	0.235**	2.25	0.093**
	Agriculture	0.563***	6.36	0.219***	0.493***	5.19	0.191***
Economics		0.286***	4.03	0.114***	0.383***	4.92	0.152***
Country of authors	USA	Ref			Ref		
	Australia	0.700***	5.23	0.263***	0.868***	5.37	0.307***
	Canada	0.472***	2.64	0.182***	0.680***	3.32	0.249***
	France	− 0.273	− 1.38	− 0.108	− 0.220	− 0.98	− 0.087
	Germany	0.116	0.78	0.046	0.247	1.34	0.097
	Netherlands	0.158	1.03	0.063	0.365**	2.10	0.141**
	Spain	0.009	0.08	0.004	− 0.067	− 0.48	− 0.027
	Sweden	0.236	1.36	0.093	0.318	1.43	0.124
	UK	0.462***	4.77	0.181***	0.603***	5.30	0.228***
	Other	0.037	0.40	0.015	− 0.071	− 0.79	− 0.028
Number of observations		1619			5314		
Predicted probability of CE (at sample means)		0.5119			0.5207		
Pseudo R^2		0.1100			0.1255		

Estimates from Probit models, with standard errors clustered at the author level in model (2). The sample is restricted to published papers having chosen either CE or CV, but not both. Significance levels are respectively 1% (***), 5% (**), and 10% (*). When an author has several affiliations, the one that appears first in ISI web of knowledge is considered

journals are more likely to contain CE than those published in non-economic journals (+ 11.4%).

Interestingly, our results also show substantial differences by affiliation country of authors. In particular, CE studies are more frequently published by authors from

Australia (+ 26.3%), Canada (+ 18.2%), and the UK (+ 18.1%) than in the USA—similar trends exist in other fields and can be traced to the fact that especially Australian and UK academics have been leading the research on development of new CE design techniques.

In a second specification (2), we estimate the same Probit regression on a sample in which each author of a given article is counted as one observation.[13] Since variables like year of publication and type of journal are the same for a given article, we cluster the standard errors at the article level. Overall, we reach similar conclusions with an excess of CE publications over the more recent years and in journals related to agriculture and health. Concerning affiliation country, CE studies are more frequently published by researchers from Australia, Canada, Netherlands, Sweden, and the UK.

DCE versus MM

In Table 3, we perform the same regression analysis for DCE versus MM. Again, we estimate the Probit regression at the article level (1) and at the author level (2). The predicted probability of an article to use CE is approximately equal to 82% in (1) and (2). In both specifications, the probability of a CE study is higher in 2006, 2009, 2010, 2011, 2012, 2013, 2014, 2015, and 2016 compared to 2004.

Compared to papers published in environmental journals, papers published in agriculture are more likely to use the CE method (+ 11% in (1) and (2)). Articles published in economic journals are more likely to contain CE than those published in non-economic journals (+ 9% in (1) and (2)). Finally, DCE studies are less frequently published by researchers from the UK, France, and Germany according to both specifications.

Discussion and concluding comments

Our main result from a review of the literature of SP studies published over 13 years is that CE is becoming more popular than CV, which is consistent with the prediction made about 13 years ago by Adamowicz (2004).

A combination of several factors may explain the increasing popularity of CE in agriculture, environment, and health:

(a) Leading researchers in transportation or marketing have made many methodological contributions over the last decades in CE, including the generalized multinomial Logit model (Fiebig et al. 2010), individual modelling approaches (Louviere et al. 2008), discrete choice model in WTP space (Train and Weeks 2005), or the experimental designs for mixed Logit models (Bliemer and Rose 2010), which have been used by researchers in other fields. These leading researchers have collaborated with researchers from other fields and published articles in agricultural, environmental, and health journals (Hess and Giergiczny 2015; Scarpa and Rose 2008). They have also edited manuals describing state-of-the-art practices or econometric procedures (Hensher et al. 2005; Hess and Daly 2014; Louviere et al.

[13] An article written by four coauthors will contribute four observations to the new sample.

Table 3 Probit estimates explaining the DCE choice

Variables		(1) Article level			(2) Author level		
		Coefficient	*t* value	Marginal effect	Coefficient	*t* value	Marginal effect
Constant		0.205	1.02		0.371*	1.67	
Year of publication	2004	Ref.			Ref.		
	2005	0.315	1.22	0.071	0.180	0.63	0.043
	2006	0.496**	1.97	0.102**	0.527**	1.97	0.107**
	2007	0.084	0.37	0.021	0.099	0.39	0.025
	2008	0.289	1.26	0.066	0.350	1.37	0.078
	2009	0.923***	3.93	0.161***	1.003***	3.87	0.167***
	2010	0.584**	2.50	0.117**	0.519**	2.00	0.107**
	2011	0.536**	2.36	0.111**	0.452*	1.85	0.097*
	2012	0.500**	2.22	0.105**	0.485*	1.95	0.103*
	2013	0.889***	3.75	0.157***	0.923***	3.54	0.161***
	2014	0.550**	2.43	0.113**	0.696***	2.83	0.135***
	2015	0.591***	2.59	0.120***	0.704***	2.82	0.137***
	2016	0.722***	3.35	0.144***	0.749***	3.13	0.149***
Type of journal	Environment	Ref			Ref		
	Health	− 0.058	− 0.54	− 0.015	− 0.016	− 0.13	− 0.004
	Agriculture	0.516***	4.42	0.115***	0.532***	4.22	0.117***
Economics		0.362***	4.32	0.094***	0.357***	3.93	0.092***
Country of authors	USA	Ref			Ref		
	Australia	0.174	1.09	0.042	0.079	0.45	0.020
	Canada	0.381	1.63	0.083	0.245	0.93	0.057
	France	− 0.532**	− 2.48	− 0.168**	− 0.833***	− 3.37	− 0.283***
	Germany	− 0.292*	− 1.72	− 0.085*	− 0.493**	− 2.50	− 0.153**
	Netherlands	0.012	0.07	0.003	− 0.284	− 1.35	− 0.082
	Spain	− 0.145	− 1.03	− 0.040	− 0.579***	− 3.48	− 0.183***
	Sweden	− 0.069	− 0.31	− 0.019	− 0.424	− 1.61	− 0.130
	UK	− 0.287***	− 2.65	− 0.081***	− 0.445***	− 3.33	− 0.132***
	Other	− 0.133	− 1.22	− 0.035	− 0.426***	− 3.95	− 0.115***
Number of observations		1512			4981		
Predicted probability of CE (at sample means)		0.8230			0.8232		
Pseudo R^2		0.0709			0.0822		

Estimates from Probit models, with standard errors clustered at the author level in model (2). The sample is restricted to published papers having chosen either DCE or MM, but not both. Significance levels are respectively 1% (***), 5% (**), and 10% (*). When an author has several affiliations, the one that appears first in ISI web of knowledge is considered

2000) which have been used by many practitioners in agricultural, environmental, and health economics to design questionnaires and estimate welfare estimates. They have launched a series of conferences ("International Choice Modelling Conference") and a journal (*Journal of Choice Modelling*).

(b) Implementation of CE has been facilitated by the development or creation of statistical software. For instance, the NGENE software has been created to help with the experimental design while econometric software such as STATA or NLOGIT have developed routines for choice models (Hole 2007), and numerous other choice modelling packages are now available, including free ones. Also, web-based surveys, which allow presenting the choice set in a friendly manner, are becoming less costly to implement and the number of people connected to the internet keeps increasing, which limits biased sampling.

(c) Some journals may have played a key role in improving and diffusing CE in the field of agriculture, environment, or health as shown in Appendix (see Table 4) which reports the journals having published the most CV and CE articles. As an illustration, the journal *Environmental and Resource Economics* (*ERE*) has published a significant number of CE methodological articles over the last years. Examples of topics addressed in *ERE* include attribute non-attendance (Carlsson et al. 2010), scale and/or preference heterogeneity (Hensher et al. 2011), and protest answers (Meyerhoff and Liebe 2008).

(d) Many issues have been worked out so that with CV, practitioners can apply it to policy problems. In contrast, CE questions provide another opportunity to test issues that have arisen during development of the CV and raise a number of new issues. Researchers anxious to publish in a peer-reviewed journal are finding more opportunities with the CE.

(e) Computing power has increased. Complex models (e.g., generalized mixed Logit models) estimated with large samples of panel data can be estimated very quickly.

(f) Prominent researchers were hired by Exxon and BP after oil spills to criticize CV as part of the court process. CE can be perceived as a safer route by researchers to publish their research.

A second result is that MM is less popular in agricultural journals than in environmental journals. One possible explanation is that a sizeable part of the SP applications in agricultural journals deal with food (33.43% of the articles published in a journal dealing with agriculture contain the word "food" in the title/abstract/authors' keyword). Researchers/practitioners may prefer DCE to MM because it better mimics real market decisions.

A third result is that the proportion of CE and DCE is higher in economic journals than in non-economic journals. A possible explanation is that articles published in non-economic journals are more policy oriented than articles published in economic journals. To investigate whether this is the case, we can check the proportion of articles reporting the words "policy" in the title/abstract/authors' keyword. In total, 29.8% of the articles published in non-economic journals report the expression "policy" while only 19.5% of the articles published in an economic journal report this expression ($p = 0.000$).

A fourth result is that "incentive compatibility" has received a great attention in the recent literature. In our database, the article published by Carson and Groves (2007) in *Environmental and Resource Economics* has been widely quoted (999 citations were reached in Google Scholar in September 2017). Among other things, it could explain/contribute to why articles in environmental journals are more likely to contain a single-bounded dichotomous choice application than a double-bounded dichotomous choice

application. Indeed, a double-bounded dichotomous choice application cannot truthfully reveal WTP according to Carson and Groves (2007).

Furthermore, regarding incentive compatibility, no variable was created to define the type of good to be valued (public, quasi-public good, or private good). For public good incentive-compatible response formats, like the single-bounded format (Johnston et al. 2017), and the trend of CE becoming more popular than CV is interesting and puzzling. Moreover, surveys involving private goods raise issues regarding incentive compatibility (Carson and Groves 2007), since respondents know that they have the chance to influence the provision of the good without having to actually buy it if it is provided. Hence, unless they also anticipate that the price may be influenced by a "yes answer," they have incentives to exaggerate their WTP for the private good (Carson and Groves 2007, pp. 188–189).

The fifth and final result to discuss is the country effect. We find some strong country effects regarding the choice of elicitation technique. This could be considered troubling, if we assume that elicitation format and technique should be based on which format and technique that best suit the choice situation, and not which technique that is popular in a specific country/region. That is, when controlling for both potential time trends and type of area (here reflected by type of journal), we would expect not to find any country effects. A caveat regarding our discussion on country differences is that we cannot control for all underlying heterogeneity in our data. Hence, the country findings may also capture other effects that we cannot control for.

It is worth noting that our database does not include all the existing journals in the fields of environment, agriculture, and health and that all the articles dealing with CV or CE may not include "contingent valuation" or "choice experiment" in the abstract/keywords and/or title, which may imply missing observations. However, we checked the full list of the journals and found that our database contains all the major journals in the fields of agriculture, environment, and health. Also, we checked if some CV and CE articles did not contain the expression CV or CE in the abstract/title or keyword list but we found very few observations. It is also worth noting that some articles may be published in a journal with a specific topic (e.g., environment), although the article deals with another topic (e.g., health). Again, we analyzed a set of observations in our database and found that the good under consideration was related to the topic of the journal in the vast majority of the cases. Also, our database does not include books. Recent books that contain SP applications include Bennett and Birol (2010), Hess and Daly (2014), Ryan et al. (2007), Bennett (2011), and Birol and Koundouri (2008). Finally, special cases of DCE were excluded from our database (e.g., our database does not contain studies using ranking or best-worst tasks). Likewise, special cases of MM were not included (e.g., asking participants to state the quantity of good—rather the quantity of money—that leaves them indifferent between two situations).

An open question is whether a variant of CE called the best-worst choice experiment will become more popular than CE in the future. In this approach, which was introduced by Louviere et al. (2008), people are faced with several goods/programs and are asked to indicate the good/program they prefer the most and the one they prefer the least. The same exercise is then performed with the remaining programs/goods. Interestingly, the best-worst choice experiment provides more information on preferences than CE, which can be helpful to reduce the sample size, increase the efficiency of the choice models, or estimate individual level models.

Appendix

Table 4 Ranking of the 15 journals publishing the most in the fields of agriculture, environment, and health

Journal name	Journal belonging to the ISI category "economics"	Number of SP articles	CV ration	MM ration
Agriculture				
Journal of Agricultural Economics	Yes	37	0.33	0.06
Food Policy	Yes	33	0.32	0.03
Australian Journal of Agricultural and Resource Economics	Yes	32	0.45	0.04
American Journal of Agricultural Economics	Yes	30	0.33	0.00
European Review of Agricultural Economics	Yes	19	0.18	0.06
Journal of Agricultural and Resource Economics	Yes	19	0.82	0.06
Agricultural Economics	Yes	17	0.31	0.14
Canadian Journal of Agricultural Economics	Yes	16	0.23	0.06
International Food and Agribusiness Management Review	Yes	15	0.07	0.00
Spanish Journal of Agricultural Research	No	9	2.00	0.40
Environment				
Ecological Economics	Yes	210	1.01	0.27
Environmental and Resource Economics	Yes	114	1.35	0.26
Journal of Environmental Management	No	63	1.17	0.23
Energy Policy	No	57	0.97	0.20
Land Economics	Yes	40	0.86	0.14
Journal of Environmental Planning and Management	No	39	1.60	0.35
Journal of Environmental Economics and Management	Yes	30	1.54	0.13
Resource and Energy Economics	Yes	26	1.45	0.13
Land Use Policy	No	26	0.86	0.09
Sustainability	No	23	2.83	0.40
Health				
Health Economics	Yes	58	1.95	0.62
Value in Health	Yes	39	0.43	0.12
Health Policy	No	23	1.88	0.44
Journal of Health Economics	Yes	20	0.54	0.25
Pharmacoeconomics	Yes	20	0.31	0.18
BMC Health Services Research	No	14	1.33	0.63
European Journal of Health Economics	Yes	14	1.00	0.30
Patient-Patient Centered Outcomes Research	No	13	0.08	0.00
Health Policy and Planning	No	9	1.25	0.50
Medical Decision Making	No	6	0.50	0.00

The database contains 223 journals. CV ration is the number of CV (contingent valuation) divided by the number of CE (choice experiments). MM ration is the number of MM (matching method) divided by the number of DCE (discrete choice experiment)

Acknowledgements We would like to thank two anonymous reviewers and the editors for constructive comments. We are also grateful to an anonymous referee from FAERE on a previous version of the paper. Finally, we would like to thank Jordan Louviere, Gildas Appéré and Muriel Travers for helpful comments.

Funding information We acknowledge financial support by the European Research Council through the consolidator grant 615596-DECISIONS.

References

Abrantes, P. A., & Wardman, M. R. (2011). Meta-analysis of UK values of travel time: an update. *Transport Res A-Pol, 45*, 1–17.

Adamowicz, W. (2004). What's it worth? An examination of historical trends and future directions in environmental valuation. *Australian Journal Agricultural Economics, 48*, 419–443. https://doi.org/10.1111/j.1467-8489.2004.00258.x.

Adamowicz, W., Dupont, D., Krupnick, A., & Zhang, J. (2011). Valuation of cancer and microbial disease risk reductions in municipal drinking water: an analysis of risk context using multiple valuation methods. *Journal of Environmental Economics and Management, 61*, 213–226.

Alberini A, Kahn JR (2009) Handbook on contingent valuation. Edward Elgar Publishing,

Banzhaf, H. S. (2010). Economics at the fringe: non-market valuation studies and their role in land use plans in the United States. *Journal of Environmental Management, 91*, 592–602.

Bateman, I., et al. (2002). *Economic valuation with stated preference techniques: a manual*. Cheltenham: Edward Elgar.

Bennett, J. (2011). *The international handbook on non-market environmental valuation*. Cheltenham: Edward Elgar Publishing.

Bennett, J., & Birol, E. (2010). *Choice experiments in developing countries: implementation, challenges and policy implications*. Cheltenham: Edward Elgar Publishing.

Bennett, R., & Balcombe, K. (2012). Farmers' willingness to pay for a tuberculosis cattle vaccine. *J Agr Econ, 63*, 408–424.

Bijlenga, D., Bonsel, G. J., & Birnie, E. (2011). Eliciting willingness to pay in obstetrics: comparing a direct and an indirect valuation method for complex health outcomes. *Health Economics, 20*, 1392–1406.

Birol, E., & Koundouri, P. (2008). *Choice experiments informing environmental policy: a European perspective*. Cheltenham: Edward Elgar Publishing.

Bliemer, M. C., & Rose, J. M. (2010). Construction of experimental designs for mixed logit models allowing for correlation across choice observations. *Transport Res B-Meth, 44*, 720–734.

Carlsson, F., Kataria, M., & Lampi, E. (2010). Dealing with ignored attributes in choice experiments on valuation of Sweden's environmental quality objectives. *Environmental and Resource Economics, 47*, 65–89.

Carson, R. (2012). *Contingent valuation: a comprehensive bibliography and history*. Cheltenham: Edward Elgar Publishing.

Carson, R., & Czajkowski, M. (2014). The discrete choice experiment approach to environmental contingent valuation. In S. Hess & A. Daly (Eds.), *Handbook of choice modelling*. Cheltenham: Edward Elgar Publishing.

Carson, R. T., & Groves, T. (2007). Incentive and informational properties of preference questions. *Environmental and Resource Economics, 37*, 181–210.

Carson, R. T., & Louviere, J. L. (2011). A common nomenclature for stated preference elicitation approaches. *Environmental and Resource Economics, 79*, 539–559.

Christie, M., & Azevedo, C. D. (2009). Testing the consistency between standard contingent valuation, repeated contingent valuation and choice experiments. *Journal Agricultural Economics, 60*, 154–170.

Clark, M. D., Determann, D., Petrou, S., Moro, D., & de Bekker-Grob, E. W. (2014). Discrete choice experiments in health economics: a review of the literature. *PharmacoEconomics, 32*, 883–902.

Crastes, R., & Mahieu, P.-A. (2014). Contingent valuation versus choice experiments: a meta-analysis application exploring the determinants of the time for publication acceptance. *Economic Bulletin, 34*, 1575–1599.

de Bekker-Grob, E. W., Ryan, M., & Gerard, K. (2012). Discrete choice experiments in health economics: a review of the literature. *Health Economics, 21*, 145–172.

Fiebig, D. G., Keane, M. P., Louviere, J., & Wasi, N. (2010). The generalized multinomial logit model: accounting for scale and coefficient heterogeneity. *Market Science, 29*, 393–421.

Hanley, N., Mourato, S., & Wright, R. E. (2001). Choice modelling approaches: a superior alternative for environmental valuation? *Journal of Economic Surveys, 15*, 435–462.

Harrison, M., Rigby, D., Vass, C., Flynn, T., Louviere, J., & Payne, K. (2014). Risk as an attribute in discrete choice experiments: a systematic review of the literature. *Patient, 7*, 151–170.

Hensher, D., Beck, M., & Rose, J. (2011). Accounting for preference and scale heterogeneity in establishing whether it matters who is interviewed to reveal household automobile purchase preferences. *Environmental and Resource Economics, 49*, 1–22.

Hensher, D. A., Rose, J. M., & Greene, W. H. (2005). *Applied choice analysis: a primer*. New York: Cambridge University Press.

Hess, S., & Daly, A. (2014). *Handbook of choice modelling*. Cheltenham: Edward Elgar.

Hess, S., & Giergiczny, M. (2015). Intra-respondent heterogeneity in a stated choice survey on wetland conservation in Belarus: first steps towards creating a link with uncertainty in contingent valuation. *Environmental and Resource Economics, 60*, 327–347.

Hess, S., & Rose, J. M. (2009). Should reference alternatives in pivot design SC surveys be treated differently? *Environmental and Resource Economics, 42*, 297–317.

Hole, A. R. (2007) Estimating mixed logit models using maximum simulated likelihood. *Stata Journal, 7*, 388–401.

Hynes, S., Campbell, D., & Howley, P. (2011). A holistic vs. an attribute-based approach to agri-environmental policy valuation: do welfare estimates differ? *Journal Agricultural Economics, 62*, 305–329.

Johnston, R. J., et al. (2017). Contemporary guidance for stated preference studies. *Journal of the Association of Environmental and Resource Economists, 4*, 319–405.

Laurans, Y., Rankovic, A., Billé, R., Pirard, R., & Mermet, L. (2013). Use of ecosystem services economic valuation for decision making: questioning a literature blindspot. *Journal Environmental Management, 119*, 208–219.

Lindhjem, H. (2007). 20 years of stated preference valuation of non-timber benefits from Fennoscandian forests: a meta-analysis. *Journal Forest Economics, 12*, 251–277.

Lindhjem, H., Navrud, S., Braathen, N. A., & Biausque, V. (2011). Valuing mortality risk reductions from environmental, transport, and health policies: a global meta-analysis of stated preference studies. *Risk Analysis, 31*, 1381–1407.

Louviere, J., Hensher, D., & Swait, J. (2000). *Stated choice methods: analysis and applications*. Cheltenham: Cambridge University Press.

Louviere, J. J., Flynn, T. N., & Carson, R. T. (2010). Discrete choice experiments are not conjoint analysis. *Journal Choice Modelling, 3*, 57–72.

Louviere, J. J., Street, D., Burgess, L., Wasi, N., Islam, T., & Marley, A. A. (2008). Modeling the choices of individual decision-makers by combining efficient choice experiment designs with extra preference information. *Journal Choice Modelling, 1*, 128–164.

Mahieu, P.-A., Crastes, R., Kriström, B., & Riera, P. (2015). Non-market valuation in France. An overview of the research activity. *Revue Econ Pol, 125*, 171–196.

McNair, B. J., Bennett, J., & Hensher, D. A. (2011). A comparison of responses to single and repeated discrete choice questions. *Resource and Energy Economics, 33*, 554–571.

Meyerhoff, J., & Liebe, U. (2008). Do protest responses to a contingent valuation question and a choice experiment differ? *Environmental and Resource Economics, 39*, 433–446. https://doi.org/10.1007/s10640-007-9134-3.

Meyerhoff, J., Mørkbak, M. R., & Olsen, S. B. (2014). A meta-study investigating the sources of protest behaviour in stated preference surveys. *Environmental and Resource Economics, 58*, 35–57.

Murphy, J. J., Allen, P. G., Stevens, T. H., & Weatherhead, D. (2005). A meta-analysis of hypothetical bias in stated preference valuation. *Environmental and Resource Economics, 30*, 313–325.

Özdemir, S., & Johnson, F. R. (2013). Estimating willingness to pay: do health and environmental researchers have different methodological standards? *Applied Economics, 45*, 2215–2229.

Ryan M, Gerard K, Amaya-Amaya M (2007) Using discrete choice experiments to value health and health care vol 11. Springer Science & Business Media,

Ryan, M., & Watson, V. (2009). Comparing welfare estimates from payment card contingent valuation and discrete choice experiments. *Health Economics, 18*, 389–401.

Sach, T., Smith, R., & Whynes, D. (2007). A 'league table' of contingent valuation results for pharmaceutical interventions. *PharmacoEconomics, 25*, 107–127.

Scarpa, R., & Rose, J. M. (2008). Design efficiency for non-market valuation with choice modelling: how to measure it, what to report and why. *Australian Journal Agricultural Resource Economics, 52*, 253–282. https://doi.org/10.1111/j.1467-8489.2007.00436.x.

Smith, V. K. (2000). JEEM and non-market valuation: 1974–1998. *Journal Environmental Economics Management, 39*, 351–374.

Thurstone, L. L. (1931). The indifference function. *The Journal of Social Psychology, 2*, 139–167.

Train K, Weeks M (2005) Discrete choice models in preference space and willingness-to-pay space. Department of Applied Economics, University of Cambridge.

Whitehead JC (2011) Contingent valuation versus choice experiment: 1989–2010 Blog posted on June 17, 2011.

Whitty, J. A., Lancsar, E., Rixon, K., Golenko, X., & Ratcliffe, J. (2014). A systematic review of stated preference studies reporting public preferences for healthcare priority setting. *Patient, 7*, 365–386.