Vacation Travel Behaviour in a Very Different Future

Sander van Cranenburgh

Vacation Travel Behaviour in a Very Different Future

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[†] Prof. dr. P. Rietveld sadly passed away on 1-11-2013; between his approval of the manuscript and the defence.

In memory of
Jan Hendrik van der Wart
1929 – 2013 †

Preface

It has been a journey; an interesting one in most regards. My Ph.D. embarked with a brief email conversation with Caspar Chorus about a Ph.D. vacancy he had posted. At that time I was on a round-the-world trip, travelling in the southernmost part of Chili, and I was starting to prepare for my return to The Netherlands a few months later. I was sure that I wanted to apply for a Ph.D. position once back home. The title of the position Caspar posted was: *Modelling the impact of unconventional trends on mobility*. What attracted me in that title? I suppose it was the modelling part that intrigued. After two Skype meetings, one with Caspar and one with Bert van Wee, I was fully convinced: this was going to be my Ph.D. Fortunately, they were positive too. In retrospect, I made this decision without really knowing what I choose for.

This Ph.D. has opened a whole new world for me: it has taken me from engineering towards social sciences. Admittedly, I was by and large unfamiliar with social sciences. I never had written down a hypothesis. Neither was I aware of what utility theory or discrete choice models were. The latter models would become the core of this thesis. Especially during the first year I remember coming home and tell Saskia about all the new theories I had discovered that day (sorry Saskia). Somewhere during that time I also realized that at best I could make fairly strong inferences about what might happen if some sort of unconventional change

would happen. The behaviour of travellers is not exactly well governed by the laws of mechanics, or thermodynamics; the laws I was mostly familiar with at that time.

Furthermore, through this Ph.D. I came to learn academia; a collection of institutions sharing a long history and a rich tradition in conducting research – such a fascinating place. It took a while before I rumbled its ins and outs: the impacts factors, the nuances of writing and citing, the publish or perish paradigm, and so forth. Writing the first journal paper was a truly insightful experience. Recently, I had a pleasant feeling – realizing that I had become part of the travel behaviour research community, part of academia.

In all, it has been an exciting and inspirational time. I consider myself privileged.

I would like to express words of thanks to many people. Firstly, I owe great gratitude to Caspar. Caspar you are a great supervisor! Thank you for your inspiration, and for teaching me the intricacies of conducting research, and writing it down. Bert, thank you for all your useful suggestions, comments and good ideas – including your 4 by 4 matrices! Bert and Caspar, I believe that the two of you complement each other's supervising skills: the two of you form a great team!

A number of people have provided valuable support during the realisation of this thesis. I would like to thank my roommates, Niek and Zack. As we have been through the same stages of our Ph.D.'s we encountered the same difficulties. I learned a lot from the discussions we had. Regardless of all the interesting stuff which is out there, without you two in the office it would have been a boring flight. Niek: thank you for all your conversations on cost-benefit analyses; Zack: thank for your often unfathomable sense of good Chinese humour. I appreciated it. Also I would like to take the opportunity to thank the TLO section. Thanks for the pleasant working environment. In addition, I would like to thank Chris Davis for running an incredibly slow Matlab code onto his section's mainframe computer. Lastly, I would like to thank Olaf Landman and Rodney Maliepaard for respectively printing the thesis and designing the cover page – as well as for their occasionally good, but honestly mostly poor jokes about my research.

Special thanks go to my family. First of all to my parents: thank you for all your moral support and encouragement. Furthermore, I attribute this achievement to Jan van der Wart. He was among the most encouraging people I have ever met. By taking me on a trip to the European Space Agency in Noordwijk he encouraged me to study Aerospace Engineering: a crossroad in retrospect. Finally, I would like to thank you, Saskia. Thank you for your support, discussions, and love!

Sander van Cranenburgh
Delft, October 2013

Contents

1. Introduction

1.1 Research background

Vacation is increasingly considered an indispensable aspect of life (Richards 1998). Worldwide more and more people engage in tourism. The tourism industry has become among the largest industries in the world. Between 1980 and 2010 global vacation travel demand more than tripled (UNWTO 2012). As a result, societal impacts associated with vacation travel have increased considerably too. For instance, while three decades ago vacation travel was accountable for only a marginal share of the global CO_2 emissions, currently 4% of the global CO_2 emissions are due to vacation travel (UNWTO 2008).

Moreover, many foresee a continuation of this strong growth path. With that also its societal impacts are expected to increase considerably. The lion's share of this growth is expected to come from currently industrializing countries (in particular from the BRIC[1] countries). However, vacation travel demand in developed countries is expected to grow too. The growth in developed countries is primarily attributed to increasing life expectancies, increasing standards of living and increasing amounts of leisure time. Many developed countries will see

[1] BRIC is a grouping acronym that refers to the countries of Brazil, Russia, India and China. These countries are considered to be at a similar stage of newly advanced economic development.

a rapid growth in its elderly population in the coming decades. This group is considerably more mobile than its previous elderly cohorts.

A continuation of the current growth path is however not the only future which has been envisioned. On the horizon various ‘unconventional’ changes or *substantial changes* as they are referred to in this thesis*,* loom that, if one takes place, impair a continuance of current mobility trends in general, and in particular of current vacation travel trends. Many of which are likely to result in a substantial increase in travel costs. The most widely debated of these potential substantial changes is probably a peak oil event (Hubbert 1956; Curtis 2009; Krumdieck et al. 2010; Aftabuzzaman and Mazloumi 2011; Becken 2011). In a peak oil event the demand for fossil fuels exceeds supply capacity causing volatile and higher fuel prices – leading to a substantial increase in travel costs. Other potential substantial changes on the horizon that are likely to increase travel costs substantially are inter alia local political instability, in particular in large oil exporting countries or regions and fierce climate change mitigation measures (Njegovan 2006).

When a substantial change occurs especially vacation travel demand can be expected to be relatively heavily affected. Historical analyses show that vacation travel demand responds relatively strong and rapid to changes in e.g. inflation, fuel prices, public funding, safety (terrorism), etc. (Steinnes 1988; Bonham et al. 2006). This relatively high susceptibility of vacation travel demand as compared to travel demand associated with work-, education-, and social activities primarily stems from the fact that the vacation activity is generally more flexible in time and location (Schwanen et al. 2008).

1.2 Problem statement

Given the major economic importance of tourism to many countries it may be advisable for governments to develop policies anticipating on the occurrence of such substantial changes. For instance, a substantial increase in travel costs (especially air travel cost) presumably poses a considerable threat to economies that rely heavily on long-haul tourism such New Zealand, Hawaii, the Maldives, and many others. On the other hand, for countries that are in proximity of major source markets (e.g. The Netherlands to Germany, or Cambodia to China) an substantial increase of travel costs may rather create new opportunities (Gössling et al. 2008; Ringbeck et al. 2009). In both cases adequate anticipation may enhance future economic prosperity. Moreover, the significance of tourism goes beyond fostering economic prosperity. Tourism bears important social and environmental aspects. Therefore, anticipating on the effects of potential substantial changes is not only of major economic importance. For instance, in modern Western lifestyles vacation is by many considered an indispensable part of life (Richards 1998). The freedom to travel is a value that is firmly established in the minds of many tourists (Becken 2007; Hares et al. 2010). Such norms and values may be corroded by substantial changes. As for the environmental aspect; environmental impacts associated with vacation travel are considerable e.g. in terms of CO_2 emissions. A substantial change may change tourism considerably and hence may rearrange vacation travel and its associated impacts. Insights on the impacts of a substantial change on vacation travel demand may for instance feed climate change debates.

To assist policy makers dealing with the uncertain future commonly scenario studies are used. Scenarios are put forward as narratives that portray either a snap-shot picture of some future state or a plausible evolution from the present onwards (Bunn and Salo 1993). There are two dominant practices of using scenario studies. Developing a range of forecasts scenario studies can assist policy makers to: 1) select a specific strategy, or to 2) evaluate a selected strategy against a number of different futures.

Scenarios come in many forms. Various typologies of scenarios have been suggested in the literature to classify them (e.g. Ducot and Lubben 1980; Bunn and Salo 1993; Börjeson et al. 2006). Most typologies reflect the view that scenarios address one of the following questions: What will happen?; What can happen?; or, How can a specific target be reached?. Based on this divide Börjeson et al. (2006) make a distinction between three categories of scenarios: predictive scenarios, explorative scenarios, and normative scenarios. Adhering to this typology, this thesis is principally concerned with predictive scenarios. Predictive scenarios studies take a probabilistic view on future outcomes. They are developed to make it possible to plan and adapt to situations that can be expected to occur. As such, they are especially useful to policy makers and investors, who need to deal with foreseeable challenges and take advantage of foreseeable opportunities (Börjeson et al. 2006). Two types of predictive scenarios can be distinguished, namely: (business-as-usual) forecasts scenarios, and what-if scenarios. The first type is concerned a continuation of present trends while the latter is used to investigate what will happen on the condition of the occurrence of some kind of future foreseeable change. Clearly, especially the latter type is of prime interest to this thesis: what if one of the substantial changes looming at the horizon takes place.

Remarkably, to date the vast majority of tourism scenario studies is only concerned with business-as-usual forecasting (see among many others Akal 2004; Papatheodorou and Song 2005; Blake et al. 2006; Jackman and Greenidge 2010). Only rarely what-if scenarios studies or other type of scenario studies (exploratory or normative) are conducted. One exception regards climate change. The impacts of climate change on the geographical distribution of tourism demand have received some attention recently (e.g. Lise and Tol 2002; Berrittella et al. 2006; Bigano et al. 2006; Koetse and Rietveld 2009). Moreover, – and more of interest in the context of this thesis – a few studies have been conducted which assess the impacts on air travel demand of a substantial aviation fuel levy – a policy put forward to mitigate CO_2 emissions (Olsthoorn 2001; Mayor and Tol 2007; Tol 2007).

Given the real chance that a substantial change can occur and the relatively high susceptibility of the tourism industry to changes, to establish that only a few attempts have been made so-far to develop what-if scenario studies is striking. Failure to develop credible what-if scenarios (amongst other types of scenarios) hampers countries with tourism industries that wish to ensure long-term welfare to make strategic long-term robust transport and tourism policies. Ultimately, this may lead to undesirable situations in the long run.

To construct credible what-if scenarios requires vacation travel demand models with a thorough behavioural foundation. However, two knowledge gaps specifically hamper the development of such behaviourally realistic vacation travel demand models.

The first knowledge gap is that thorough understanding of vacation travel behaviour under substantially changed conditions is by and large missing. While vacation behaviour has been studied extensively, recent empirical research on vacation travel behaviour under substantially changes conditions is virtually non-existent. Some research efforts have however been made during, or in the aftermath of the oil crises of the 1970s (Pisarski and Terra 1975; Corsi and Harvey 1979; Williams et al. 1979). However, as it is well-known that tourism patterns are transient (Oppermann 1995) these findings are unlikely to provide accurate insights on how vacationers would adapt today. Besides that, the methods used to study the impacts on vacation travel behaviour in those days (mainly descriptive statistics) are not as advanced as they are today. Therefore, insights into the subtle behavioural trade-offs underlying the vacation travel choice – which are likely to be important for understanding vacation travel behaviour under substantially changed conditions – are by and large missing.

The second, not unrelated, yet rather methodological knowledge gap is that no efforts have been made to develop dedicated models to forecast vacation travel demand under what-if scenarios. Therefore, currently no modelling tools – other than the conventional modelling tools – are available for those who feel the necessity to analyse what-if scenarios. As no dedicated models have been developed and tested, at present it is unclear to what extent current models are adequate to forecast vacation travel behaviour under such substantially changed conditions. To quote Song (2008) regarding this omission:

"Considering the enormous consequences of various crises and disasters, events' impact evaluation has attracted much interest in tourism demand forecasting research. It is crucial for researchers to develop some forecasting methods that can accommodate unexpected events in predicting the potential impacts of these one-off events through scenario analysis."

An additional methodological gap in the literature is that to develop a modelling tool that can be used to forecast vacation travel demand under what-if scenarios requires quite exceptional data. Presuming that travel behaviour *will* change substantially – that is, new type of substitution behaviour will emerge –, implies that estimation of such a model can only rely on experimental type of data. To the author's knowledge, to date no experiments have been put forward in the literature specifically suitable to elicit vacation choices under truly unconventional situations.

The most obvious way to go about to collect such data is by conducting a stated preference (SP) experiment. Key is that in an SP experiment the analyst is able to carefully design and hence control the presented (choice) situations (Louviere et al. 2000; McFadden 2001; Rose et al. 2008). However, although SP experiments have proved effective to elicit preferences in many occasions (e.g. to predict the market share of a new bridge, of subway line), a conventional SP experiment is unlikely to adequately capture vacation behaviour under truly unconventional situations. SP experiments are known to potentially suffer from what is called hypothetical bias i.e. deviation from real market behaviour (Brownstone and Small 2005; Hensher 2010). This type of bias may occur when respondents do not have to live up to their choices. When respondents are presented truly unconventional hypothetical choice situations chances on hypothetical bias are profound. Moreover, an additional difficulty arises in the context of the vacation choice. To set up a SP experiment requires the analyst to have prior knowledge on the vacation alternatives considered by the respondents. It is well-known that correct information about consideration sets is a necessity for correct estimation of the parameter estimates and correct prediction of choices by discrete choice models (Manski 1977; Thill 1992). Yet, the set of alternatives considered by vacationers is by and large unknown to the analyst. Therefore, to develop a modelling tool that can be used to adequately forecast vacation travel demand under what-if scenarios requires an unconventional experimental approach.

1.3 Research objectives

The main objectives of this thesis are threefold and can be formulated as follows.

I. *To acquire thorough understanding of vacation travel behaviour under high travel cost conditions*
II. *To develop and empirically test a modelling tool that can be used to forecast vacation travel demand under high travel cost conditions*
III. *To derive implications for policy makers who are concerned with designing strategic and robust long-term tourism and transport policy*

Note that this thesis focusses on a high travel costs scenario. More precisely, in this thesis the impacts of an increase of travel costs of up to a factor three are explored. This focus stems from the need to operationalize the very broad notion of a potential substantial change. Clearly, there are many potentially substantial changes looming that act upon vacation travel behaviour in other ways than by affecting the costs side of travel. For instance, climate change may potentially substantially change vacation choices as local climate is an important determinant of the vacation destination choice (see Koetse and Rietveld 2009 for an overview). More generally, substantial changes in the environment of all sorts (e.g. pollution of seas, or disasters leading to health concerns) may have far-reaching impacts on future vacation behaviour. Besides that, preferences (e.g. regarding destinations, or types of vacations) and attitudes (e.g. towards flying) may shift over time – leading to substantially different vacation behaviour. Nonetheless, as many potential substantial changes can be expected to translate into a substantial increase in travel costs (e.g. a peak oil event, political instability in large oil exporting countries, fierce climate change mitigation measures, to name a few), confining to high travel cost conditions provides a tangible and relatively generally applying operationalization of a potential substantial change.

Adhering to these objectives and the addressed knowledge gaps in the section 1.2, the following six research goals are formulated:

1. *Develop a definition and typology of substantial changes*
2. *Inventory the current state-of-the-art knowledge on the impacts of past (substantial) changes on vacation travel behaviour, and – more broadly – on passenger*[2] *mobility*
3. *Develop broad empirical insights on vacationers' responses to a substantial increase in travel costs*
4. *Develop and test a model to forecast vacation travel demand under high travel cost conditions*
5. *Develop a data collection method to collect data that allow estimation of the vacation travel demand model*
6. *Conduct a what-if scenario analysis using the developed model*

Table 1-1 depicts how the research goals relate to the research objective.

Table 1-1: Relation between research objectives and research goals

Research goals \ Research objective	I	II	III
1	X		
2	X		X
3	X		X
4	X	X	X
5		X	
6	X		X

1.4 Research strategy and methods

1.4.1 Research strategy

Figure 1-1 charts the studies employed in this thesis to achieve the main research objectives. The horizontal axis depicts the time: past and future; the vertical axis depicts the specificity ranging from generic to specific. Each of the balloons represents a study in this thesis. It goes without saying that there exists an inevitable trade-off between in-depth and specific versus cursory and broad. This thesis aims to address both levels of specificity. First, it takes a broad standpoint in Chapters 2 and 3, addressing research goals 1 to 3. After that, it goes more in-depth when dealing with research goal 4 in Chapters 4 and 5.

[2] We consider passenger mobility to consist of all travel activities undertaken by an individual.

This thesis takes the following steps to achieve the formulated research goals. The first study, Chapter 2, employs a literature review. It explores existing literature on empirical insights on the impacts of changes on vacation travel behaviour, and – more broadly – on passenger mobility (research goal 2). To do so, it proposes a definition and typology of substantial changes (research goal 1). Next, this thesis goes on by conducting two empirical studies: Chapter 3 and Chapter 4. Insights of Chapter 2 are used in Chapters 3 and 4. To develop broad empirical insights on vacationers' responses to a substantial increase in travel costs (research goal 3) Chapter 3 conducts a vacation travel questionnaire among Dutch vacationers. Chapter 4 develops a vacation choice model (research goal 4) and collects the data needed to estimate the vacation choice model using a novel type of SP experiment (research goal 5). Finally, Chapter 5 uses the developed model to conduct a what-if scenario study. As an illustrative case a high air travel cost scenario is studied (research goal 6). Thereby, a feeling for the effects of a substantial increase in air travel costs on aggregate level indicators of mobility is acquired.

Vacationers have a wide range of ways to respond to a substantial increase in travel costs. Besides quite obvious ways such as to skip the vacation, or to go to a closer-by destination, there are many more complex, and often not so obvious ways in which vacationers can respond. This thesis makes a distinction between three types of behavioural responses, namely: intra-vacation responses, inter-vacation responses, and non-vacation responses. Intra-vacation responses are the most 'simple' type of responses. They directly translate into changes in one or a few attributes of the vacation such as changing the destination, mode of travel, length of stay, etc. Inter-vacation responses are often more complex responses. They span across multiple vacations. Examples are to skip a second or third vacation, or to substitute one luxury vacation to a long-haul destination for two vacations with domestic destinations. Lastly, non-vacation responses are responses that are not directly related to vacation behaviour; rather, they have to do with any other sorts of behaviour, such as to reduce spending on groceries, increase labour hours, etc.

Acknowledging that the method of study largely determines the type and complexity of the vacation responses that can be captured (Verschuren et al. 2010), it is important here to address which study aims to capture what types of vacation responses. On the right-hand side of Figure 1-1 it is shown which study covers what types of responses. The literature review (Chapter 2) covers in principle all three types of responses. However, it should be noted that in the studies assed for review their respective authors may have constrained the responses or simply have had a specific focus. Furthermore, as a result of the broad and aggregate scope, (i.e. on mobility rather that only on vacation travel), intra-vacation responses are only scantly addressed. The survey method used in Chapter 3 on the other hand specifically focusses on intra-, and inter-vacation responses. Finally, Chapters 4 & 5 focus most strongly: intra-vacation responses are studied in-depth.

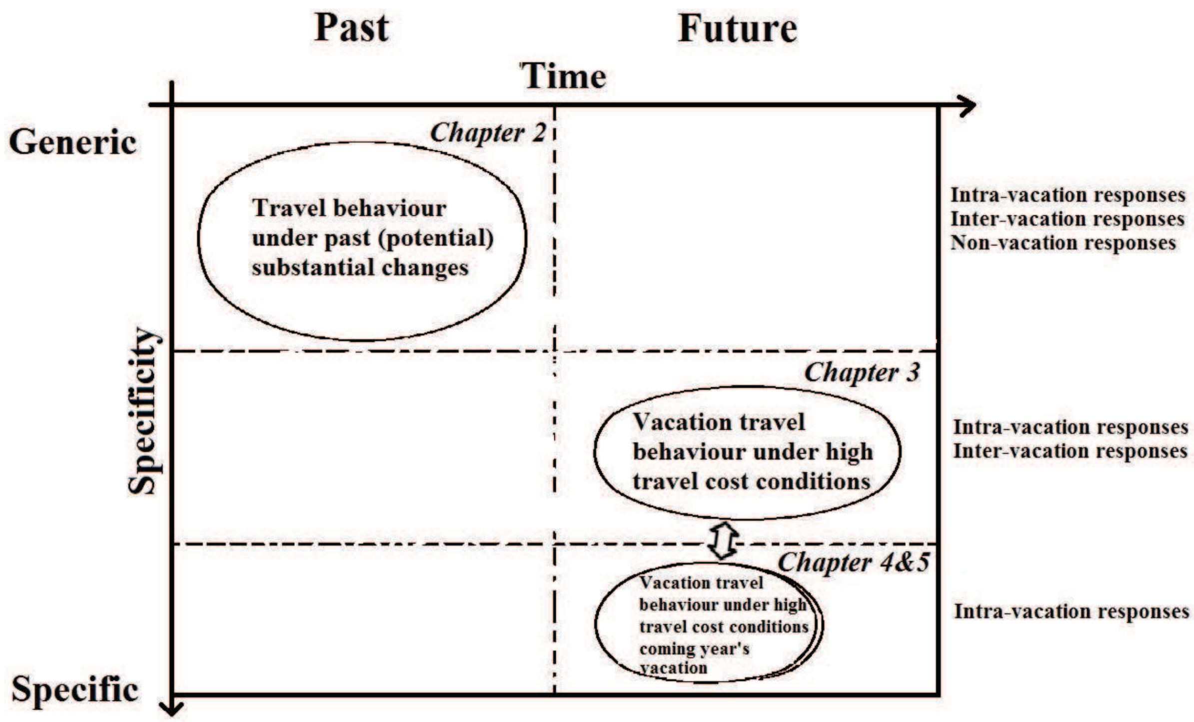

Figure 1-1: Research strategy

1.4.2 Research methods

This subsection provides justification for the methods used in each of the studies of this thesis. The method used in the last study, Chapter 5, is however nested in the choice of method in Chapter 4. Therefore, for Chapter 5 no additional justification is discussed below.

<u>*Chapter 2*</u> employs a literature review: a broad body of scholarly literature arrayed across a variety of research fields on changes that impacted on vacation travel behaviour and on passenger mobility is assessed and reviewed. An overview of which is made. Furthermore, a definition of what constitutes a substantial change is proposed, as is a typology of substantial changes. By looking at past impacts of changes on passenger mobility, this chapter acquires extensive understanding. Thereby, it provides insights on what types of vacation responses one may expect in response to future substantial changes.

Besides a literature review, other methods could have been used to achieve research goals 1 and 2. In particular to achieve research goal 2 – i.e. to inventory the current state-of-the-art knowledge on the impacts of past changes on mobility – other methods were available. For instance, interviews with transport pundits could have provided a valuable inventory. Alternatively, instead of reverting to the existing literature also own data analyses could have been conducted. However, since there was an extensive and yet unreviewed body of literature on the impacts of past changes on passenger mobility, a literature review was considered the most auspicious method to start of this thesis.

An important demarcation regarding the literature review methodology concerns the time horizon. The literature review in this thesis assesses the body of literature on past changes that impacted on mobility which took place within the last four decades. Clearly, the time scale at which changes and their impacts are evaluated is crucial. For instance, on the scale of millennia there have been a number of changes that had tremendous impacts on mobility (e.g. improvements in shipbuilding and navigation, 1st millennium CE; railways and steamships, early 19th century; internal combustion engine, late 19th century, etc.) (Gilbert and Perl 2010). However, despite that such long-term historical research is insightful, it is unlikely to be much of a help in developing more reliable vacation travel demand forecasts under what-if scenarios for the coming three decades[3]. Therefore, while acknowledging that the last decades have been relatively smooth, mirroring the many scenario studies that look one generation ahead, the literature review in this thesis looks one generation, or more specifically: four decades, back.

Chapter 3 employs a quantitative vacation travel questionnaire among a by and large representative sample of Dutch vacationers. Data of this questionnaire are statistically analysed. Thereby broad and generalizable empirical insights on vacationers' (intended) responses to a substantial increase in travel costs are obtained. An additional advantage of conducting a quantitative vacation travel questionnaire is that it allows analysis of the correlation structure across responses. Such insights can be particularly useful from a policy making perspective – highlighting which bundles of responses are likely to prevail in combination.

Having the objective to obtain broad and generalizable insights on vacationers' responses to a substantial increase in travel costs a questionnaire is considered most auspicious. However, to design such a questionnaire requires adequate a priori insights on vacation responses by the analyst. To obtain such prior insights three qualitative methods are customary, namely Delphi studies, interviews with transport pundits, and focus group sessions. While acknowledging that such (qualitative) methods could have provided valuable, elaborative and complex insights (Verschuren et al. 2010), none of these methods are used. There are two reasons why. Firstly, Delphi studies and interviews with transport pundits rely on expert judgement. However, 1) a high validity environment and 2) adequate opportunities for learning the environment are necessary conditions for the development of skilled intuitions (Kahneman and Klein 2009). Clearly, as recent years did not see the kind of high travel cost conditions that are of interest to this thesis, experts did not have adequate opportunities to learn on vacation travel behaviour under high travel cost conditions. Therefore, methods that rely on expert judgement seem to be unsuitable in this context. Besides that, experts willing to participate (for interviews) are presumably hard to find, at least on a national level. Secondly, it is important to note that the literature review at the time of designing the questionnaire already provided insights on the behavioural responses that can be expected in response to

[3] More specifically, this thesis looks at 2040 as this matches the time horizon of the "NWO Duurzame Bereikbaarheid van de Randstad" research project.

high travel cost conditions. Therefore, the contribution of a focus group meeting was expected to be relatively modest.

Chapter 4 develops and tests a discrete vacation choice model that can be used to forecast vacation travel demand under high travel cost conditions (research objective 4). Data needed to estimate the vacation choice model are obtained using a stated preference choice experiment (research objective 5). The choices to 1) develop a discrete choice model and 2) to collect data using a stated preference discrete choice experiment tie closely together. In fact, in the discrete choice modelling community choice model development and experimental design of a discrete choice experiment are intertwined to a large extent. Nonetheless, for reasons of clarity this section discusses these choices separately. First the choice for discrete choice modelling is discussed. After that, the choice to conduct a stated preference choice experiment is discussed.

Modelling approach

This chapter opts for discrete choice modelling to forecast vacation travel demand under high travel cost conditions for a number for reasons. Firstly, to make inferences on vacation demand under high travel cost condition a disaggregate approach is needed. Presuming that behaviour under high travel cost conditions differs strongly from what we see today, macro-economic relationships that currently hold are unlikely to be valid under future high travel cost conditions. Obviously, the same holds true for currently holding micro-economic relationships. However, key is that a disaggregate approach allows conducting small-scale experiments that may provide knowledge on newly emerging micro-economic relationships under potential future conditions. Thereby, as opposed to aggregate approaches, they can provide insights on vacation travel behaviour under high travel cost conditions. Discrete choice modelling forms one such a disaggregate modelling approach. Secondly, it is the author's opinion that despite some well-known disadvantages (such as e.g. identification problems) discrete choice modelling offers a coherent, elegant and effective framework for the analysis of choice behaviour. Thirdly, a major advantage is that it allows building on a very rich body of knowledge on discrete choice models. Fourthly, as discrete choice models are well-known in the transport and travel demand forecasting communities, straightforward adoption and application of the insights developed in this thesis is assured.

More specifically, the Random Utility Maximization (RUM) model is used (Thurstone 1927; McFadden 1974; Ben-Akiva and Lerman 1985). That is, it is assumed that the decision-maker chooses the maximum utility alternative from his or her choice set, and that the utility of an alternative is the sum of a real valued function and an error term which is added to the utility function to account for unobserved utility. As the name suggests, the RUM model is grounded in the neo-classical utility framework. As such, it is consistent with neo-classic demand theory (Small and Rosen 1981).

However, the random utility maximizing framework does not accommodate for various behavioural phenomena which might be relevant in the choice situation which is aimed to model such as e.g. the compromise effect, status quo bias, etc. (see e.g. Chorus 2012; Leong and Hensher 2012 for an overview of modelling efforts). Although such behavioural phenomena are likely to play a role in vacation choices under high travel cost conditions, given the exoticness of the main research objective it is considered wise to stick to the well-proven, robust, and most widely-known model of choice behaviour.

Perhaps such a traditional discrete choice modelling approach may seem to contrast to the unconventional character of the main research objective. However, discrete choice models are theoretically not limited to model ‘conventional’ choice situations. In fact, it has even been used to potential demand for space-tourism (Crouch et al. 2009). The unconventional character of this thesis rather imposes a challenge for the data collection (as will be discussed latter on).

Furthermore, although disaggregate approaches model behaviour at the level of individual travellers they can be used to make aggregate level statements. After all, for policy making usually not so much the travel behaviour of individual is of interest; rather are the aggregate level travel flows (Van Wee and Annema 2013). In order to arrive at aggregate level flows, disaggregate probabilities are summed and grossed up according to sampling fractions in the population of study. This approach is state-of-the-art practice in travel demand modelling (de Jong et al. 2007). For instance, the appraised Dutch National Model System is based on this approach. As such, in Dutch CBA practice the benefits for travellers are incorporated by calculating changes in travel time and expressing these in generalised travel costs using values of time (which are typically obtained from choice studies to monetise travel time savings).

In this context it is also interesting to note that while in the transport community discrete choice modelling is regarded to be the leading modelling approach to forecast travel demand, in the tourism field applications of discrete choice models, and more generally disaggregates models, are fairly limited. In the tourism forecasting literature, generally three types of techniques are distinguished: time series models, econometric models, and expert-opinion methods (Sheldon and Var 1985; Song and Li 2008). However, none of these techniques provides a likewise auspicious alternative to a discrete choice modelling to develop a model to forecast vacation travel demand under high travel cost conditions. In the tourism forecasting literature, time series models are most popular, followed by econometric models (Song and Li 2008). Time series models extrapolate historic trends of tourism demand into the future: they are not concerned with the underlying causal relationships between the tourism demand variable and its influencing factors. As such, time series models cannot be used given the goals of this thesis. Econometric models on the other hand do have the ability to identify relationships between tourism demand and its influencing factors. Modern econometric techniques to forecast tourism demand are generally comprehensive and numerous in number: Time Varying Parameter models (TVP), autoregressive distributed lag models (ADLM), error correction models (ECM), Almost Ideal Demand Systems (AIDS), Vector Autoregressive (VAR) models, and (stochastic) Computable General Equilibrium (CGE) models, to name a few (see e.g. Song et al. 2009 for an overview). However, these econometric models are primarily developed to make business-as-usual forecasts for e.g. the number of tourist arrivals or for the total tourism expenditure. Usually, outputs of these models concerning transport are on a high level of aggregation. More crucially however, these models are typically estimated on longitudinal tourism data. Therefore, forecasts based on these models presume that current relationships persist. As such, these models are not suitable for forecasting under scenarios in which current relationships are unlikely to persist – as is the case in this thesis. Lastly, expert-opinion methods are not considered a viable alternative for the same reasons as discussed under Chapter 3.

Data collection approach
Given the choice to use discrete choice modelling, there are in principle two data types that can be used: Stated Preference (SP) data and Revealed Preference (RP) data. RP data is collected in real markets – hence describing actual behaviour. SP data on the other hand are collected in choice experiments. Hence, SP data are based on stated behavioural intentions and responses to hypothetical choice situations rather than actual observed behaviour. For that reason SP data are generally less preferred. However, as alluded above RP vacationer travel data under conditions of interest to this thesis are non-existent. Therefore, this thesis can only rely on SP data. In fact, as discussed above the feasibility to use SP data was a decisive reason to adopt a discrete choice modelling approach in the first place.

An advantage of conducting an SP experiment is that the choice situations can carefully be designed. As such, identification problems stemming from for instance collinearity between explanatory variables can easily be avoided (Louviere et al. 2000; McFadden 2001; Rose et al. 2008). Nonetheless, as discussed in section 1.2 conducting an SP experiment in the context of truly unconventional hypothetical choice situations is far from trivial as substantial hypothetical bias is on the lure – jeopardising the external validity of the data.

To collect SP data on vacation choice behaviour under high travel cost conditions this thesis proposes a novel type of choice experiment: a so-called free format SPoffRP choice experiment. In this experiment the choice sets presented to respondents consists of alternatives which are constructed by pivoting of alternatives considered ‘relevant’ by the respondent. Thereby, the realism of the choice task is enhanced and hypothetical bias is minimized (Caussade et al. 2005; Hensher 2006; Hensher and Rose 2007; Train and Wilson 2008; see for a critical review on pivoting: Hess and Rose 2009).

However, to pivot of alternatives considered ‘relevant’ requires that the analyst has knowledge on the consideration sets held by the decision-makers. Clearly, pivoting of an ‘irrelevant’ alternative does not enhance the realism of the choice task presented to the respondent and hence may rather provoke hypothetical bias than reduce it. Yet, contrary to a situation in which the number of relevant alternatives is confined to just a few trivial ones such as for example in the commute mode choice, or to situations in which the analyst may reasonably be able to infer the alternatives considered by the decision-maker, in a vacation choice context the number of potentially relevant vacation alternatives is vast. Therefore, the decision-maker’s so-called consideration set is by and large unknown to the analyst (Crompton 1992). Consequently, a standard pivoting approach cannot be used.

To deal with this limited a priori knowledge from the analyst's perspective on the decision-makers' individual consideration sets, the proposed free format SPoffRP choice experiment consists of two parts: a Revealed Preference (RP) part and a Stated Preference (SP) part. In the RP part, respondents are asked to compose a number of real-world alternatives which they consider to take in the future. Next, in the SP part, hypothetical alternatives are constructed by pivoting of these user-composed real-world alternatives. This creates a one-to-one correspondence between SP and the self-reported RP alternatives. In contrast to traditional pivoted choice experiments in which only is pivoted of the chosen alternative, in the free format SPoffRP experiment all SP alternatives are constructed by pivoting of consideration set alternatives. Hence, whereas usually pivoted experimental designs are put forward to enhance realism as to reduce response error variance, in this experiment pivoting is mainly used as an approach to deal with the limited knowledge from the analyst's perspective on the decision-makers' individual consideration sets.

However, due to the SPoffRP design of the experiment endogeneity may be present. Firstly, in the experiment unobserved utilities associated with RP alternatives can be expected to carry over to the SP choice experiment. As a result, fundamental assumptions that are maintained in standard estimation procedures may be violated. Therefore, to estimate a choice model on data collected in such a SPoffRP choice experiment requires a non-standard estimation procedure: it requires an estimation procedure that aims to capture this. Train and Wilson (2008; 2009) have recently proposed such an estimation procedure: the SPoffRP estimation procedure. This thesis proposes and illustrates the use of a generalization of this SPoffRP estimation procedure. The proposed so-called Generalized SPoffRP estimation procedure has the standard logit and the recently proposed SPoffRP estimation procedure as a special case. Secondly, endogeneity may be present stemming from the use of self-reported choice sets. This source of endogeneity is however not captured in the Generalized SPoffRP estimation procedure, hence potentially biasing results.

1.5 Outline of the thesis

The remainder of thesis is organised as follows. As mentioned earlier, this thesis contains four studies. These four studies are presented in Chapters 2 to 5. Chapter 2 provides the literature review of substantial changes and their impacts on mobility. Chapter 3 presents this thesis' first empirical study: an exploration of vacationers' intended responses to a substantial increase in travel costs. After that, Chapter 4 presents this thesis' second empirical study. In this study the vacation choice model is proposed and estimated using the proposed Generalized SPoffRP estimation procedure. Moreover, the free format SPoffRP experiment is presented here. This chapter can be considered the core of this thesis. In the last study of this thesis (Chapter 5) the developed vacation choice model is tested. To illustrate its use vacation travel behaviour is simulated under a scenario in which air travel costs are substantially increased. Finally, this thesis closes with conclusions and implications (Chapter 6).

2 Substantial Changes and Their Impact on Mobility: A Typology and an Overview of the Literature

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2.1 Introduction

Long-term transport policy decisions are predominantly based on so-called business-as-usual scenarios (Cf. Schäfer and Victor 2000; Olsthoorn 2003). These scenarios generally exhibit a continuation of current trends. However, transport history has convincingly demonstrated a propensity to transcend the expected (Prideaux et al. 2003). Consequently, it is increasingly being acknowledged that using business-as-usual scenarios for long term transport forecasting may be inaccurate (Annema and De Jong 2011). During the past decades, several non-trivial deviations from these trends have occurred; these have been caused by major unconventional changes – or *substantial changes* as we refer to them in this paper. Examples of such substantial changes are the liberalisation of aviation markets after WOII, the oil crises and ICT developments. In this context, it seems unlikely that the coming 40 years will merely see a continuation of current trends; free from such *substantial changes* and their resulting enduring changes of mobility patterns. Especially if we take into consideration the challenges faced by society today, such as oil depletion and climate change, a steady continuation of current trends seems even more unlikely than it might have been in past decades.

One way to learn about the extent to which the predominant use of conventional scenario studies may be inappropriate in the context of long-term mobility forecasts is to look at the extent to which such past substantial changes have changed mobility patterns. Fortunately, some substantial changes have extensively been studied and valuable knowledge related to their impacts on mobility has been acquired (e.g. Ross 1989; Blunk et al. 2006; Choo and Mokhtarian 2007). However, despite that this valuable knowledge is out there, it is not readily available for scholars and policy makers who are concerned with long-term transport scenarios. This is principally due to the facts that 1) a widely acknowledged and coherent typology of substantial changes is missing and 2) an overview of the literature on substantial changes and their findings is missing. This hampers structured discussions concerning the impacts of potential substantial changes on future mobility patterns and concerning the adequacy of the use of conventional scenarios studies for long-term transport policy-making.

This paper aims to take a first step in helping to solve the above-mentioned problem by addressing the two mentioned issues. We first propose a typology of substantial changes and go on to provide an overview of studies that report on the impacts of potential substantial changes on mobility patterns. We apply our typology to these studies to assess its applicability and its correspondence within this sample of the literature. Furthermore, in our overview we identify research trends (which changes have been studied extensively? Which have only received scant attention?), and we try to summarize conclusions regarding the impact of substantial changes on mobility. By doing so, this paper aims to enable and spark a structured discussion on substantial changes and their potential impact on mobility patterns.

The remaining part of this paper is organised as follows. Section 2.2 starts with developing a common understanding of substantial changes. It puts forward a working definition and proposes a typology of substantial changes. After that, section 2.3 provides an overview of the literature. Section 2.4 provides conclusions and a discussion, and it addresses several directions for future research.

2.2 A Definition and a Typology of Substantial Changes

This section aims to develop common ground concerning how *substantial changes* can be defined and how different types of substantial changes can be classified in a coherent way.

2.2.1 What is a substantial change?

The impacts of substantial changes have been studied in various research fields, such as economics, tourism and transport, and in many different contexts. Yet, to the authors' knowledge, no widely accepted definition of the concept of a substantial change exists. Moreover, the terminology on substantial changes varies substantially. Many different words for what we would refer to as substantial changes are used in the literature almost interchangeably, like structural breaks, shocks, events, transitions, disruptions, intervention, spikes, incidents, crises, disasters, scares and rare events. Moreover, in each discipline specific terminology typically comes with specific connotations. As a consequence, there is no unambiguous understanding of what substantial changes are, especially not across disciplines.

To resolve this ambiguity, we start by defining what we consider to be a *substantial change*. In its most general form, we consider a change to be substantial if a change is ‘unconventional’ and causes a profound change on a supranational scale. Because in this paper we are primarily interested in passenger mobility patterns, we propose a more narrow working definition specific for this context. This definition is used throughout the remainder of this paper.

A <u>substantial change</u> is an unconventional change that directly or indirectly causes an ‘enduring’ change in at least one principal indicator of mobility of at least 5% on a supranational scale.

With this definition[4] a substantial change is defined indirectly; namely by its impact on mobility. ‘Enduring’ is operationalized as follows: the impact of a substantial change on mobility has to be at least 5% - relative to a credible baseline scenario - one decade after the substantial change initially set in. Hence that this operationalization does not specify how the change is reached: the impact on mobility can be abrupt, gradual or anything in between as long as after a decade a 5% change is measured compared to a credible baseline scenario.

Note that we provide a quantitative definition of a substantial change. The main aim of this definition here is to provide a sense of the magnitude of what we consider to be a substantial change. Importantly, we do not intend to set very strict criteria on what is, and what is not a substantial change. Clearly, any such criteria are contestable.

Furthermore, the ‘principle indicators of mobility’ refer to the most commonly used indicators to measure mobility patterns on national and supranational scales. These include: the total yearly number of passengers, the total yearly distance travelled, the modal split, the frequency of travel, etc. With a supranational scale we mean that the impacts of a substantial change are not confined to just one country or region, but are cross-border[5].

Lastly, we require that a substantial change is an ‘unconventional’ change. ‘Unconventional’ is however a transitory statement. To deal with this, we consider a change unconventional if at the time it set in, its impacts were not or not sufficiently recognised, and as such the change was not or not properly included in most business-as-usual scenario studies at that time. Accordingly, most abrupt changes are by nature unconventional as they are typically unforeseen. Substantial changes that take place more gradually are often adequately foreseen

[4] In the book Transport Revolutions, Gilbert and Perl (2010) propose an in essence similar definition of a substantial change. However, as the name of the book suggests, Transport Revolutions is concerned with ‘revolutions’. Our scope instead is on changes that have major impacts; in our context substantial changes not necessarily need to cause a true ‘transport revolution’. Therefore, our definition deviates from theirs in terms of the required magnitudes of impacts on mobility and in terms of the time period in which a change in mobility needs to emerge.

[5] Or on a supra-state scale when it applies to the US.

and timely included in the prevailing business-as-usual scenarios (e.g. demographic trends, economic cycles). However, sometimes the impacts of a change are not adequately or not timely recognised and therefore not included in the prevailing business-as-usual scenarios at that time (e.g. ICT developments, and the emergence of low-cost carriers). In that case, we consider the change unconventional.

Practically, it may however be hard to evaluate whether a change satisfies the aforementioned definition or not. A change specifies a difference compared to some kind of reference situation or baseline. However, often a credible baseline against which to compare what actually did happen is lacking. For example, to see how and to what extent ICT has attributed to a change of mobility patterns over the last decades, we have to know what mobility patterns would have looked like without the ICT developments. This implies that we would have to disentangle its impacts from other (substantial) changes that took place during that same time period. Obviously, for ICTs this is a challenging task. Yet, the majority of scholars and policy makers in transportation would agree that ICTs have fundamentally changed mobility patterns. Therefore, in case a credible baseline is missing, to evaluate whether a change can be considered substantial, studies and expert judgement need to be used complementary.

Another practical shortcoming of the aforementioned definition is that only after a decade a change can be evaluated on whether or not it has been substantial. As a consequence, in the meantime it can only be said whether a change has the potential to be substantial, or not.

2.2.2 A typology of substantial changes

To help structure the various substantial changes described in the literature, we need a typology of substantial changes. Because no widely acknowledged typology exists, we propose a typology of substantial changes in this section. We aim to develop a general typology to classify substantial which is coherent and at the same time largely consistent with the prevailing, yet generally implicit, interpretation of the terminology on substantial changes in the literature.

To classify substantial changes there are many dimensions of substantial changes that could be used, e.g. its magnitude of impact, its cause of impact, its manageability, its predictability, its class of uncertainty, just to name a few. To see which dimensions are leading to explain the prevailing terminology in the literature, we examine the literature to see for general patterns.

Especially in the literature on substantial changes (rather than on their impacts), two dimensions appear to be auspicious for further exploration, namely 1) the sphere or domain in which the substantial change takes place and 2) the rate at which the substantial change takes place. The first dimension seems promising as it is observed that to describe changes that take place in natural and technical domains specific terminology is used. The second dimension seems promising because many words used in the literature for substantial changes appear to have a clear connotation with the rate at which they take place. For example, transition, evolution or transformation commonly refer to changes that take place gradually whereas shock, spike, event, break, etc. typically refer to changes that take place abruptly.

For the first dimension it appears natural to discern between three distinct spheres, namely the biosphere, the anthroposphere and the technosphere. Changes that take place in the biosphere are the result of natural processes, thus independent of human activity, such as pandemic outbreaks, tsunamis, and climate change. Changes that take place in the anthroposphere are specifically the result of human activity. Examples are terrorist attacks, economic crises, and policy directives (e.g. Open Skies agreements). Lastly, in the technosphere we have changes that are specifically inclined with technology. Examples include the emergence ICTs, electric bikes, and jet engines and possibly also technology failures such as the Maglev incident (2006, Lathen, Germany) or the Hindenburg incident (1937, Lakehurst, New Jersey, USA).

For the second dimension it appears most natural to simply distinguish between two rates of change, namely: abrupt changes (high rate of change) and gradual changes (low rate of change). Terminology that has a connotation with high rates of change typically refers to changes that take place within days or weeks. Terminology that has a connotation with low rates of change is typically used to refer to all more time consuming changes. Accordingly, abrupt substantial changes are usually assigned dates whereas in case of gradual substantial changes usually is spoken in terms of periods in which they emerge. Importantly, the rate of change refers to the rate at which the substantial change itself takes place, not the rate of change of its impact.

This categorisation results in six types of substantial changes. To each category we have assigned a type name based on its prevalence and such that it constitutes to a coherent typology. The resulting typology can be seen in Figure 2-1.

	Technosphere	**Anthroposphere**	**Biosphere**
Abrupt change	*Incident*	*Event*	*Disaster*
Gradual change	*Development*	*Trend*	*Evolution*

Figure 2-1: Typology of substantial changes

To show the use of our typology, Table 2-1 provides an illustration. It classifies historical examples of potential substantial changes. For gradual changes it is generally hard to identify the year at which they 'started'. Therefore, the periods in the far right column of Table 2-1 rather indicate the emerging periods. Despite the fact that these examples are historical, we recall them as 'potential' because it is often not clear whether they satisfy our definition of a substantial change. For some of these changes it is simply too early to judge, for others convincing scientific evidence is missing. It appears relatively easy to classify these potential substantial changes according to this typology. However, as with most typologies, classification cannot be completely unambiguous: grey areas will inevitably exist between the different spheres and between abrupt and gradual changes. More importantly, classification in most cases appears more or less natural.

Table 2-1: Examples of potential substantial changes

Type of substantial changes	Examples of substantial changes	Year / Period
Incidents*[6]*: *(abrupt substantial changes in the technosphere)*	MS Herald of Free Enterprise incident, Zeebrugge, Belgium	1987
	Opening of Channel Tunnel	1994
	Concorde incident, Gonesse, France	2000
	Maglev incident, Lathen, Germany	2006
Events: *(abrupt substantial changes in the anthroposphere)*	Lockerbie bombing, Lockerbie, Scotland	1988
	September 11 terrorist attacks, USA	2001
	Bali bombings, Bali, Indonesia	2002 / 2005
	First and second oil crises, Global	1973 / 1979
Disasters: *(abrupt substantial changes in the biosphere)*	Severe acute respiratory syndrome outbreak (SARS), Global	2003
	Indian Ocean earthquake and tsunami, South East Asia	2004
	H1N1 flu pandemic, Global	2009
	Eruptions of Eyjafjallajökull, Iceland	2010
Developments: *(gradual substantial changes in technosphere)*	Jet engine technology: turbojet, turbofan, turboprop, etc.	1920 – present
	Automotive navigation systems	1980 – present
	Hybrid electric and electric vehicles	1990 – present
	Trans-European high-speed rail network, Europe	1996 – present
Trends: *(gradual substantial changes in the anthroposphere)*	Depletion of oil and other fossil fuels	1820 – present
	Liberalization of international aviation markets	1944 – present
	Emergence of low-cost airlines	1970 – present
	CAFE standards, USA	1975 – present
Evolutions: *(gradual substantial changes in the biosphere)*	Climate change	-

Often for gradual changes it is ambiguous which change started the series of changes that eventually led to changes in mobility patterns. Typically, it is a matter of taste or scope of the study. The proposed typology can however be applied independent of the question which change started a series of changes. For example, the late 2000s economic recession can be seen as a potential substantial change - it was a not properly anticipated economic trend, yet with considerable impacts. However, another author might consider this recession the result of the default of the Lehman Brothers. In that case the substantial change (the default of the Lehman Brothers) is an event. Yet another perspective is that the recession was the unforeseen result of the trend of financial deregulation from the 1990s onwards. Accordingly, financial deregulation is the substantial change (trend) that enacted a series of subsequent changes including the default of the Lehman Brothers and the late 2000s economic recession. Thus, the typology can be applied freely in accordance with the taste and scope of the user.

[6] Note that although a technological breakthrough is also an abrupt substantial change in the technosphere, they are missing in the list. This is because no good examples of true technological breakthroughs were found.

2.3 Literature overview

The literature study is conducted with two objectives in mind. The first objective is to provide an overview of academic research efforts into substantial changes: we would like to know which, and what types of, potential substantial changes have been studied and how they have been studied. The second objective is to bring together the findings on the impacts of past potential substantial changes on mobility. More specifically, we would like to see to what extent these changes have impacted on mobility patterns. Besides that, we apply the proposed typology on a sample of the literature to see its added value and test for its correspondence with the prevailing terminology in the literature.

2.3.1 Review methodology

The literature search was conducted using various databases, such as Google Scholar and Scopus. Combinations of words which are closely related to the terms 'substantial change' and 'mobility' were used as search tags. Next, the search results were assessed in terms of whether the changes studied potentially satisfied our definition of a substantial change. Studies on changes that clearly did not satisfy our definition were omitted. Furthermore, we required that the studies provided quantitative insights into changes in mobility patterns or traveller behaviour compared to a credible baseline. All bases for quantification were accepted (e.g. modelling studies, expert judgements, etc.). Lastly, we required that the changes in mobility patterns were caused by real substantial changes; we omitted from our search results experimental, conceptual and theoretical studies.

Furthermore, mirroring the many scenario studies that look one generation ahead and presume that no substantial changes will take place, we look one generation (more specifically: 40 years) back to see which substantial changes have actually taken place. Consequently, we did not dwell into historical research on for example the rise and fall of complete transport systems as such transformation cycles typically take up 50 years or more (Grübler and Nakisemovic 1991). This is beyond the time horizon of our demarcation.

Importantly, given space limitations and in light of the fact that this is – to the best of our knowledge – the first paper to provide an overview of the literature on substantial changes in the field of transportation in general and in passenger mobility in particular, we started with the low hanging fruit: we required that the studies themselves specifically addressed the impact of a potential substantial change on mobility. That is, we did not *connect* different strands of literature to show that particular substantial changes have taken place. For example, while no studies were found that specifically addressed the impact of the increase in female labour force participation on mobility patterns, it is well known by economists and demographers that female labour force participation has substantially increased over the last decades in many OECD countries (see e.g. Juhn and Simon 2006) and it is well known among transport researchers that labour participation and household composition are strong predictors for travel demand (e.g. Kitamura 2009). Thus, by connecting these studies, evidence may be found for substantial changes that are currently missing in our overview. We consider the establishment of these literature connections a particularly important direction for future research.

After having applied the above criteria, a snowball approach was used: reference lists from appraised papers were checked for further useful references and references that cited appraised papers were checked for useful references. Using this approach, a total of 41 relevant studies were identified, see Table 2-3. It goes without saying that it is unlikely that Table 2-3 provides a full list of every single potential substantial change that has been studied in the past 40 years. Nonetheless we are confident that the studies in Table 2-3 provide an illustrative sample of the literature on substantial changes.

2.3.2 General observations on the literature

Column 2 of Table 2-3 shows that most studies into potential substantial changes and their impact on mobility have been published in transport- and tourism-oriented journals. This is not surprising given our definition of a substantial change and our search criteria. Nevertheless, as substantial changes also take place outside of the transport system, studies have also been found in adjacent fields such as economics, energy, geography and urban planning.

Column 3 reveals that most studies use data that are collected in the US and in Asia. Other regions, most notably Europe, seem to lag in this regard. Presumably, this is because the impacts of some of the most eye-catching recent potential substantial changes, such as 9/11 and SARS were most heavily felt in respectively the US and Asia.

Looking at column 4, we note that there is surprisingly little variation in the potential substantial changes that have been studied. Four topics have been especially popular among scientists. In order of decreasing popularity, these topics are: ICT developments, terrorist events, pandemics, and the oil crises. Because studies on the impacts of ICTs on mobility are so numerous[7], we choose to focus on those studies that were most closely related to our perspective on substantial changes. A much smaller number of studies were found on electric bikes, economic crises and fuel economy standards. Furthermore, we see that many studies investigate more than one potential substantial change simultaneously. As such, these studies are able to compare impacts of various potential substantial changes in a consistent way as they are based on the same method or data set.

Column 5 presents the classification of the potential substantial changes according to the proposed typology. Classification of these potential substantial changes studied was straightforward and relatively unambiguous. However, interestingly in the reviewed literature it appears that mostly is referred to the potential substantial changes by simply recalling its name (e.g. ICT, CAFE regulation, Avian flu, etc.) rather than considering the change as being a specific type of change. This confirms our expectation that a widely acknowledge typology

[7] We only consider the literature on the impact of ICTs on e.g. teleworking, teleconferencing, etc. and do not dwell into the literature on the impacts of ICTs on travel supply, e.g. intelligent transportation systems.

is missing. An alternative explanation for the observed lack of use of typology is that this strand of literature is mainly concerned with the impacts of the substantial change (on mobility) rather than with the substantial change itself.

As can be seen in column 5, mostly abrupt substantial changes appear to have been studied, even though no studies were found on what we have coined incidents. More strikingly, studies on the impacts on mobility patterns of some rather obvious substantial changes appear to be missing in the overview, especially gradual ones. To name a few, no studies were found on the impacts on mobility patterns of the roll out of trans-national high-speed rail networks, of changing lifestyles, or of the large scale liberalisation of the aviation markets after WOII.

To test our typology on its correspondence with the prevailing terminology in the literature, we used the literature of Table 2-3. We hypothesize that in a study on a specific type of substantial change (according to our typology) the corresponding terminology is more frequently observed than non-corresponding terminology. Table 2-2 shows the observed frequencies[8] of specific terminology. It can be seen that for events, developments and trends the terminology prescribed by the typology is indeed most frequently encountered.

Table 2-2: Observed frequencies of type names in the selected literature review

	Number of papers	Number of counts:					Number of papers	Number of counts:			
		Incident	Event	Disaster	Totals			Developmer	Trend	Evolution	Totals
Paper deals with the impact of a:						*Paper deals with the impact of a:*					
Incident	0					Development	11	**30**	20	2	52
Event	17	6	**39**	11	56	Trend	2	18	**62**	0	80
Disaster	3	4	8	5	17	Evolution	0				
Totals		10	47	16	73	Totals		48	82	2	132

However, as noted earlier, these papers are mainly concerned with impacts of substantial changes. Therefore, we may have counted the terminology used to describe the impacts of substantial changes instead of the terminology used for the substantial changes itself. Therefore, Table 2-2 does not provide conclusive support for the typology. It provides some indication of correspondence within this strand of literature. We are positive that on a broader set of literature more convincing evidence can be found.

[8] Only papers that consider one type of substantial change (according to our typology) were used.

Table 2-2 Overview of studies on potential substantial changes and their impacts on mobility patterns

1. Study	2. Journal	3. Geographical region of study	4. Potential substantial change(s) studied	5. Classification according to typology	6. Causal chain of changes (focus of study in bold)		
					Substantial change and endogenous changes	Indirectly via	Change in mobility pattern
Small and Van Dender (2007)	–	US	CAFE standards	Trend	CAFE	-> **Increase in fleet fuel efficiency**	-> Change in travel demand
Cherry and Cervero (2007)	*Transport Policy*	CN	E-bikes developments	Development	E-bikes	->	Change in travel behaviour
Choo, Mokhtarian, and Salomon (2005)	*Transportation*	US	ICT	Development	ICT -> Telecommuting	<-> Economic activity, transportation price, transportation supply, socio-demographics	<-> Change in car travel demand
Choo and Mokhtarian (2007)	*Transportation Research Part A*	US	ICT	Development	ICT -> Telecommuting	<-> ICT cost, transportation cost, ICT infrastructure, transportation infrastructure, land use, economic activity, socio-demographics	<-> Change in mobility
Handy and Yantis (1997)	–	US	ICT	Development	ICT -> Non-work travel behaviour	->	Change in travel demand
Lenz and Nobis (2007)	*Transportation Research Part A*	DE	ICT	Development	ICT -> Fragmentation	->	Change in travel demand
Nilles (1991)	*Transportation*	US	ICT	Development	ICT -> Telecommuting	<-> Changes residential/ work location choices -> urban sprawl	<-> Change in commuter travel demand
Mokhtarian, Collantes, and Gertz (2004)	*Environment and Planning A*	US	ICT	Development	ICT -> Telecommuting	<-> Changes residential/ work location choices -> urban sprawl	<-> Change in commuter travel demand

Ory and Mokhtarian (2006)	*Urban Geography*	US	ICT	Development	ICT -> Telecommuting	<-> Changes residential/ work location choices -> urban sprawl	<-> Change in commuter travel demand
Senbil and Kitamura (2003)	*Annual Review of Energy*	JP	ICT	Development	ICT -> Home and cellular phone use -> out of home activities	->	Change in travel demand
Srinivasan and Raghavender (2006)	*Transportation Research Record*	IN	ICT	Development	ICT -> Unplanned activity-chaining, unplanned ride-shares, shopping over phone	->	Change in travel demand
Wang and Law (2007)	*Transportation*	HK	ICT	Development	ICT-> Time use	->	Change in travel behaviour
Dobruszkes and Van Hamme (2011)	*Urban Geography*	–	Late 2000s economic crisis	Trend	Late 2000s economic crisis -> Change in GDP	->	Change in air travel demand
Corsi and Harvey (1979)	*Journal of Travel Research*	US	Oil crisis	Event	Oil crisis -> Change in fuel price	->	Change in vacational travel behaviour
Hartgen and Neveu (1980)	*Proceedings of the National Energy Users*	US	Oil crisis	Event	Oil crisis -> Change in fuel price	->	Change in travel behaviour
Johnston, Elliott, Fletcher, and Lauder (1983)	*Conference for Transport Reviews*	NZ	Oil crisis	Event	Oil crisis -> Change in fuel price	-> **Fuel rationing scheme**	-> **Change in travel behaviour**
Ross (1989)	*Annual Review of Energy*	US	Oil crisis	Event	Oil crisis -> Change in fuel price	-> Change in transport policies -> Advances in tech. dev., changes in fleet composition	<-> Change in travel demand

Table 2-2 Continued

1. Study	2. Journal	3. Geographical region of study	4. Potential substantial change(s) studied	5. Classification according to typology	6. Causal chain of changes (focus of study in bold)		
					Substantial change and endogenous changes	Indirectly via	Change in mobility pattern
Pitfield (2011)	*Spatial Economic Analysis*	EU, US	Open skies agreements EU–US	Event	Open skies	->	Change in number of passengers on open sky routes
Lean and Smyth (2009)	*Asia Pacific Journal of Tourism Research*	MY	Pandemics: Avian flu, terrorism: various threats	Disaster	Avian flu, terrorism (various)	->	Change in tourism demand
Kuo, Chen, Tseng, Ju, and Huang (2008)	*Tourism Management*	AS	Pandemics: SARS + Avian flu	Disaster	SARS, Avian flu	->	Change in tourism demand
Min, Lim, and Kung (2011)	*Quality & Quantity*	TW	Pandemics: SARS	Disaster	SARS	->	Change in tourism demand
McAleer, Huang, Kuo, Chen, and Chang (2010)	*Environmental Modelling & Software*	AS	Pandemics: SARS + Avian flu	Disaster	SARS, Avian flu	->	Change in tourism demand
Page, Song, and Wu (2012)	*Journal of Travel Research*	UK	Pandemics: swine flu, late 2000s economic crisis	Disaster trend	Late 2000s economic crisis, swine flu	->	Change in tourism demand
Narayan (2005)	*Tourism Economics*	FJ	Political coups	Event	Political coup	->	Change in tourism demand
Blalock, Kadiyali, and Simon (2007)	*Journal of Law & Economics*	US	Terrorism: 9/11	Event	9/11	-> **Enhanced security measures**	-> **Change in air travel demand**
Blunk et al. (2006)	*Applied Economics*	US	Terrorism: 9/11	Event	9/11	->	Change in air travel demand

Bonham, Edmonds, and Mak (2006)	*Journal of Travel Research*	US	Terrorism: 9/11	Event	9/11	->	Change in air travel demand
Cunado, Gil-Alana, and de Gracia (2008)	*Tourism Economics*	US	Terrorism: 9/11	Event	9/11	->	Change in air travel demand
Guzhva and Pagiavlas (2004)	*Journal of Air Transport Management*	US	Terrorism: 9/11	Event	9/11	->	Change in air travel demand
Haywood and Randal (2006)	–	NZ	Terrorism: 9/12	Event	9/11, 1997 Asian financial crisis, 1987 US stock market crash	->	Change in tourism demand
Ito and Lee (2005a)	*Journal of Economics and Business*	US	Terrorism: 9/11	Event	9/11	->	Change in air travel demand
Ito and Lee (2005b)	*International Journal of the Economics of Business*	AU, CA, EU, JP	Terrorism: 9/11	Event	9/11	-> Changes in risk perception	-> Change in air travel demand
Lai and Lu (2005)	*Journal of Air Transport Management*	US	Terrorism: 9/11	Event	9/11	->	Change in air travel demand
Lee, Oh, and O'Leary (2005)	*Tourism Analysis*	US	Terrorism: 9/11	Event	9/11	->	Change in air travel demand
Njegovan (2006)	*Journal of Transport Economics and Policy*	UK, US, CA, DE	9/11, oil crises, Second Gulf War	Event	9/11, oil crises, Second Gulf War	->	Change in air travel demand
Srinivasan, Bhat, and Holguin-Veras (2006)	*Transportation Research Record*	US	Terrorism: 9/11	Event	9/11	-> **Enhanced security measures -> increased travel time, changed security perceptions**	**Change in mobility patterns**

Table 2-2 Continued

1. Study	2. Journal	3. Geographical region of study	4. Potential substantial change(s) studied	5. Classification according to typology	6. Causal chain of changes (focus of study in bold)			
					Substantial change and endogenous changes		Indirectly via	Change in mobility pattern
Pizam and Fleischer (2002)	*Journal of Travel Research*	US	Terrorism: general	Event	Severity and frequency of terrorism	->		Change in tourism demand
Coshall (2003)	*Journal of Travel Research*	UK	Terrorism: Lockerbie, Libyan bombing and Gulf war	Event	Lockerbie, Libyan bombing, Gulf war	->		Change in tourism demand
Bhattacharya and Narayan (2005)	*Applied Economics*	IN	Events in general	Event	Events in general	->		Change in tourism demand
Narayan (2008)	*Transportation Research Part A*	AU	Terrorism: 9/11, 1997 Asian financial crisis	Event, trend	9/11, 1997 Asian financial crisis	->		Change in tourism demand
Smyth, Nielsen, and Mishra (2009)	*Applied Economics*	ID	Terrorism: Bali Bombing, 9/11, 1997 Asian financial crisis	Event, trend	Bali bombing 9/11, 1997 Asian financial crisis	->		Change in tourism demand

Notes: AS, Asia; AU, Australia; CA, Canada; CM, Cambodia; CN, China; DE, Germany; EG, Egypt; EU, Europe; FJ, Fiji; HK, Hong Kong; ID, Indonesia; IN, India; IL, Israel; IS, Iceland; JP, Japan; KH, Korea; MY, Malaysia; NL, The Netherlands; NZ, New Zealand; UK, United Kingdom; US, United States; TW, Taiwan; ->, prevailing directional causal relation; <->, correlation.

2.3.3 Direct and indirect impacts of substantial changes

Substantial changes can either directly impact on mobility patterns or impact indirectly on mobility patterns by starting a series of other changes that eventually leads to changes in mobility patterns. The last column (6) of Table 2-3 shows how the potential substantial change caused changes in mobility patterns in the perception of the author(s) of the paper. In the first sub column, we see the substantial change that is considered responsible (by the author(s)) for the changes in mobility patterns. The column is complemented with so-called 'endogenous' changes. The endogenous changes are changes that are considered to belong to the potential substantial change that led to changed mobility patterns. For example: the oil crises echo fuel shortages and these in turn echo high fuel prices. The far right sub column shows the reported changes in mobility patterns that were, directly or indirectly, the result of the change. If only the left and the right sub columns are filled, it implies that the potential substantial change directly led to a change in mobility patterns, according to the author(s) of that paper. The middle column is used when the potential substantial change indirectly led to a change in mobility patterns. For example, the 9/11 event led to increased security measures which changed air travel demand (Blalock et al. 2007). As can be seen, relatively few studies on indirect impacts have been found. The studies that do study indirect impacts typically do not devote equal amounts of attention to both relations in the causal chain. If one part of the causal chain has been studied more in-depth than the other, then in Table 2-3 this relation is depicted in bold.

As noted earlier, we find that the impacts on mobility patterns of only a relatively small number of gradual substantial changes have been studied. However, that is not to say that these gradual substantial changes have not been studied at all; rather, it appears that many studies on gradual substantial changes investigate only direct impacts. For example, many studies were found on the direct impacts of the liberalisation of aviation markets on e.g. airfares, airline services, alliances, strategies, etc. (e.g. Dresner and Tretheway 1992; Barrett 2000; Adler and Golany 2001). These studies have developed valuable insights on the direct impacts of these substantial changes. Yet, typically the impacts of many gradual substantial changes on mobility involve indirect impacts. This explains the relatively small number of gradual substantial changes in our overview.

One of the reasons why mostly direct, instead of indirect, impacts have been studied, stems from the complexity of indirect impacts. When studying indirect impacts in complex systems, such as the transport system, confounding of dynamics with other impacts is very difficult to avoid. This impedes tractability. Yet, tractability is essential for quantifying the impact of a substantial change. Thus, the dynamics which are typically present in complex systems often hamper a quantification of the impact of those substantial changes that indirectly impact on mobility patterns. This is particularly well illustrated by two gradual substantial changes, namely the Corporate Average Fuel Economy (CAFE) standards and ICT developments. Accordingly, research on both substantial changes exhibits some peculiarities. These are discussed here in a bit more detail.

Indirect impact of the CAFE standards on mobility patterns

CAFE standards are USA regulations that intended to improve the average fuel economy of cars and light trucks. First standards did apply to 1978 car models. What is interesting with respect to the CAFE standards is the asymmetric underpinning of their impacts on mobility patterns. It is widely believed that the principal impact of the CAFE standards on mobility patterns is an increase in vehicle miles travelled (VMT) resulting from reduced vehicle travel costs due to increased vehicle fuel economy. Therefore, to properly assess this indirect impact, two impacts need to be understood, namely: the impact of the CAFE standards on vehicle fuel economy and the impact of vehicle fuel economy on mobility patterns. Both impacts are equally important. Numerous studies on 'rebound effects' have been conducted to elicit the impacts of improved fuel efficiency and reduced vehicle travel costs on travel and (see Jones (1993); Dargay (2007); Hymel et al. (2010) and see Greening et al. (2000), Goodwin (2004) and Graham et al. (2004) for recent reviews studies on rebound effects and fuel price elasticities). More importantly, findings reported in these studies are more or less unanimous: they predominantly report that the long run fuel price per mile elasticities fall between - 0.10 and - 0.25. However, substantially fewer studies have specifically addressed the impact of the CAFE standards on the vehicle fuel economy i.e. tried to disentangle the impact of the CAFE standards on vehicle fuel economy from other changes in explanatory variables such as increasing fuel prices. More importantly, findings reported in this latter type of studies have not been quite so unanimous: some studies report significant impacts on fuel economy while others do not (Cf. Crandall et al. 1986; Mayo and Mathis 1988; Greene 1990; Small and Van Dender 2007). Therefore, the degree to which the CAFE standards have contributed to the improved vehicle fuel economy remains uncertain. Thus, although one part of the causal chain is quite clear, the other is not. As a result, the impact of the CAFE standards on mobility patterns remains largely unclear (NRC 2002).

Indirect impacts of ICT developments on mobility patterns

With respect to the impacts of ICTs on mobility, it is interesting to see that the research focuses on direct impacts. Early studies were mainly concerned with the direct impacts resulting from ICTs' potential to substitute the commute. Then, from the 1990s, scholars started to study, besides substitution effects, modification and complementarity effects. Research was also extended towards maintenance activities (e.g. teleshopping and telebanking) and discretionary activities (e.g. teleleisure). See Andreev et al. (2010) for a recent review. Yet, these were all direct impacts of ICTs. Towards the end of the 1990s, it was realised that relations between ICT and transport are much more subtle and complex than initially thought (Banister and Stead 2004). Banister and Stead (2004) elaborated on new perspectives on the relations between ICT and travel and highlighted the need for research into the often subtle interactions and indirect impacts such as changes in land use, lifestyles, residential location as well as travel supply (e.g. intelligent transportation systems). However, as another recent paper argues, empirical research that specifically addresses indirect impacts of ICTs on mobility is still relatively scarce (Van Wee et al. 2011). As can be seen in our overview-table, only a few studies have been found that specifically addressed such indirect impacts of ICTs (e.g. Nilles 1991; Mokhtarian et al. 2004; Ory and Mokhtarian 2006). Thus, while the direct impacts of ICT have been widely studied and are clear, the indirect impacts remain largely unclear. As a result, the full picture on the impacts of ICTs on mobility remains unclear.

2.3.4 Findings on the impacts of potential substantial changes on mobility

In this subsection we aim to see which of the potential substantial changes listed in our overview have indeed been found to have enduringly changed mobility patterns, and to what extent. Table 2-4 shows the reported findings on the impacts of potential substantial changes on mobility patterns.

To see which dimensions of mobility have been changed by past potential substantial changes, we can look at the indicators that are used to measure their impacts. Column 2 of Table 2-4 shows that mostly distance related indicators are used, such as vehicle miles travelled (VMT), revenue passenger miles (RPM), and one-way commute lengths. Distance-related indicators appear to be mostly used for substantial changes that are not exclusively linked to one particular geographical region (e.g. the oil crisis or ICT developments). When it concerns specific geographical regions 'international tourist arrivals' is predominantly used as indicator. Lastly, also modal split is frequently used as an indicator. Not surprisingly, this indicator is either used when the potential substantial change has changed the availability of modes of transport or when it has substantially altered attributes of a modes of transport.

If we look at column 3, what catches the eye is that the degree of impact on mobility of the potential substantial changes varies dramatically. On the one hand, most studies focusing on ICTs and 9/11 report profound and 'enduring' changes in mobility patterns. On the other hand, mild changes or major but merely temporary changes have been reported for many other changes such as SARS, various terrorist events (except for 9/11), the 2008 EU-US open sky agreement, etc. Apparently, these changes did not, or not yet, 'enduringly' change mobility patterns profoundly. Remarkably, for the oil crises the picture of their impacts remains largely unclear. The reported impacts of the oil crises in our overview do not give rise to think that their impacts have been considerable. Yet, it is widely believed that their impacts on mobility have been far from insignificant (see e.g. Ross 1989). So, it seems that particularly quantitative studies to underpin this believe are largely missing. However, it should be noted that many of the advanced econometrics we have today were not available at that time. Lastly, no indication of a relation between the magnitude of impact on mobility and the type of change (according to our typology) has been found.

Table 2-4 Reported findings on the impacts of potential substantial changes on mobility patterns

1. Study	2. Indicator used to measure change in mobility pattern	3. Reported changes in mobility patterns
Small and Van Dender (2007)	VMT	(1) The degree to which the CAFE regulations have affected fleet fuel efficiency remains uncertain (2) Short- and long-run rebound effects are estimated to have led to an increase in VMT of, respectively, 4.5% and 22.2% over the period 1966–2001 (3) Increase in real income and falling fuel prices diminished the effects of CAFE
Cherry and Cervero (2007)	Modal split, vehicle kilometres travelled (VKT)	(1) Electric bikes displace a small amount of car trips (2) The VKT of electric bikes is 9% and 22% higher than ordinary bicycles in Shanghai and Kunming, respectively. The result is increased daily VKT and thus energy use and emissions
Choo et al. (2005)	VMT	(1) Reduction of VMT as a result of ICTs is most likely small, falling somewhere between a 2% reduction in VMT and essentially no change in VMT
Choo and Mokhtarian (2007)	VMT	(1) The net effects between telecommunications and travel are positive in both directions, indicating that the aggregate relationship between telecommunications and travel is complementarity, that is, as telecommunications demand increases, travel demand increases, and vice versa
Handy and Yantis (1997)	VMT	(1) The degree to which inhome versions of activities substitute for out-of-home versions of an activity depends on the nature of the activity and the characteristics of the individuals (2) The travel implications are not always clear. No reduction in travel has been found
Lenz and Nobis (2007)	Travel demand in general	(1) Mobile fragmenters practice fragmentation in all fields of activities and have a higher demand for travel. However, the causal relationships between the fragmentation of activities and the effects on travel demand are still not fully understood
Nilles (1991)	One-way commute lengths	(1) Telecommuting does not exacerbate urban sprawl and therefore does produce net reductions in household travel: it decreases automobile use, both in terms of number of trips and in trip distance. Reductions are proportional to the intensity of telecommuting
Mokhtarian et al. (2004)	One-way commute lengths	(1) One-way commute distances were higher for telecommuters than for non-telecommuters (2) Total commute distances were generally lower for telecommuters than for non-telecommuters, indicating that they telecommute often enough to more than necessary to compensate for their longer one-way commutes
Ory and Mokhtarian (2006)	One-way commute lengths	(1) Telecommuting more often follows, rather than precedes the relocations that lengthen the commuting trips. However, residential moves that are temporally associated with telecommuting episodes tend to increase commute time and length compared to other moves

Senbil and Kitamura (2003)	Travel time	(1) Substitution effects prevail between telecommunications and travel when work activities are concerned (2) Complementary effects are prevalent for discretionary activities (3) There appears to be neutral relationships between telecommunications and maintenance activities
Srinivasan and Raghavender (2006)	Mode choice, frequency of travel	(1) Mobile phones significantly affect travel dimensions and activity participation. However, to what extent do the observed changes in individual travel behaviour translate into aggregate impacts, for example, in terms of trip reduction, congestion, energy consumption is not clear yet
Wang and Law (2007)	Travel time, trip-making propensity	(1) The use of ICT generates additional time use for out-of-home recreation activities and travel and increases trip-making propensity (2) Wide application of ICT probably leads to more travel
Dobruszkes and Van Hamme (2011)	Number of passenger seats	(1) During the 2008−2010 crisis period, the annual growth rates of the number of seats for the US and Europe were, respectively, −8% and −4%. GDP growth is the most significant variable to explain changes in the number of seats at the national level
Corsi and Harvey (1979)	Modal split, distance to holiday destination	(1) Compared to 1972, in 1975, 22% of the respondents indicated to have changed modes of travel, 26% have indicated to have cancelled long distance holidays and 33% have indicated to have taken a vacation of shorter distance
Hartgen and Neveu (1980)	Mode split, travel speed, travel distance, travel frequency	(1) Most conservation occurred through car-related actions, particularly fuel-efficient car purchasing and car selling (2) Popular conservation strategies were: combining shopping with other trips, driving slower, shopping closer to home, tuning car, vacationing closer to home, etc. The nature of the responses varies by area and by group (3) Consumer actions were generally independent of government directives
Johnston et al. (1983)	Modal split	(1) Three main adaptations were made to travel behaviour on the selected carless day: use of another car (which favoured the multi-car families); postponement of the trip to another day; sharing a car with another person
Ross (1989)	VMT	(1) The energy intensity of automobiles and light truck decreased approx. 2% per year over the period 1972−1985. However, the combined VMT growth was about 3% over the same period
Pitfield (2011)	Number of air passengers	(1) No particular boost or discontinuity in passenger numbers was found, except for the route Amsterdam−New York. (2) The impact on the Amsterdam−New York route is approx. 10% of the average traffic volume on that route

(*Continued*)

Table 2-4 Continued

1. Study	2. Indicator used to measure change in mobility pattern	3. Reported changes in mobility patterns
Lean and Smyth (2009)	International tourist arrivals	(1) Following substantial changes, the growth in tourist arrivals have generally slowed (2) The impacts of substantial changes on tourist arrivals were only transitory. NB: the unit root test with one break is able to reject the unit root for between 60% of source markets where the break is specified as in the intercept and 90% of source markets where the break is specified as in the intercept and slope. The unit root test with two breaks is able to reject the unit root for all source markets, irrespective of how the break is specified
Kuo et al. (2008)	International tourist arrivals	(1) Asian tourism demand has been significantly damaged by SARS, but not by Avian flu (2) The numbers of affected cases appear to have a significant impact on SARS-affected countries but not on Avian flu-affected countries: the impact of each SARS-infected person on tourist arrivals ranges from 175 to 1742 depending on the location
Min et al. (2011)	International tourist arrivals	(1) Inbound tourism from Japan was devastated disaster, particularly during the first 5 months after the SARS outbreak. The impact of SARS on tourism demand lasted for about a year
McAleer et al. (2010)	International tourist arrivals	(1) Both the short run and long run SARS effect have a more significant impact on international tourist arrivals than does Avian flu (2) The effects of deaths arising from both SARS and Avian flu suggest that SARS is more important to international tourist arrivals than is Avian flu
Page et al. (2012)	International tourist arrivals	(1) The swine flu pandemic and the global economic crisis that began in 2008 have together had a significantly negative impact on the demand for UK inbound tourist arrivals ranging from −7% form Hong Kong to −64% from mainland China
Narayan (2005)	International tourist arrivals	(1) Visitor arrivals in Fiji from Australia, New Zealand and the USA are stationary, implying that such events have a temporary effect
Blalock et al. (2007)	Number of air passengers	(1) Baggage screening reduced passenger volume by about 6% on all flights and by about 9% on flights departing from the nation's 50 busiest airports
Blunk et al. (2006)	Revenue passenger	(1) The impacts of 9/11 were not temporary (2) The difference between *ex post* forecasted RPM and actual RPM is 54.1% in September 2001 and steadily falls throughout the remainder of the year. Even in December2002, the difference was still 12%
Bonham et al. (2006)	International tourist arrivals	(1) A sharp decline in inbound travellers in the wake of 9/11 (2) Hawaii tourism arrivals did fully recover, perhaps because of substitution for international arrivals by Americans
Cunado et al. (2008)	International tourist arrivals	(1) Structural breaks have been identified and the break dates can be associated with 9/11 (2) The negative shock produced by the 9/11 terrorist attacks should be transitory

Guzhva and Pagiavlas (2004)	Revenue passenger	(1) Four US major airlines were responsible for more than 63% of total decline in industry RPMs due to the September 11th terrorist attack (2) Some regional airlines were able to significantly improve their performance immediately following the September 11th attack
Haywood and Randal (2006)	International tourist arrivals	(1) The events of 9/11 did not have much influence on the longer term numbers of visitors to New Zealand, and especially not a negative influence (2) Other events, such as the stock market crash of October 1987, the Asian financial crisis of 1997–1998 and SARS had a more significant impact on both the intercept and slope of total arrivals
Ito and Lee (2005a)	RPMs	(1) September 11 resulted in both a negative transitory shock of over 30% and an on-going negative demand shock amounting to roughly 7.4% of pre-September 11 demand. This on-going demand shock has yet to dissipate (as of November 2003) and cannot be explained by economic, seasonal or other factors
Ito and Lee (2005b)	Revenue passenger kilometres	(1) All countries and regions in the analysis suffered significant declines in the demand for international air travel as a result of the 9/11 event (2) The on-going downward shift in demand for international travel through the end of 2003 ranged between −15% and −36.5% for various countries (3) The impact on international air travel demand appears to have been the most significant in Europe and Japan
Lai and Lu (2005)	Number of air passengers	(1) After 9/11 both domestic and international air traffic was significantly impacted for 1 and 2 months, respectively (2) The impact pattern was thus abrupt and temporary, instead of gradual and permanent
Lee et al. (2005)	Number of air passengers	(1) Empirical results indicated that the US air transport passenger demand has not yet fully recovered from the September 11 terrorist attacks (2) It seems that the terrorist attacks appear to have a short-term impact on air transport passenger demand (3) No strong long-term impacts on air transport passenger demand are expected
Njegovan (2006)	Number of air passengers	(1) For the UK, Australia, and Germany the findings suggests that shocks to air passenger traffic are largely transitory. The exception is the shock associated with 1970s oil price rises, and the concurrent worldwide economic recession, which is found to have had a long-term impact on air passenger traffic growth in these countries (2) For the US and Canada no evidence of trend-reverting behaviour is found

(*Continued*)

Table 2-4 Continued

1. Study	2. Indicator used to measure change in mobility pattern	3. Reported changes in mobility patterns
Srinivasan et al. (2006)	Safety preference	(1) Travellers have become increasingly conscious about travel safety and security issues. Individuals who hold positive impressions about the security measures are more likely to fly (2) The utility of air mode decreases with increasing inspection and boarding time, reducing air travel demand
Pizam and Fleischer (2002)	International tourist arrivals	(1) The frequency of acts of terrorism had caused a larger decline in international tourist arrivals than the severity of these acts
Coshall (2003)	Number of air passengers	(1) The effects of terrorist events on UK air travel vary in onset, magnitude and duration according to the destination involved and the state that a crisis has reached (2) Highly attractive destinations for the UK traveller experience rapid recovery after events. Thus, travellers are highly willing to substitute insecure images for secure ones once a situation has simmered down
Bhattacharya and Narayan (2005)	International tourist arrivals	(1) In the period 1980–1999, for India, only temporary effect on tourist arrivals were found (no structural breaks were needed in the test to find stationary data). This is perhaps due to the nature of the tourists India receives.
Narayan (2008)	International tourist arrivals	(1) For the period 1991:01–2003:09, visitor arrivals to Australia are stationary for 25/28 countries using a univariate unit root test that allows to accommodate two structural breaks. (2) The structural breaks predominantly coincide with 9/11 and the Asian financial crisis and has slowed down the growth rate in visitor arrivals to Australia from 22 out of 28 of the tourism source markets
Smyth et al. (2009)	International tourist arrivals	(1) Shocks to international tourist arrivals from Bali's 11 major source markets are jointly trend stationary with transitory shocks, thus following shocks, international tourist arrivals from Bali's major source markets will revert to their long-run growth path. NB: the univariate unit root tests with and without structural breaks were unable to reject non-stationarity in international tourist arrivals in Bali; however, the panel unit root tests with one and two structural breaks were able to reject non-stationarity for Bali's 11 major tourist source markets

Given the objective of this paper, we are mainly interested in the changes that, in retrospect, have indeed enduringly considerably changed mobility patterns. Therefore, next we discuss findings on ICT developments and the 9/11 event more in-depth. Although it is likely that the oil crises also can be considered substantial changes, we do not discuss their impacts for reasons of succinctness and because quantitative studies on their impacts are scant.

The impacts of ICT developments on mobility patterns

In the literature there is little doubt that the impacts of ICTs on travel behaviour have not been considerable. It is widely acknowledged that ICTs have changed travel behaviour in a wide variety of ways. However, to date it is largely unclear how these have unfolded in terms of aggregate mobility patterns. Below we discuss some of the important findings in this context.

One might expect to find many studies concerning ICTs' impact on mobility using aggregate longitudinal data. Such studies can provide insights on the joint evolution of ICT-market shares and aggregate mobility patterns over time. However, as can be seen in the overview, only two such studies were found and only on one highly aggregate measure for mobility, namely vehicle miles travelled (VMT). Choo et al. (2005) studied the impact of telecommuting on VMT using a multivariate time series (MARIMA) model. They found that the reduction of VMT as a result of ICTs is most likely falling somewhere between a 2% reduction and essentially no change. A second, follow up, study has been conducted by Choo and Mokhtarian (2007). In this study aggregate relations between telecommunications and total vehicle travel demand (VMT) were explored. Using structural equations models (SEM) on multivariate aggregate time series data spanning from 1950 to 2000, this study found strong evidence for a positive net effect between use of ICTs and travel demand; indicating that on the aggregate level complementarity effects prevail.

Most studies on ICTs have been conducted on disaggregate data. These studies have provided indispensable insights on how mobility patterns are affected by ICTs. Many report considerable impacts on various mobility patterns. Generally, studies on disaggregate data found that: 1) at least on the short term, substitution effects prevail for commute travel, 2) mixed effects prevail for maintenance activity travel, and 3) complementary effects prevail for discretionary activity travel (Cf. Senbil and Kitamura 2003; Andreev et al. 2010; Holden and Linnerud 2011). However, most of these studies also conclude that aggregation of their findings is difficult. Therefore, the aggregate impacts on mobility patterns of the effects studied remain largely unclear (e.g. Handy and Yantis 1997; Senbil and Kitamura 2003; Srinivasan and Raghavender 2006).

Altogether, we conclude that the literature does not provide a clear picture of the magnitudes of impacts of ICTs on mobility patterns. Nevertheless, based on the literature we feel that it is safe to say that the impacts of ICTs on mobility have indeed been enduring and probably larger than 5% on various indicators of mobility.

The impacts of the 9/11 event on mobility patterns

In the literature there is no doubt that the 9/11 terrorist events severely changed mobility patterns in the months right after. However, to date there is controversy about whether or not new, enduring mobility patterns have emerged (Cf. Lai and Lu 2005; Lee et al. 2005; Blunk et al. 2006). Most studies however indicate that the impacts on mobility patterns are enduring. For example, Ito and Lee (2005a) used monthly domestic US RPM data from 1986 to 2003 to evaluate the impact of 9/11. Using simultaneous equation modelling, they found that, in the US, 9/11 resulted in an 'on-going' negative demand shock of roughly 7.4% as of November 2003 that cannot be explained by economic, seasonal, or other explanatory variables that were considered in their model. Blunk et al. (2006) evaluated the impact of 9/11 on US air travel demand (RPM) using a vector autoregressive model and found that air travel demand did not return to the levels expected to have occurred in the absence of the attacks. They reported that in December 2002, the difference was still minus 12% compared to what would be expected in the absence of the attacks. Similar results are reported for other regions of the world (see e.g. Ito and Lee 2005b). Furthermore, also a number of studies that used unit root tests with structural breaks have found evidence for 9/11 having an enduring impact. In international tourist arrivals time series they generally found structural breaks associated with the 9/11 event (e.g. Narayan 2008; Smyth et al. 2009).

Disaggregate studies can be used to provide underpinnings for why the impact of 9/11 has been enduring. A number of such studies report evidence that the security measures that were enacted after 9/11 are primarily responsible for the enduring impacts on mobility (e.g. Srinivasan et al. 2006; Blalock et al. 2007). These studies argue that the measures have led to increased travel times and travel inconveniences, thereby reducing air travel demand. Besides this explanation, various others have been suggested: e.g. that fear levels have increased and that US visa-entry requirements have become more strict relative to many other countries (Floyd et al. 2004; Bonham et al. 2006). However, there is relatively little empirical evidence for those explanations.

With respect to 9/11, we can conclude that the impacts of 9/11 are most likely still apparent and likely the result of increased security measures. However, as no studies were found that compared observed time series with estimated time series without the event beyond the year 2005 studies to conclusively underpin this are missing. Nevertheless, as the enhanced security measures are still in force, we roughly estimate that its current impact in the US and perhaps also elsewhere in the world on air travel demand is likely to be somewhere in the order of minus 5%.

Conclusion

All in all, based on the indications in the literature, we believe that ICTs, 9/11 and the two oil crises can be considered substantial changes (see Table 2-5 for their time allocation). However, it should be noted that it appears challenging to estimate the impacts of substantial changes on mobility. In fact, not a single study provided conclusive evidence that any change strictly qualified the criteria for a substantial change.

Table 2-5: Identified substantial changes

Identified substantial changes	Year / Period of emergence
First oil crisis	1973
Second oil crisis	1979
ICT developments	1985 - present
9/11 terrorist attacks	2001

2.4 Conclusions and discussion

Conclusions

Firstly, with respect to the terminology used in the literature we found that in the papers selected for review the potential substantial changes were most often recalled by their names rather than being considered of a specific type change. This confirmed our suspicion that a generally acknowledged typology is lacking. Secondly, with respect to the proposed typology on substantial changes, we found that it was relatively easy and unambiguous to apply. Furthermore, we found some initial support for the proposed typology: the terminology prescribed by the typology was more frequently encounter in the studies on this type of change than in studies that were not. However, more research is needed to find more conclusive evidence for its correspondence with the prevailing terminology in the literature on substantial changes.

Content wise, a first finding of our literature study is that four sorts of potential substantial changes appear to have especially been popular research topics among scholars, in order of decreasing popularity: ICT developments, terrorist events, pandemics, and the oil crises. Moreover, we found that the impacts on mobility patterns of some quite obvious, mostly gradual, substantial changes have not or very little been studied (e.g. roll out of trans-national high-speed rail networks, changing life-styles, the liberalisation of the aviation markets, developments of electric cars and bikes). Furthermore, it was found that indirect impacts have received relatively little attention from the scientific community.

Not surprisingly, the level of impact of the reviewed potential substantial changes on mobility patterns varied dramatically. We found that most changes merely had transitory impacts. However, for the emergence of ICTs and for the 9/11 event most studies indicated ‘enduring’ changes in mobility patterns which suggests that these changes can be considered to be substantial changes. Based on indications from the literature, we roughly estimate that the average impacts of ICTs and the 9/11 event have been in the order of 5% to 10% on various indicators of mobility. This implies that if we also count the two oil crises, loosely speaking, during the last 40 years in each decade a substantial change has taken place. Accordingly, our findings suggest that to the extent that these substantial changes have not, or not carefully, been accommodated in past transport models or scenarios, they may have caused considerable inaccuracies in past modelling and scenario studies.

Discussion

Limitations of this study are clear: with respect to our research approach, it should be noted that to identify substantial changes we relied on the published literature. However, authors of these papers are unlikely to have had the same research objective and ideas about change while studying the impacts of changes as we have. Therefore, our findings are based on the interpretation of results of studies with divergent research objectives. In addition, it should be noted that for each of the four identified substantial changes the evidence is not incontestable: for the oil crises quantitative studies are largely missing, for ICTs their impacts are so diverse and complex that it largely unclear how these unfold on aggregate level mobility patterns and for 9/11 conclusive evidence on its long term impacts is missing as no studies have been conducted using data after 2005. Nevertheless, despite these shortcomings, with the typology and the overview of the studies that report on the impacts of potential substantial changes, we have taken the first necessary step to facilitate discussions and research on the impacts of potential substantial changes on future mobility patterns. Having this overview, a next natural step is to carefully seek out for primary data to find conclusive evidence on the impacts of specific potential substantial changes.

Furthermore, we found some initial support for the proposed typology. However, various questions can be raised about the proposed typology. Our typology is based on prevalence of terminology in the literature that specifically reports on the impacts of changes on mobility. Accordingly, it is not grounded in the literature on 'change' or 'transition'. Further research is needed to see to what degree the proposed typology can be embedded in this literature. Besides that, concerning the effectiveness of the proposed typology; it is by no means sure whether no better typology exists to explain the used terminology in the literature. Moreover, it can be questioned whether correspondence with prevailing literature is intrinsically a desirable property of a typology at all - especially when the terminology used in the literature seems to be blurred. In addition, one generally applying typology – as we propose - may be too rigid: it may mask more than it reveals. Perhaps future research and discussions concerning substantial changes would be better served by a small number of typologies specific for fields such as risk management, medical sciences, and natural sciences. To what extent other typologies would perform better or worse in terms of facilitation of future research and discussions on substantial changes or in terms of correspondence with the prevailing terminology in the literature is unclear and needs to be addressed in future research.

The non-trivial question is of course how to interpret our findings on the impacts of past substantial changes from a policy makers' perspective, or from the perspective of a scholar or practitioner interested in doing forecasting studies with the aim of informing long term transport policies. At first sight, one may be inclined to conclude that our findings do not give rise to grave concern: if the coming 40 years will see similar substantial changes in terms of order of magnitudes and directions as the ones we have seen during the last 40, then our findings suggest that scenario studies based on business-as-usual scenarios will do a fairly reasonable job. However, the fact that the last 40 years did not see substantial changes that turned mobility upside down is by no means a guarantee that the coming 40 years will not see them either. Especially if we take into consideration the challenges faced by society today, such as oil depletion and climate change the absence of more drastic substantial changes in the coming 40 years seems relatively unlikely.

And even if we would be sure that the coming 40 years will see one or more substantial changes in the order of magnitude that goes well beyond what we have seen in the past forty years, then the implications of this knowledge are still not straightforward. It merely raises the fundamental question of how to deal with the large number of substantial changes[9] that may (or may not) occur in the medium- and long-term future, of which many have very low a priori probabilities of occurrence. Scenario studies can be conducted to derive insights on how the future could look like. However, for sure, constructing scenarios for all potential substantial changes will not contribute to more informed policy making. Therefore, it is probably best to deal with this dilemma by periodically selecting a small number of relatively likely and potentially profound substantial changes, construct scenarios based on these, assess their impacts on the transport system and evaluate the robustness of the transport system and transport policies. Examples of potential substantial changes would possibly include severe pandemic outbreaks, peak oil, and heavy carbon taxes if we were to make a selection today. Importantly, we do not wish to suggest here to haphazardly develop all kinds of 'wild' scenarios, and dispose of the business-as-usual scenario studies; rather, we suggest a more conservative approach in which conventional scenarios studies are complemented with scenarios studies that include potential future substantial changes. We feel that this approach contributes to more informed long term transport policies.

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[9] To name a few: severe pandemic outbreaks, oil depletion, technological breakthroughs of e.g. solar energy or nuclear fusion, a new world order, climate change, a complete financial meltdown, a third world war, etc.

3 Vacationers' intended responses to a substantial increase in travel costs

3.1 Introduction

In its present form, tourism relies heavily on the availability of cheap mobility (e.g. Becken 2011). However, as well illustrated by the oil crises in the 1970s, cheap mobility is not a fact of life. As has been argued in the introduction of this thesis various substantial changes loom on the horizon which may impair cheap mobility in the future. Therefore, given the major economic and social importance of the tourism, it might be advisable for governments and tourism industry to anticipate on such substantial changes.

However, anticipation to such potential changes is hampered by limited knowledge on vacation travel behaviour under high travel cost conditions. To the best of the author's knowledge to date just three empirical studies have been conducted that address vacation travel behaviour under high travel cost conditions (Corsi and Harvey 1979; Kamp et al. 1979; Williams et al. 1979). These three studies have been conducted in the US during, or in the aftermath of the oil crises and investigated vacation travel behaviour under two possible future fuel supply situations: high fuel costs and fuel rationing. It was found that a variety of vacation responses were to be expected if the sketched high oil prices or rationed fuel supply situation was to occur. Besides that, socio-economic characteristics such as income, age of household head, and education level were found to be important for vacationers' responses.

Yet, despite that these studies are insightful they are unlikely to provide accurate insights for what can be expected if in the coming decade vacationers would be confronted with a substantial increase in travel costs – especially not outside of the US. Vacation travel behaviour is well-known to be transient and cross-culturally different (Oppermann 1995; Pizam and Sussmann 1995). Moreover, various important determinants of vacation travel behaviour have changed dramatically ever since (e.g. income levels, demography, and transport infrastructure, just to name a few). Yet, to adequately anticipate on high travel costs conditions requires having accurate insights on the vacation responses to a substantial increase in travel costs.

The present study takes this thesis' first empirical step in exploring vacation travel behaviour under high travel cost conditions. More specifically, this study has three objectives. Firstly, it aims to inquire how vacationers intend to respond when confronted with a substantial increase in travel costs. For instance, do vacationers intend to skip relatively few vacations and seek closer-by destinations, or do they intend to skip relatively many vacations without looking for other closer-by destinations, or neither of these? Secondly, it aims to explore whether vacationers intend responding by taking specific bundles of responses – as opposed to opting for just one response. It is hypothesized that specific combinations of responses such as for instance to book a cheaper accommodation, to reduce location expenses, and to stay longer at a destination might be popular. Thirdly, it aims to identify relations between socio-economic characteristics and vacationers' intended responses to a substantial increase in travel costs. In addition, also relations between attributes of the future vacation which is impaired by the high travel costs such as travel party or travel period, and vacationers their intended responses are explored.

The remainder of this chapter is organised as follows. Section 3.2 starts by identifying potential vacation responses to a substantial increase in travel costs. Next, section 3.3 presents the methodology used to investigate vacationers' intended responses to a substantial increase in travel costs. Section 3.4 presents the results and a discussion. Lastly, section 3.5 draws conclusions.

3.2 Identifying vacation responses to a substantial increase in travel costs

If travel costs increase substantially, how will vacationers respond? It goes without saying that vacationers have a wide range of options. As discussed in the introduction of this thesis (subsection 1.4.1) theoretically vacationers can adopt three types of responses: inter-, intra- and non-vacation responses[10]. This study focusses on inter- and intra-vacation responses.

[10] Recall that intra-vacation responses directly translate into changes in one or a few attributes of the vacation: e.g. changing the destination, mode of travel, etc. Inter-vacation responses are responses that span across multiple vacations: e.g. skipping a second or third vacation. Non-vacation responses are responses that are not

To identify potential inter- and intra-vacation responses the literature is assessed (inter alia the literature that is reviewed in Chapter 2). In addition, a number of potential vacation responses are identified through discussions with peers. Table 3-1 displays the identified set of potential vacation responses. For responses identified through the literature, one or a few references are given. Furthermore, a brief description of the context in which the response was observed is given if applicable. The outer right column of Table 3-1 gives the type according to the classification proposed in the introduction of this thesis.

Table 3-1: Potential responses a substantial increase in travel costs

#	Vacation responses	Reference	Context in reference	Vacation response type
1	*Seek destinations closer to home*	Corsi and Harvey (1979) Williams et al. (1979) Smeral (2009)	First oil crisis	Intra-vacation
2	*Increase length of stay when at a faraway destination*	Alegre and Pou (2006) Papatheodorou (2010)	 World economic crisis	Intra-vacation
3	*Reduce yearly number of vacations*	Corsi and Harvey (1979) Williams et al. (1979)	First oil crisis	Inter-vacation
4	*Book cheaper accommodations*	Smeral (2009)	World economic crisis	Intra-vacation
5	*Reduce local spending*	Schiff and Becken (2011) Steinnes (1988)	 Second oil crisis	Intra-vacation
6	*Seek for budget vacation deals*	Papatheodorou (2010)	World economic crisis	Intra-vacation
7	*Change the travel parties*			Intra-vacation
8	*Combine business and vacation travels*			Inter-vacation
9	*Move to low-season vacation periods*			Intra-vacation
10	*Postpone expensive faraway vacations*	Corsi and Harvey (1979)	First oil crisis	Inter-vacation
11	*Go to previously been destinations*	Gitelson and Crompton (1984) Smeral (2009)	 World economic crisis	Inter-vacation
12	*Take more often the car to go on vacation*	Corsi and Harvey (1979)	First oil crisis	Intra-vacation
13	*Take more often the train or bus to go on vacation*	Corsi and Harvey (1979)	First oil crisis	Intra-vacation
14	*More often undertake domestic bike, hike, or sailing vacations*			Intra-vacation

Most responses listed in Table 3-1 are intuitive, and therefore do not require further explanation e.g. regarding the expected directions when travel costs increase. However, to increase length of stay when at a faraway destination, and to go to previously been destinations may require a brief explanation. Whether vacationers will increase their length of stay when at a faraway destination, or perhaps do the opposite is a priori not clear. When travelling to a faraway destination it makes sense to stay longer at that destination as the relative travel costs per vacation day drops. However, there are also indications that vacationers with tighter budgets tend to stay shorter (e.g. Smeral 2009).

Likewise, whether going to previously been destinations becomes more popular, or not, under when travel costs increase substantially is a priori unclear. It is known that familiarity with a

directly related to vacation behaviour, such as to reduce spending on groceries, or to increase labour hours. Hence, this latter type is beyond the scope of this study.

destination influences the vacation planning process (Zalatan 1996). Furthermore, it is widely acknowledged that the vacation decision involves considerable risk – in particular when visiting new destinations (Sirakaya and Woodside 2005). Therefore, one strategy to mitigate the increased risk when confronted with a substantial increase in travel costs is by choosing for a lower risk alternative i.e. to choose for a destination to which one has been before (Gitelson and Crompton 1984).

3.3 Methodology

3.3.1 Data collection

A self-administered questionnaire was developed. The questionnaire was part of an online survey which was administered online in June 2012. This survey started with a stated choice experiment, after which respondents were asked to continue with the vacation travel questionnaire. The choice experiment and questionnaire was completed by 419 vacationers – constituting a by and large representative sample of the Dutch population that went at least once on vacation in 2010 in terms of gender, income, age and educational level (CBS 2011). See Chapter 4 subsection 4.3.3 for a more extensive description of this sample.

In the questionnaire information from the stated choice experiment is used. In the stated choice experiment each respondent was asked to compose six vacations which they considered relevant. Subsequently, respondents were asked to indicate which of the six composed vacations they intended to take in the coming vacation period. This information on the respondents' intended coming vacations is used to frame the choice situation in the questionnaire. See subsection 4.3.1 for more details on the stated choice experiment. Column two of Table 3-2 shows the descriptive statistics of respondents' composed intended coming vacations. For comparison, column three reports – where possible[11] – revealed figures published by the Statistics Netherlands on Dutch vacation behaviour (CBS 2012).

Surprisingly, despite that sample is by and large representative for the Dutch population that went at least once on vacation in 2010 in terms of gender, income, age and educational level, there is a considerable discrepancy between market shares in the sample and market shares reported by Statistics Netherlands. In particular intercontinental destinations and, not unrelated, air travel appears to be overrepresented in the stated data. This might be the result of differences in definitions and categories. For instance, in the stated data distance is used to classify destinations: all destinations having distances smaller than 200 km are considered 'domestic', destinations over 1500 kilometres are considered 'intercontinental'. Alternatively, it might indicate selection bias, hypothetical bias, or it might stem from the relatively small sample size ($N = 419$).

[11] Categories do not one-to-one match. Therefore, reported figures are inferred.

Table 3-2: Descriptive market share statics on respondents' intended coming vacations

	Market shares across respondents' intended coming vacations in sample	Figures published by Statistics Netherlands (CBS2012)
Destination categories		
Domestic	26%	49%
Near-abroad	23%	38%
Intermediate abroad	19%	
Intercontinental	32%	13%
Length of Stays		
< 1 wk	43%	
1 wk < D < 2 wk	33%	
2 wk < D < 3 wk	19%	
> 3 wk	5%	
Accommodation types		
Hotel, Hostel, Apartment	61%	41%
Vacation homes, bungalow	26%	37%
Tent	6%	4%
Caravan, Motor home, camper	7%	18%
Mode of transport		
Car	51%	77%
Train, or bus	7%	4%
Aircraft	41%	19%

3.3.2 Questionnaire design

The questionnaire consists of two parts. In the first part of the questionnaire intended responses are elicited in a general context. That is, no specific choice situation is specified. In the second part of the questionnaire in contrast, to investigate the relations between attributes of the future vacation which is impaired by the high travel costs and vacationers their intended responses, the choice situation is more specific: it is framed in the context of the respondent's (self-reported) intended coming vacation.

In part one the following question was posed: *"Suppose that – for example due to high oil prices – travel costs of all modes of transport are tripled. How would you adapt your future vacation(s) to this situation? Could you indicate for each of the responses below the likeliness that you would respond accordingly?"* Based on the identified possible vacation responses of Table 3-1, 14 response-statements were phrased. To indicate the likeliness of each response-statement a five-point Likert-scale was used ranging from "highly unlikely" to "highly likely". Furthermore, a "does not apply-option" was given for in case the response-statement did not apply to the respondent's situation. This may for instance be the case for "*I try to combine work and vacation travel*" which is clearly only applicable to the part of the population which is involved in work-related travelling.

In part two of the questionnaire information regarding the respondent's intended vacation was used to frame the vacation choice situation. The following question – in which texts between the guillemets depend on the respondent's self-reported intended coming vacation[12] – was

[12] Note that only participants that intended to take a vacation in the coming year were allowed to conduct the experiment.

posed: *"Suppose that the travel costs to your vacation to << chosen destination >> with << selected travel party >> in << assigned vacation period >> are increased to << by the respondent estimated travel cost times three >> per person. Below a number of possible responses are given. Could you indicate for each of the responses below the likeliness that you would respond accordingly?"*.

As a result of the more specific context in part two not all of the response-statements listed in Table 3-1 were applicable (e.g. "to move to low-season period" or "to change the travel party" were clearly not applicable). Six response-statements were however still applicable. In order to fit the context of the coming vacation these six response-statements were slightly rephrased as compared to part one. They were however not changed in behavioural meaning. Again, to indicate the likeliness a five-point Likert-scale was used ranging from "highly unlikely" to "highly likely".

Lastly, the questionnaire rounded of with a number of questions regarding socio-economic characteristics of the respondents. Table 3-3 gives the elicited socio-economic characteristics and their measurement levels.

Table 3-3: Socio-economic characteristics

<table>
<tr><th>Socio-economic characteristic</th><th>Measurement level</th><th>Levels</th></tr>
<tr><td>Gender</td><td>Dichotomous nominal</td><td>Male | Female</td></tr>
<tr><td>Age group[13]</td><td>Nominal</td><td>18 – 24 yr. | 25 – 54yr. | 55+ yr.</td></tr>
<tr><td>Household discretionary income segment</td><td>Ordinal</td><td>$I < 10k \mid 10k \leq I < 20k \mid 20k \leq I < 30k \mid 30k \leq I < 40k \mid 40k \leq I < 50k \mid 50k \leq I < 75k \mid I \geq 75k$</td></tr>
<tr><td>Household type</td><td>Nominal</td><td>Household consisting of multiple adults| Single member household | Household with children</td></tr>
<tr><td>Age of the youngest child (if applicable)</td><td>Ratio</td><td></td></tr>
<tr><td>Number of household members</td><td>Ratio</td><td></td></tr>
<tr><td>Level of education</td><td>Ordinal</td><td>Elementary school | Lower education | Middle education | Higher education | University education</td></tr>
</table>

3.3.3 Data analysis

Data of the questionnaire are statistically analysed. Firstly, to see the extent to which vacationers intend to adopt different types of responses simple univariate analyses are used. Secondly, to explore whether vacationers intend to respond by taking specific bundles of responses – as opposed to opting for just one response – exploratory factor analyses are carried out. Exploratory factor analysis aims to describe the variability among observed, correlated variables in terms of a lower number of unobserved variables called factors (also often referred to as components). The resulting factor loadings indicate for each response the degree of association with the constructed factor. A set of responses that load strong on one

[13] Because it is a priori expected that age and responses to high travel cost are not linearly correlated, age groups are treated as nominal variables rather than ordinal variables.

factor, yet not on others, can be interpreted as responses that constitute an underlying response dimension. Thirdly, to identify relations between socio-economic characteristics as well as attributes of the future vacation which is impaired by the high travel costs (henceforth simply referred to as the 'impaired future vacation') and vacationers' responses bivariate analyses are conducted. More specifically, Pearson product-moment correlation coefficients are computed to explore relations between ordinal socio-economic characteristics and vacation attributes and the response-statements. One-way anovas are carried out to explore relations between nominal socio-economic characteristics and vacation attributes, and the response-statements.

3.4 Results and discussion

Subsections 3.4.1 to 3.4.3 present results in accordance with the three aims of this study. In each subsection results of the two parts of the questionnaire are discussed successively. Lastly, subsection 3.4.4 provides a discussion on differences between results of part one and two.

3.4.1 Vacationers' intended responses to a substantial increase in travel costs

Part one: general context

Table 3-4 shows the means and standard deviations of the response-statements in part one. Firstly, it can be seen that there is no clear winner. That is, no one response seems to be far more popular than all the other. Furthermore, the average is above three. Since the responses are all positively formulated[14], this suggests that respondents on average intend changing their vacation behaviour. The five most popular responses in rank order are: to seek for budget vacation deals, move to low-season vacation periods, seek destinations closer to home, to take fewer vacations, and to book cheaper accommodations. Among the least popular responses are combining business with vacation travel, changing travel party, undertaking biking, hiking or sailing vacations from The Netherlands, and taking more often the train or bus. Histograms showing the underlying densities can be found in Appendix 3A.

Furthermore, from the standard deviations (Table 3-4) it can be seen that differences in dispersion across the response-statements are relatively small. More often undertaking biking, hiking or sailing vacations from The Netherlands incurs the highest standard deviation while booking cheaper accommodations seems to be a relatively popular response across all respondents. Nonetheless, the difference in standard deviation between the two responses is only 0.27. Lastly, the outer left column displays the popularity ranking across the five response-statements which are also used in part two. These will be discussed latter on in subsection 3.4.4.

[14] For as far as there were a priori expectations

Table 3-4: Means and standard deviations on response-statements – part one

	Response-statements	Mean	SD	*N*	*Rank*
A1	*I seek destinations closer to home*	3.77	1.24	392	1
A2	*I increase my length of stay when I go to a faraway destination*	3.38	1.29	374	4
A3	*I take fewer vacations*	3.67	1.17	391	2
A4	*I book cheaper accommodations*	3.65	1.10	390	3
A5	*I reduce my local spending*	3.36	1.15	393	5
A6	*I seek for budget vacation deals*	3.85	1.14	380	-
A7	*I change travel parties – for instance by travelling with a larger group*	2.27	1.23	359	-
A8	*I try to combine business and vacation travels*	2.11	1.26	316	-
A9	*I move to low-season vacation periods*	3.78	1.34	377	-
A10	*I postpone expensive, faraway vacations hoping that future travel costs will decrease*	3.32	1.31	372	-
A11	*I go to destinations where I have previously been to*	3.17	1.22	392	-
A12	*I take more often the car to go on vacation*	3.20	1.22	377	-
A13	*I take more often the train or bus to go on vacation*	2.62	1.21	380	-
A14	*I more often undertake bike, hike, or sailing vacations from The Netherlands*	2.52	1.37	372	-
	Average	3.19	1.23	376	

Part two: specific context

Table 3-5 shows the means and standard deviations of the response-statements in part two of the questionnaire. Histograms showing the underlying densities can be found in Appendix 3B. However, care should be taken in interpreting these statistics. Part two is specifically conducted having in mind to acquire insights on the relations between attributes of the impaired vacation and the responses. The contexts under which vacation responses were elicited varied per respondent. For instance, while for one respondent the travel cost to Belgium tripled from 20 to 60 euros, for another respondent the travel cost to Thailand tripled from 700 to 2100 euro. Clearly, these differences in contexts evoke different responses. Nonetheless, despite the variations in contexts the descriptive statistics of Table 3-5 may still provide interesting insights.

The first thing that catches the eye in Table 3-5 is that the mean is below three. This suggests that on average respondents were intending to change their vacation behaviour albeit not to a large extent. Only two responses have means above three. These two most popular responses are: to book a cheaper accommodation, and to reduce local spending. Among the least popular are: to increase the length of stay at the destination and to pick another mode of transport if that is considerably cheaper. The latter was to be expected. For many, particularly intercontinental, destinations air travel is generally considered to be the only viable alternative (Hares et al. 2010). Therefore, for many vacation contexts this response was not a feasible option. Within the subsample consisting of vacationers having destinations below 1500 kilometres this response-statement has a mean of 3.13 (*N=255*).

Furthermore, given the variation in vacation choice situations considerable dispersion can be expected. Looking at standard deviations, what stands out is the relatively large dispersion regarding to not go to the chosen destination. This makes sense as presumably the attractiveness of this response is highly dependent on the (distance/travel costs to) the chosen destination. These kinds of relations are explored more in-depth in subsection 3.4.3. Lastly, the outer left column displays the popularity ranking across five response-statements which are also used in part one. Differences in rankings will be discussed latter on in subsection 3.4.4 which deals with differences of results between the two parts.

Table 3-5: Means and standard deviations on response-statements – part two

	Response-statements	**Mean**	**SD**	***N***	***Rank***
B1	*I do not go to my chosen destination. Rather I look for a closer-by destination*	2.95	1.52	395	3
B2	*I increase the length of stay at the destination*	2.67	1.36	390	5
B3	*I skip this vacation*	2.86	1.44	389	4
B4	*I book a cheaper accommodation*	3.07	1.29	377	2
B5	*I reduce local spending*	3.15	1.20	383	1
B6	*I pick another mode of transport if that is considerably cheaper*	2.81	1.41	372	-
	Average	2.92	1.37	384	

3.4.2 Bundles of vacationers' responses

This subsection aims to see whether vacationers intend to respond to high travel costs by taking specific bundles of responses. To see whether the response statements are sufficiently correlated to apply factor analyses, first Kaiser-Meyer-Olkin test of sampling adequacy and Bartlett's test of sphericity are carried out, see Appendix 3C. Both tests indicate that sufficient correlation across responses is present to carry out factor analyses.

In the factor analyses not all response-statements are used. A step-wise procedure is used to keep or remove response-statements for the analyses: response-statements that loaded strong on at least one factor were kept, while response-statements that loaded only low on multiple factors were removed. These latter response-statements do not seem to belong to any underlying factor. To identify the number of factors, the Kaiser-criterion is used, i.e. all factors with eigenvalues lower than one are dropped.

Part one: general context

The step-wise procedure results in that the following response-statements are removed from the factor analysis: A2, A9, A11, and A12. Using the ten remaining response-statements, three factors surface. Table 3-6 shows the rotated (orthogonal) component matrix.

Table 3-6: Rotated component matrix – part one

Rotated component matrix				
		Component		
Label	Response	1	2	3
A8	*I try to combine business and vacation travels*	**.831**	-.109	.013
A7	*I change travel parties – for instance by travelling with a larger group*	**.798**	-.037	.163
A13	*I take more often the train or bus to go on vacation*	**.724**	.141	.079
A14	*I more often undertake bike, hike, or sailing vacations from The Netherlands*	**.654**	.306	-.002
A1	*I seek destinations closer to home*	.070	**.784**	.157
A10	*I postpone expensive faraway vacations*	.210	**.761**	.130
A3	*I take fewer vacations*	-.103	**.747**	.316
A4	*I book cheaper accommodations*	.032	.301	**.795**
A6	*I seek for budget vacation deals*	.061	.032	**.784**
A5	*I reduce my local spending*	.150	.291	**.709**

To visualise the factor loadings Figure 3-1 shows three orthogonal projections along each component plane. It can be seen that the response-statements belonging to a factor persist in each orthogonal projection[15]. Hence, each factor captures a distinct bundle of responses. As can be seen there is some correlation between responses across factors implying that vacationers do not think of responses as being mutually exclusive.

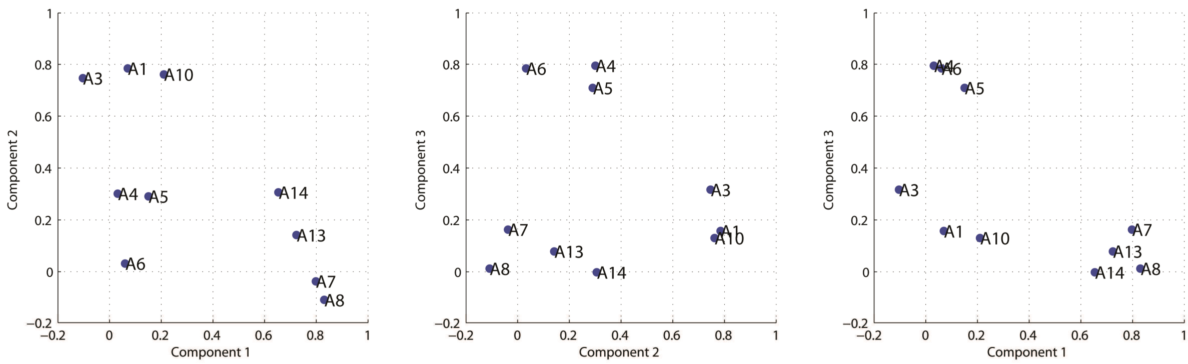


Figure 3-1: Orthogonal projections of factor loading – part one

Response-statements A8, A7, A13, and A14 load strongest on factor one. From a behavioural perspective, these responses share that they do require considerable flexibility from the vacationers. For instance it requires more in terms of flexibility from the vacationers to change to bus or train or to change travel party than to simply skip the vacation or to book a cheaper accommodation. As such, this factor is interpreted as 'flexible-responses'. Responses A1, A10, and A3 load strongest on factor two. These responses have in common that it concerns a change in destination, or skipping a vacation. Therefore, factor 2 is interpreted as 'destination-responses'. Lastly, responses A4, A6, and A5 load strong on factor 3. Clearly,

[15] One reservation needs to be made here. Because in part one the question is stated as follows: *How would you adapt your future vacation(s) to this situation?*, it possible that respondents indicated to adopt multiple responses, yet were not necessarily thinking of these responses concerning one vacation.

these responses have a cost reduction aspect in common. Factor 3 therefore is interpreted as 'budget-responses'.

Part two: specific context

In part two the step-wise procedure results in that none of the response-statements is removed from the factor analysis. Using the Kaiser-criterion, again three factors surface. Table 3-7 shows the rotated (orthogonal) component matrix.

Table 3-7: Rotated component matrix – part two

Rotated component matrix				
		Component		
Label	Response	1	2	3
B5	*I reduce local spending*	**.874**	.120	.167
B4	*I book a cheaper accommodation*	**.809**	.207	.264
B3	*I skip this vacation*	.117	**.854**	.032
B1	*I do not go to my chosen destination. Rather I look for a closer-by destination*	.164	**.809**	.146
B2	*I increase the length of stay at the destination*	.318	-.095	**.780**
B6	*I pick another mode of transport if that is considerably cheaper*	.119	.344	**.760**

Again, to visualise the factor loadings three orthogonal projections are made (see Figure 3-2). It can be seen that response-statements belonging to an underlying factor persist in each orthogonal projection.

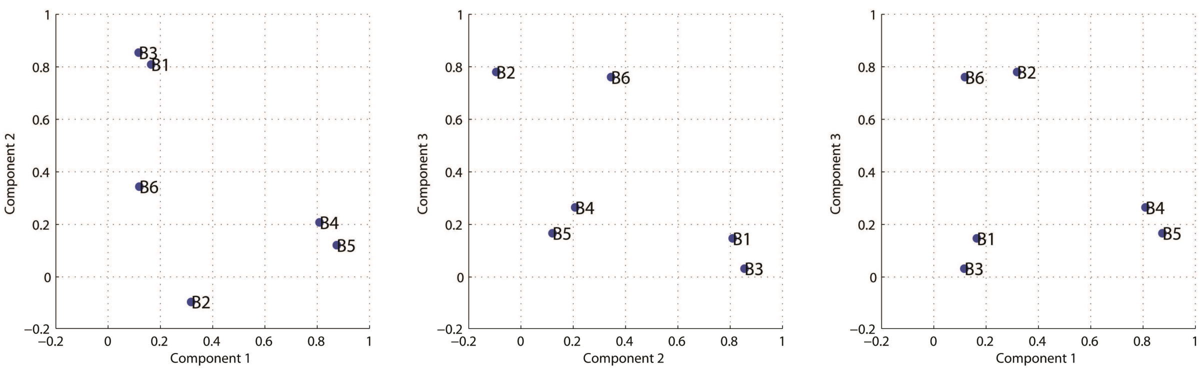


Figure 3-2: Orthogonal projections of factor loading – part two

More or less the same three factors surface as in part one. Responses B5 and B4 can also be interpreted as to belong to 'budget-responses' while responses B3 and B1 seem to belong to the 'destination-responses'. Responses B2 and B6 may seem to belong to the 'flexible-responses'. However, in the factor analysis in part one "increasing the length of stay" (A2) was removed as it didn't load on 'flexible-responses', or on one of the other factors.

Conclusion

The main conclusion stemming from these factor analyses is that vacationers appear to adapt their behaviour by taking multiple responses – as opposed to opting for just one response which was theoretically also possible. These responses are not just random combination of vacation responses; rather, it appears that specific vacation responses are strongly correlated. Furthermore, results suggest that there exist at least three underlying response dimensions, namely: 'budget-responses', 'flexible-responses', and 'destination-responses'. However, responses of vacationers are not confined to these three underlying response dimensions. After all, not all response-statements were kept in the factor analysis of part one.

3.4.3 Determinants of vacationers' intended responses

This subsection aims to identify relations between socio-economic characteristics as well as attributes of the impaired future vacation and vacationers' intended responses to a substantial increase in travel costs. For conciseness, only those socio-economic characteristics and vacation attributes having at least one significant correlation with at least one of the response-statements are reported. Furthermore, for legibility in the presented tables (in the appendices) significance levels smaller than 0.05 are depicted bold.

Part one: general context

Appendix 3D shows the Pearson product-moment coefficients and their significance levels. It can be seen that household income, age of youngest child, number of household members, and level of education correlate significantly with vacationers' intended responses to a substantial increase in travel costs.

It is found that:

1. Household income is an important determinant for vacationers' intended responses to a substantial increase in travel costs. Household income correlates significantly with six response-statements: A1, A3, A4, A5, A10, and A11. All product-moment coefficients are negative. This suggests that higher income vacationers respond less strongly to a substantial increase in travel costs than lower income vacationers. This seems in accordance with intuition. For example, in the literature on demand for automobile fuel typically figures for short run income elasticity of fuel demand are reported between 0.35 and 0.55 indicating that higher income travellers are less sensitive to changes in travel costs (Graham and Glaister 2002). Interestingly, household income is negatively correlated with going to previously been destinations. It is unclear what causes this relation. Perhaps higher income travellers are less risk-averse as compared to lower income travellers. Alternatively, it may simply reflect differences in traits across income segments.

2. Education level is an important determinant for vacationers' intended responses to a substantial increase in travel costs. The level of education correlates negatively with A4, A10, and A11; and positively with A14. However, given the strong positive

correlation between education level and household income, these negative correlations can probably be attributed to income differences too. More surprisingly, vacationers with higher education levels are more inclined to respond by undertaking bike, hike, or sailing vacations from The Netherlands. In fact, it is the only socio-economic characteristic that is found to correlate significantly with more often undertaking bike, hike, or sailing vacations from The Netherlands.

3. The number of household members and moving to low-season correlate negatively. This makes sense as number of household members is positively correlated with having children – which clearly hinders getting around the high-season vacation periods.

4. The older the youngest child, the less inclined vacationers are to go to previously been destinations. Age of the youngest child is found to correlate negatively with going to previously been destinations. A possible explanation for this correlation could be that a positive incentive to visit known, presumably child-friendly, destinations for household with young children vanishes when children grow up.

To identify relations between nominal socio-economic characteristics (age groups and household types) and vacationers' intended responses one-way anovas are used, see Appendix 3E. It can be seen that there are significant differences between age groups for response-statements: A1, A8[16], A9, and A11. Furthermore, it shows that there are significant differences between types of households and response-statements A7, A9, A13 and A14. To investigate these differences post-hoc tests are carried out[17].

With regard to age groups, it is found that:

1. Young vacationers are less inclined to seek closer-by destinations (A1) than old vacationers. There is however no significant difference between middle-aged and young vacationers regarding seeking closer-by destinations.

2. Old vacationers are significantly more inclined to move to low-season vacation periods (A9) than middle-aged and young vacationers.

3. Old vacationers are significantly more inclined to go to previously been destinations than young and middle-aged vacationers (A11). Middle-aged vacationers on their turn are significantly more inclined to go to previously been destinations than young vacationers. Hence, this implies that the older the vacationer, the more inclined he or she is to go to previously been destinations in response to a substantial increase in

[16] While the anova in Appendix 3E shows a significant difference between age groups on response-statement A8 (combine business and vacation travelling), the post-hoc Bonferroni test does not find pairwise significant differences between groups. This inconsistency is not uncommon. The post-hoc test may be more conservative. A possible explanation is that this is due to the differences in sample sizes: the group of young vacationers is considerably smaller than the middle-aged and old vacationer groups.

[17] Bonferroni or Games-Howell tests depending on homogeneity of variances

travel costs. However, it is clearly also true that the older the vacationer, the more destinations he or she has visited before.

With regard to household types, it is found that:

1. Single member households and households with children are more inclined to change travel parties (A7) than households consisting of multiple adults. Supposedly, this is because households consisting of multiple adults have relatively high discretionary household incomes. In addition, single member households are generally more flexible than households consisting of multiple adults.

2. Households with children are significantly less inclined to move to low-season period (A9) than single member households and households consisting of multiple adults.

3. Single member households intend taking more often the train or bus (A13) than households consisting of multiple adults. Clearly, car ownership and car travel is relatively more expensive for this household type, explaining this correlation at least partly.

4. Single member households intend to respond less by undertaking bike, hike, or sailing vacations from The Netherlands (A14) than households with children and households consisting of multiple adults.

Part two: specific context

Household income and level of education are the only two ordinal socio-economic variables that correlate significantly with vacationers' intended responses to a substantial increase in travel costs in part two. Remarkably, for various socio-economic characteristics for which one would expect correlations (e.g. age of youngest child, number of household members, etc.) no significant relations are identified. Appendix 3F shows the Pearson product-moment coefficients and their significance levels.

It is found that:

1. Higher income vacationers intend to skip fewer vacations and to reduce local spending less than their lower income counterparts. This can be seen by the negative correlation coefficients of income with response-statements B3 and B5.

2. Education level correlates significantly negative with booking a cheaper accommodation. Education level and household income correlate strongly positive. Household income and to book a cheaper accommodation also correlate negative - though not significant at a significance levels of $\alpha < 0.05$ (however significant at a significance levels of $\alpha < 0.10$). Therefore, presumably also this correlation can at least partly be attributed to household income.

3. Travel costs and looking for a closer-by destination (B1) are positively correlated. This positive relation is intuitive: when the travel cost goes up, substitution of a faraway destination for a closer-by destination becomes relatively more attractive.

Again, to identify relations between nominal socio-economic characteristics as well as nominal attributes of the impaired future vacation (travel party, the travel season, and whether or not the vacation has already been booked) and vacationers' intended responses one-way anovas are used[18], see Appendix 3G.

It is found that:

1. Young travellers are less inclined to seek closer-by destinations than middle-aged and old vacationers when travel costs are tripled.

2. Booking a cheaper accommodation is significantly less popular in winter than in summer. This seems plausible as for ski vacations this response is possible only to a very limited extent.

Beyond that there are no significant differences across the four seasons of the year. Interestingly, there are also no significant differences between different travel party types, or between intended responses of vacationers that already have booked the vacation and those that did not.

3.4.4 Differences between part one and part two

It is interesting to compare responses of part one with those of part two. After all, essentially both parts entail the same situation, namely the situation in which travel costs are tripled. As such, one would expect considerable commonalities across the responses in both parts. To compare the popularity of the responses five response-statements are used: response-statements A1 to A5 in part one correspond one-to-one with response-statements B1 to B5 in part two[19].

Surprisingly, looking at the descriptive statistics (Table 3-4 and Table 3-5) there appears to be quite a discrepancy between the responses in part one and two: both in terms of differences between the means as well as in terms of relative ranking. Table 3-8 shows a paired samples t-test for differences in means between A1 to A5 and B1 to B5. It can be seen that for all pairwise response-statements the means in part one are significantly higher. Significant correlations between the pairs are however present. Furthermore, looking at the relative rankings of responses A1 to A5 in part one (see Table 3-4) and B1 to B5 in part two (Table 3-5), it can be seen that there is little similarity in ranking. For instance, while to reduce local spending is the least popular response in part one, it is the most popular response in part two.

[18] As booking is dichotomous, for this relation a two sample t-test is used.

[19] Except for A2 and B2. A2 is phrased conditional on the distance: "I increase my length of stay *when* I go to a faraway destination" while this is not the case for B2.

In contrast, with regard to factors underlying the vacationer responses (subsection 3.4.2), and with regard to socio-economic characteristics (subsection 3.4.3) a different picture is displayed. For these analyses, findings are generally persistent across the two parts: in subsection 3.4.2 more or less the same underlying factors are identified; in subsection 3.4.3 the same relations between household income, education, and the vacationer responses are found to be significant.

Table 3-8: Paired sample t-test

Paired samples test				
Pair	ΔMeans	Std. Deviation	Std. Error Mean	Sig. (2-tailed)
A1 & B1	.826	1.638	.084	**.000**
A2 & B2[20]	.929	1.523	.135	**.000**
A3 & B3	.816	1.542	.079	**.000**
A4 & B4	.590	1.295	.068	**.000**
A5 & B5	.251	1.133	.059	**.000**

Paired samples correlation			
Pair	N	Correlation	Sig.
A1 & B1	381	.299	**.000**
A2 & B2	127	.310	**.000**
A3 & B3	377	.319	**.000**
A4 & B4	363	.411	**.000**
A5 & B5	373	.524	**.000**

The differences in the relative rankings and in the means between part one and part two may be due to various reasons. One possible explanation is that vacationers have only limited flexibility at a relatively short notice e.g. in agendas. This may evoke different behavioural responses. Another possible explanation lies in the presence of an endowment effect with regard to the intended coming vacation (Kahneman and Tversky 1979; Knetsch and Wong 2009). If this is the case, then it may be argued that the intentions elicited in the general context have higher predictive power in describing intermediate-term vacation travel behaviour while intentions elicited in the context of the intended coming vacation have higher predictive power on the short-term. Yet, another explanation is that the specificity helps the respondents to better comprehend the presented, quite unconventional, choice situation – yielding more accurate behavioural responses.

3.5 Conclusions

Under various scenarios it seems likely that vacationers will be confronted with a substantial increase in travel costs. This study has provided insights as to what the nature of impacts of such a substantial increase in travel costs on vacation travel behaviour might be. Firstly, this study identified a number of possible vacation responses. These vacation responses were used to set up a two-part questionnaire. In this questionnaire a scenario was sketched in which travel costs of all modes of transport were tripled. The first part of the questionnaire

[20] A2 B2 are phrased slightly different; A1 is conditional on the distance i.e. "… *when* I go to a faraway destination" while B2 is not. Therefore, the t-test is performed on the subsample ($N = 127$) of respondents that composed a vacation with distances larger than 1500 km.

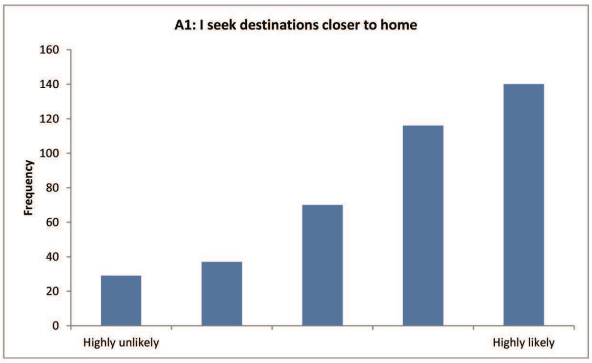
investigated vacationers’ intended responses in a general context. The second part of the questionnaire investigated vacationers’ intended responses in the context of the respondent’s intended coming vacation.

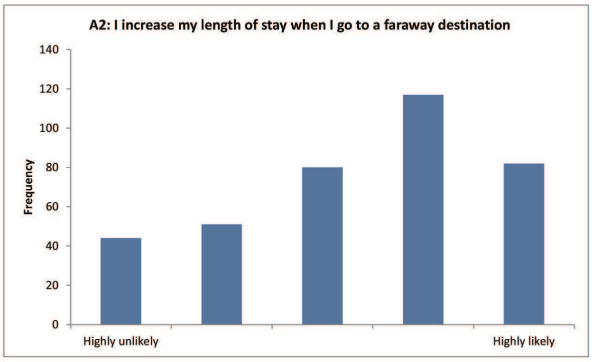
In accordance with findings of studies conducted during, or in the aftermath of the oil crises (Corsi and Harvey 1979; Kamp et al. 1979; Williams et al. 1979), this study finds that vacationers do not have one response which is far more popular than all the others. Interestingly however, it is found that the popularity of responses is not persistent across the two presented choice contexts (i.e. general context and the respondent’s intended coming vacation context). While in the general context to seek for budget vacation deals and to seek destinations closer to home are among the most popular responses, in the context of the respondent’s coming vacation these responses are not particularly popular. In the latter context, to book a cheaper accommodation and to reduce local spending are found to be the most popular responses instead. As such, it cannot be inferred which responses can be expected to be most popular when vacationers would be confronted with a substantial increase in travels costs in the near future.

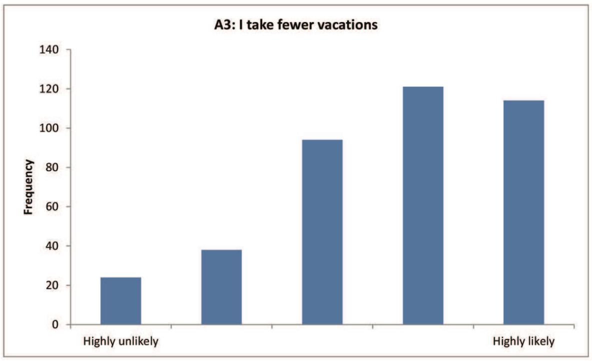
Furthermore, it is found that vacationers intend to adapt their behaviour by taking specific bundles of responses – as opposed to opting for just one. Three such bundles of responses are identified, namely: ‘flexible-responses’, ‘destination-responses’, and ‘budget-responses’. Their existence suggests that vacationers think in terms of these (and presumably more) underlying dimensions when dealing with a substantial increase in travel costs. Besides that, various relations between socio-economic characteristics and vacationers’ intended responses, and relations between attributes of the impaired vacation and vacationers’ intended responses are identified. These relations are in most cases found both in the general context as well as in the context of the respondent’s intended coming vacation – indicating to some extent robustness of findings.

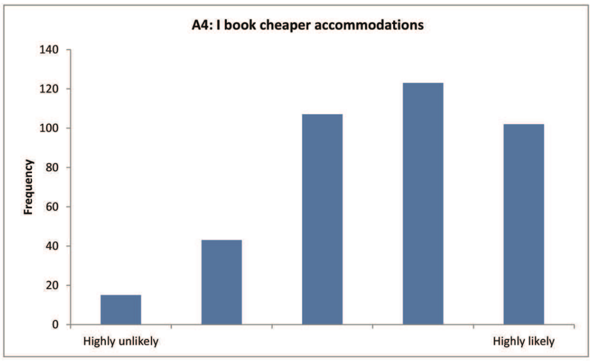
Lastly, an important, yet difficult question is how reliable are the stated intentions as a predictor for future behaviour. The considerable discrepancies between the vacations reported by the respondents and figures reported by Statistics Netherlands give at least rise to doubt the accuracy of the stated behaviour. This question touches upon a fundamental concern regarding stated behaviour: a concern which is widely debated in the literature, and for which different scientific disciplines hold strongly different believes. A discussion on this topic goes beyond the scope of this study, but the interested reader is referred to Manski (1990), and Sutton (1998). Accordingly, it is left up to the reader to decide how much value should be assigned to stated intentions, and hence the reported findings in this study.

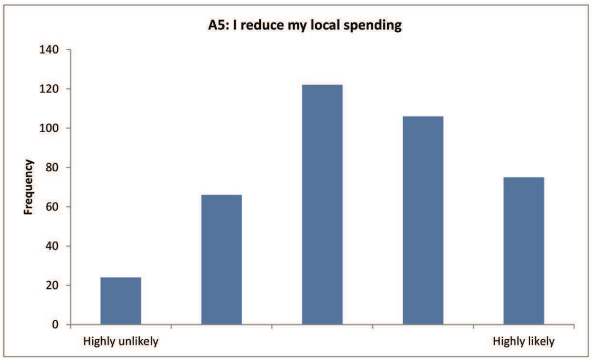
Appendix 3A

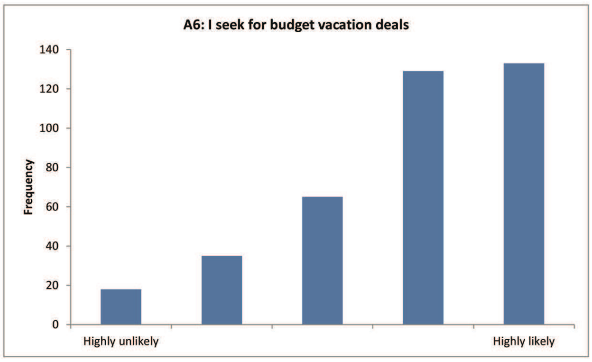

A1: I seek destinations closer to home
Frequency
160
140
120
100
80
60
40
20
0
Highly unlikely
Highly likely

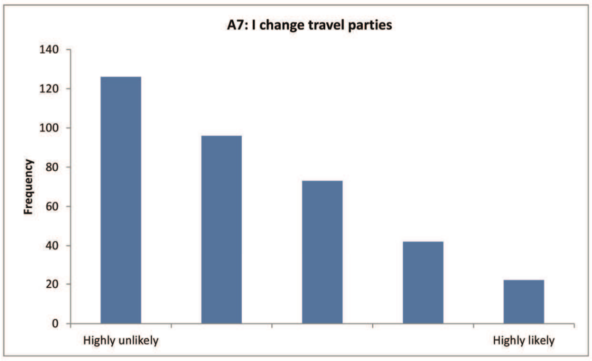

A2: I increase my length of stay when I go to a faraway destination
Frequency
140
120
100
80
60
40
20
0
Highly unlikely
Highly likely

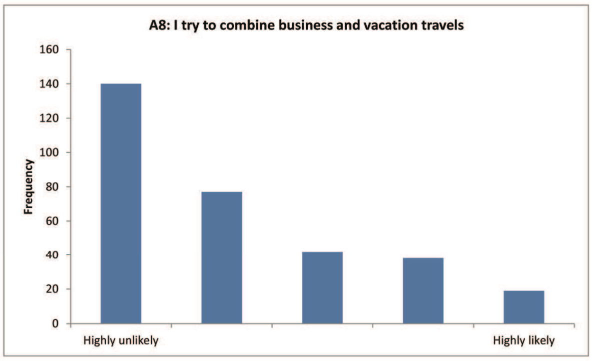

A3: I take fewer vacations
Frequency
140
120
100
80
60
40
20
0
Highly unlikely
Highly likely

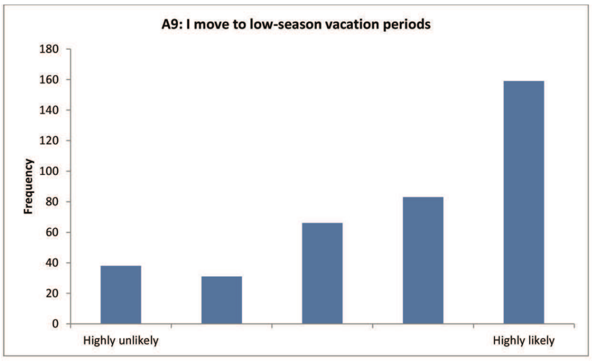

A4: I book cheaper accommodations
Frequency
140
120
100
80
60
40
20
0
Highly unlikely
Highly likely

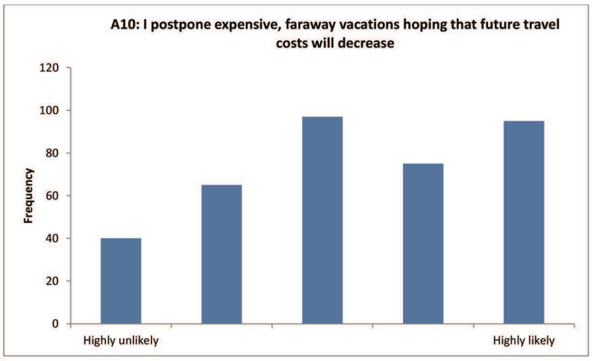

A5: I reduce my local spending
Frequency
140
120
100
80
60
40
20
0
Highly unlikely
Highly likely

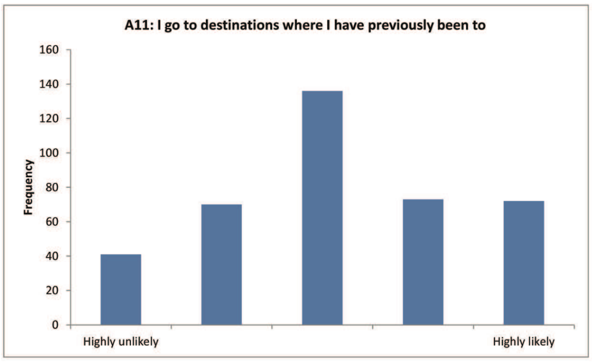

A6: I seek for budget vacation deals
Frequency
140
120
100
80
60
40
20
0
Highly unlikely
Highly likely

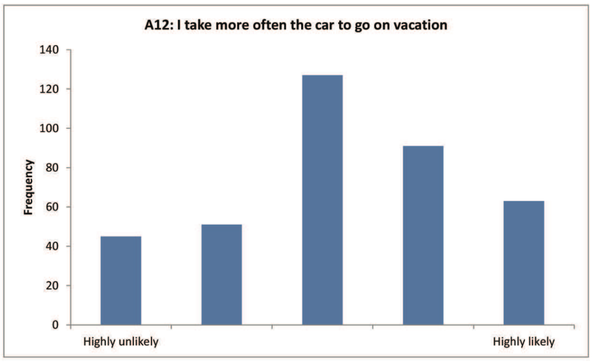

A7: I change travel parties
Frequency
140
120
100
80
60
40
20
0
Highly unlikely
Highly likely

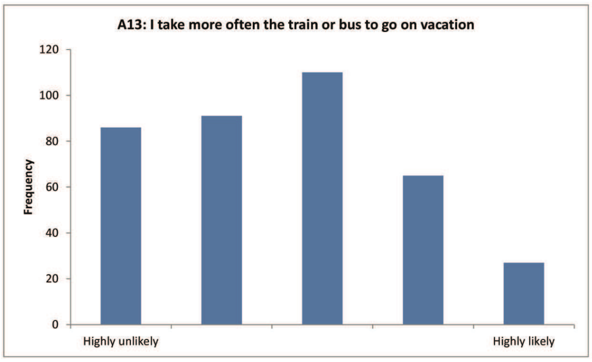

A8: I try to combine business and vacation travels
Frequency
160
140
120
100
80
60
40
20
0
Highly unlikely
Highly likely

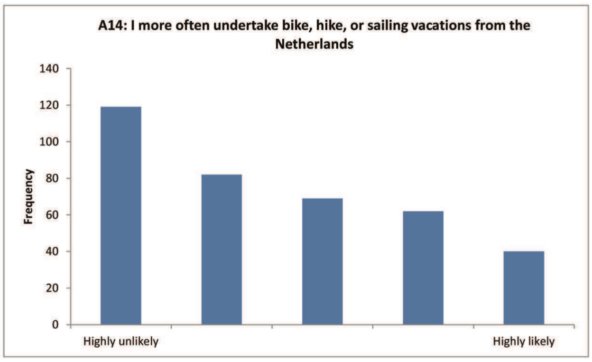

A9: I move to low-season vacation periods
Frequency
180
160
140
120
100
80
60
40
20
0
Highly unlikely
Highly likely


A10: I postpone expensive, faraway vacations hoping that future travel costs will decrease
Frequency
120
100
80
60
40
20
0
Highly unlikely
Highly likely

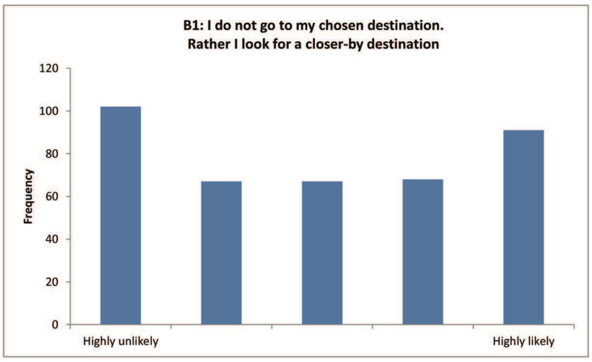

A11: I go to destinations where I have previously been to
Frequency
160
140
120
100
80
60
40
20
0
Highly unlikely
Highly likely

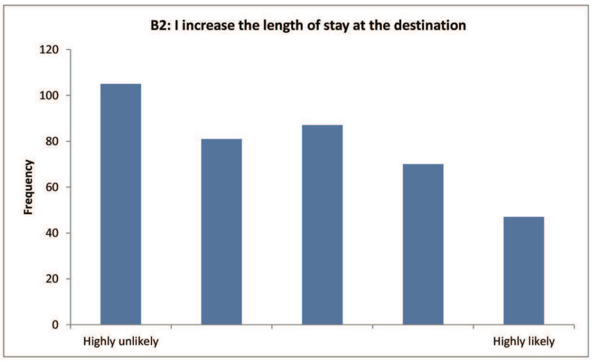

A12: I take more often the car to go on vacation
Frequency
140
120
100
80
60
40
20
0
Highly unlikely
Highly likely

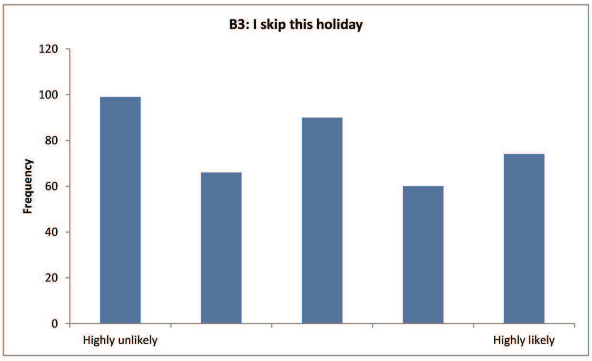

A13: I take more often the train or bus to go on vacation
Frequency
120
100
80
60
40
20
0
Highly unlikely
Highly likely

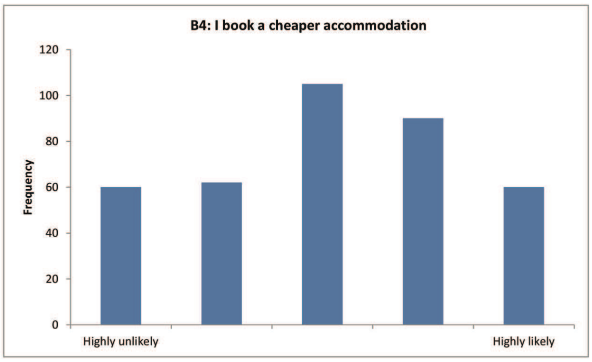

A14: I more often undertake bike, hike, or sailing vacations from the Netherlands
Frequency
140
120
100
80
60
40
20
0
Highly unlikely
Highly likely

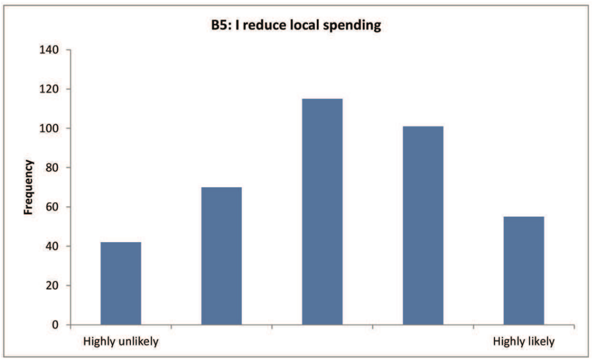
Appendix 3B

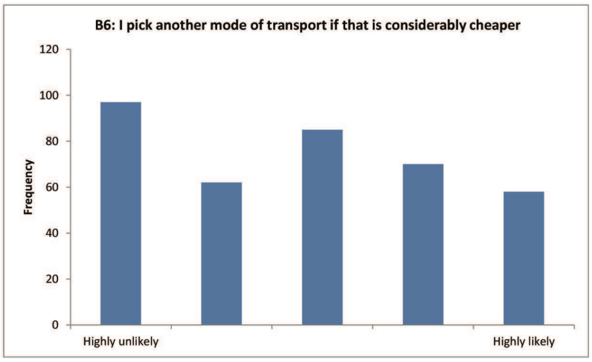

B1: I do not go to my chosen destination.
Rather I look for a closer-by destination
Frequency
0
20
40
60
80
100
120
Highly unlikely
Highly likely


B2: I increase the length of stay at the destination
Frequency
0
20
40
60
80
100
120
Highly unlikely
Highly likely


B3: I skip this holiday
Frequency
0
20
40
60
80
100
120
Highly unlikely
Highly likely


B4: I book a cheaper accommodation
Frequency
0
20
40
60
80
100
120
Highly unlikely
Highly likely


B5: I reduce local spending
Frequency
0
20
40
60
80
100
120
140
Highly unlikely
Highly likely


B6: I pick another mode of transport if that is considerably cheaper
Frequency
0
20
40
60
80
100
120
Highly unlikely
Highly likely

Appendix 3C

KMO and Bartlett's Test – Part one

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.789
Bartlett's Test of Sphericity	Approx. Chi-Square	765.078
	df	45
	Sig.	.000

KMO and Bartlett's Test – Part two

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.676
Bartlett's Test of Sphericity	Approx. Chi-Square	314.238
	df	15
	Sig.	.000

Appendix 3D

Bivariate analysis – part one

Correlations

		Household income	Education level	Number of household members	Age of child (if applicable)	A1 Seek destinations closer to home	A2 Increase length of stay when at a faraway destination	A3 Reduce yearly number of trips	A4 Book cheaper accommodations	A5 Reduce local spending	A6 Seek for budget vacation deals	A7 Change travel parties	A8 Combine business and vacation travels	A9 Move to low-season vacation periods	A10 Postpone expensive faraway vacations	A11 Go to previously been destinations	A12 Take more often the car to go on vacation	A13 Take more often the train or bus to go on vacation	A14 More often undertake bike, hike, or sailing vacations from the Netherlands
Household income	Pearson Correlation	1	.417	.153	-.258	-.161	.021	-.135	-.123	-.119	.034	-.048	.039	-.088	-.128	-.171	-.096	-.056	.035
	Sig. (2-tailed)		**.000**	**.002**	**.011**	**.001**	.683	**.007**	**.015**	**.018**	.506	.365	.492	.088	**.014**	**.001**	.062	.277	.501
	N	422	422	422	97	392	374	391	390	393	380	359	316	377	372	392	377	380	372
Education level	Pearson Correlation	.417	1	.002	-.170	-.088	-.001	-.081	-.145	-.075	.011	-.044	.058	-.008	-.144	-.224	-.085	.054	.146
	Sig. (2-tailed)	**.000**		.964	.097	.081	.989	.109	**.004**	.137	.824	.401	.301	.871	**.005**	**.000**	.097	.295	**.005**
	N	422	422	422	97	392	374	391	390	393	380	359	316	377	372	392	377	380	372
Number of household members	Pearson Correlation	.153	.002	1	-.133	.009	-.025	-.076	-.015	-.039	-.100	-.021	-.070	-.424	-.072	-.058	.049	-.048	.031
	Sig. (2-tailed)	**.002**	.964		.193	.858	.636	.136	.761	.437	.051	.695	.216	**.000**	.168	.253	.346	.351	.546
	N	422	422	422	97	392	374	391	390	393	380	359	316	377	372	392	377	380	372
Age of youngest child	Pearson Correlation	-.258	-.170	-.133	1	-.154	.059	-.061	-.132	-.145	-.081	.076	.019	-.003	-.076	-.248	.119	-.033	-.123
	Sig. (2-tailed)	**.011**	.097	.193		.136	.579	.566	.208	.164	.445	.475	.865	.976	.469	**.018**	.264	.753	.249
	N	97	97	97	97	95	91	91	93	94	91	90	86	86	92	91	90	93	89

Appendix 3E

Anovas – part one

Age groups

	Levene Statistic	Test of Homogeneity of Variances df1	df2	Sig.
A1	1.468	2	386	.232
A8	7.264	2	310	**.001**
A9	3.658	2	371	**.027**
A11	4.044	2	386	**.018**

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
A1	Between Groups	9.015	2	4.508	2.973	**.052**
	Within Groups	585.227	386	1.516		
	Total	594.242	388			

		Statistic[a]	Robust Tests of Equality of Means df1	df2	Sig.
A8	Welch	3.455	2	111.140	**.035**
	Brown-Forsythe	3.748	2	187.762	**.025**
A9	Welch	11.645	2	117.087	**.000**
	Brown-Forsythe	11.856	2	199.158	**.000**
A11	Welch	10.013	2	112.150	**.000**
	Brown-Forsythe	10.021	2	200.192	**.000**

Multiple Comparisons

Bonferroni

Dependent Variable	(I) Age	(J) Age	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
A1	1	2	-.432	.210	.121	-.94	.07
		3	-.534	.219	**.046**	-1.06	-.01
	2	1	.432	.210	.121	-.07	.94
		3	-.101	.135	1.000	-.43	.22
	3	1	.534	.219	**.046**	.01	1.06
		2	.101	.135	1.000	-.22	.43

*. The mean difference is significant at the 0.05 level.

Multiple Comparisons

Games-Howell

Dependent Variable	(I) Age	(J) Age	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
A8	1	2	-.421	.197	.090	-.89	.05
		3	-.085	.209	.913	-.58	.41
	2	1	.421	.197	.090	-.05	.89
		3	.336	.157	.084	-.03	.71
	3	1	.085	.209	.913	-.41	.58
		2	-.336	.157	.084	-.71	.03
A9	1	2	-.157	.207	.730	-.65	.34
		3	-.768	.209	**.001**	-1.27	-.27
	2	1	.157	.207	.730	-.34	.65
		3	-.611	.144	**.000**	-.95	-.27
	3	1	.768	.209	**.001**	.27	1.27
		2	.611	.144	**.000**	.27	.95
A11	1	2	-.502	.186	**.024**	-.95	-.06
		3	-.872	.199	**.000**	-1.35	-.40
	2	1	.502	.186	**.024**	.06	.95
		3	-.370	.134	**.017**	-.69	-.05
	3	1	.872	.199	**.000**	.40	1.35
		2	.370	.134	**.017**	.05	.69

*. The mean difference is significant at the 0.05 level.

Household types

	Levene Statistic	Test of Homogeneity of Variances df1	df2	Sig.
A7	3.778	2	0.3530	**.024**
A9	5.722	2	0.3710	**.004**
A13	1.385	2	0.3740	.252
A14	.538	2	0.3720	.584

		Statistic[a]	Robust Tests of Equality of Means df1	df2	Sig.
A7	Welch	6.526	2	177.320	**.002**
	Brown-Forsythe	6.232	2	277.565	**.002**
A9	Welch	49.785	2	197.288	**.000**
	Brown-Forsythe	58.737	2	299.950	**.000**

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
A13	Between Groups	10.056	2	5.028	3.486	**.032**
	Within Groups	539.430	374	1.442		
	Total	549.485	376			
A14	Between Groups	12.174	2	6.087	4.321	**.014**
	Within Groups	524.002	372	1.409		
	Total	536.176	374			

Multiple Comparisons

Games-Howell

Dependent Variable	(I) HH_type	(J) HH_type	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
A7	1	2	-.550	.165	**.003**	-.94	-.16
		3	-.362	.150	**.043**	-.72	-.01
	2	1	.550	.165	**.003**	.16	.94
		3	.188	.182	.559	-.24	.62
	3	1	.362	.150	**.043**	.01	.72
		2	-.188	.182	.559	-.62	.24
A9	1	2	-.022	.142	.987	-.36	.31
		3	1.406	.150	**.000**	1.05	1.76
	2	1	.022	.142	.987	-.31	.36
		3	1.428	.169	**.000**	1.03	1.83
	3	1	-1.406	.150	**.000**	-1.76	-1.05
		2	-1.428	.169	**.000**	-1.83	-1.03

In bold: the mean difference is significant at the 0.05 level.

Multiple Comparisons

Bonferroni

Dependent Variable	(I) HH_type	(J) HH_type	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
A13	1	2	-.428	.162	**.026**	-.82	-.04
		3	-.142	.142	.948	-.48	.20
	2	1	.428	.162	**.026**	.04	.82
		3	.286	.173	.297	-.13	.70
	3	1	.142	.142	.948	-.20	.48
		2	-.286	.173	.297	-.70	.13
A14	1	2	-.370	.158	.061	-.75	.01
		3	.116	.141	1.000	-.22	.46
	2	1	.370	.158	.061	-.01	.75
		3	.485	.170	**.013**	.08	.89
	3	1	-.116	.141	1.000	-.46	.22
		2	-.485	.170	**.013**	-.89	-.08

In bold: the mean difference is significant at the 0.05 level.

Appendix 3F

Bivariate analysis – part two

		Travel cost tripled	Household income	Education level	B1 I do not go to my chosen destination. Rather I look for a closer-by destination	B2 I increase the length of stay at the destination	B3 I skip this vacation	B4 I book a cheaper accommodation	B5 I reduce local spending	B6 I pick another mode of transport if that if considerably cheaper
Household income	Pearson Correlation	.119	1	.417	.015	.000	-.111	-.089	-.109	-.040
	Sig. (2-tailed)	**.015**		**.000**	.767	.993	**.029**	.084	**.032**	.438
	N	415	422	422	395	390	389	377	383	372
Education level	Pearson Correlation	.027	.417	1.000	-.023	-.021	.013	-.102	-.066	.077
	Sig. (2-tailed)	.588	**.000**		.644	.675	.799	**.047**	.200	.139
	N	415	422	422	395	390	389	377	383	372
Travel cost tripled	Pearson Correlation	1	.119	.027	.133	-.005	.034	.070	-.070	-.070
	Sig. (2-tailed)		**.015**	.588	**.009**	.921	.510	.177	.178	.183
	N	415	415	415	388	383	382	370	376	365

Appendix 3G

Anovas – part two

Age groups

Test of Homogeneity of Variances

	Levene Statistic	df1	df2	Sig.
B1	30.093	2	389	**.046**

Robust Tests of Equality of Means

		Statistic[a]	df1	df2	Sig.
B1	Welch	4.097	2	113.782	**.019**
	Brown-Forsythe	3.609	2	200.477	**.029**

Multiple Comparisons

Games-Howell

Dependent Variable	(I) Age	(J) Age	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
B1	1	2	-.644	.234	**.021**	-1.21	-.08
		3	-.663	.253	**.028**	-1.27	-.06
	2	1	.644	.234	**.021**	.08	1.21
		3	-.019	.170	.993	-.42	.38
	3	1	.663	.253	**.028**	.06	1.27
		2	.019	.170	.993	-.38	.42

In bold: the mean difference is significant at the 0.05 level.

Vacation season

	Levene Statistic	Test of Homogeneity of Variances df1	df2	Sig.
B4	1.071	3	370	.361

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
B4	Between Groups	13.358	3	4.453	2.694	**.046**
	Within Groups	616.562	373	1.653		
	Total	629.920	376			

Multiple Comparisons

Bonferroni

Dependent Variable	(I) Season	(J) Season	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
B4	1	2	-.366	.286	1.000	-1.13	.39
		3	-.576*	.217	**.050**	-1.15	.00
		4	-.590	.233	.070	-1.21	.03
	2	1	.366	.286	1.000	-.39	1.13
		3	-.210	.228	1.000	-.82	.40
		4	-.224	.243	1.000	-.87	.42
	3	1	.576*	.217	**.050**	.00	1.15
		2	.210	.228	1.000	-.40	.82
		4	-.014	.156	1.000	-.43	.40
	4	1	.590	.233	.070	-.03	1.21
		2	.224	.243	1.000	-.42	.87
		3	.014	.156	1.000	-.40	.43

*. The mean difference is significant at the 0.05 level.

4 Vacation behaviour under high travel cost conditions – An SPoffRP approach

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4.1 Introduction

Tourism forecasts are known to be highly uncertain (Wilkinson 2009; Dubois et al. 2010). One reason for this uncertainty is that tourism, and in particular long-haul tourism, relies heavily on the availability of affordable transport connections with tourist source markets (Yeoman et al. 2007; Becken 2008), while on the horizon various substantial changes loom that could jeopardize future affordable mobility (Van Cranenburgh et al. 2012).

The most often cited potential substantial change in this regard is probably a peak oil event (e.g. Yeoman et al. 2007; Becken 2008; Curtis 2009; Krumdieck et al. 2010; Aftabuzzaman and Mazloumi 2011; Becken 2011; Becken and Lennox 2012). In a peak oil event the demand for fossil fuels exceeds supply capacity causing considerably higher fuel prices and hence a substantial increase in travel costs (Hubbert 1956). Besides a peak oil event however, various other – far from unimaginable – scenarios are likely to result in substantially increased travel costs, e.g. local political instability in large oil exporting countries or regions and fierce climate change mitigation measures such as high aviation carbon taxes, to name a few (see e.g. Dwyer et al. 2009; Sgouridis et al. 2011).

In order to be able to anticipate on such potential changes it is of crucial importance to have models that are able to adequately assess their impacts. Existing tourism models may however not be appropriate to make such assessments as they are generally based on previously found demand elasticities. Under substantially changed conditions new vacation behavior (and hence substitution patterns) is likely to emerge – potentially rendering previously found elasticities unreliable.

To develop tourism models that are able to adequately assess the impacts on tourism demand of a substantial increase in travel costs a thorough understanding of vacation behavior under high travel cost conditions is needed. However, the number of studies investigating vacation behavior in the context of high travel cost conditions is strikingly limited (Becken 2011). Most published efforts have been made during, or in the aftermath of, the oil crises of the 1970s (Pisarski and Terra 1975; Corsi and Harvey 1979; Williams et al. 1979). Surprisingly, while these studies clearly show that vacation behavior is relatively heavily affected by a substantial increase in travel costs, recent research efforts investigation behavior under high travel cost conditions have primarily taken place outside the tourism arena e.g. investigating the impacts on work and maintenance related travel behavior (e.g. Noland et al. 2001; Loukopoulos et al. 2006; Horeni et al. 2007; Krumdieck et al. 2010; Weis et al. 2010; Watcharasukarn et al. 2012).

Studies conducted during, or in the aftermath of the oil crises on vacation behavior showed that vacationers use an array of ways to adapt to a substantial increase in travel costs (Corsi and Harvey 1979; Williams et al. 1979). However, as it is well-known that tourism patterns are transient (Oppermann 1995) these findings are unlikely to provide accurate insights on how travelers would adapt to a substantial increase in travel costs today. Besides that, the methods used to analyze the impacts on vacation behavior in those days (mainly descriptive statistics) are not as advanced as they are today. Therefore, insights into the subtle behavioral trade-offs underlying the vacation choice – which are likely to be important for understanding vacationers' responses to a substantial increase in travel costs – are by and large missing. In addition, over the past few decades many socio-demographic determinants of vacation behavior have changed dramatically (e.g. income levels, demography, transport infrastructure, travel information availability, just to name a few). Therefore, in all, it may be concluded that at present very little is known about the impact of high travel cost conditions on vacation behavior, and that there is a need for new methodological approaches (i.e., behavioral models) to study this impacts.

In this paper we explore vacation behavior under high travel cost conditions. To investigate this we develop and estimate discrete portfolio vacation choice models. Our portfolio vacation choice models are geared to capture interaction effects between multiple relevant vacation choice dimensions. Vacation choice data are obtained in a novel so-called free format SPoffRP choice experiment. This pivoted experiment consists of two parts: a Revealed Preference (RP) part and a Stated Preference (SP) part. The RP part aims to elicit from respondents their late consideration set: they are asked to compose a number of vacation alternatives they consider for a coming vacation period. Next, in the SP part, hypothetical alternatives are constructed by pivoting of these self-reported vacation alternatives. With this experimental design we: 1) aim to reduce hypothetical bias – which is especially on the lure as in our high travel cost context respondents face hypothetical choice situations to which they are unfamiliar, and 2) avoid estimation bias caused by misspecification of the decision-makers' consideration sets by the analyst (Manski 1977; Williams and Ortuzar 1982).

However, as a result of the pivoted experimental design endogeneity may be present: unobserved utilities associated with the self-reported alternatives can be expected to carry over to the SP experiment. Therefore, fundamental assumptions under standard logit estimation procedures may be violated and biased estimates may be obtained when standard logit estimation procedures would be used. To accommodate for this, we propose a generalization of the recently proposed SPoffRP estimation procedure (Train and Wilson 2008; 2009). The structure of SPoffRP estimation procedures is such that it captures the process that is assumed to drive the endogeneity and thereby aims to reduce the potential bias stemming from the pivoted experimental design.

The substantive contribution of this paper is to develop new insights into vacation behavior under high travel cost conditions. The methodological contribution of this paper is twofold. Firstly, whereas usually pivoted experimental designs are primarily put forward to enhance realism as to reduce response error variance, in our experiment we use pivoting as an approach to deal with the limited knowledge from the analyst's perspective on the decision-makers' consideration sets. In contrast to earlier pivoted choice experiments, alternatives are constructed by pivoting of consideration set alternatives, rather than only of the chosen alternative. Thereby, our choice experiment contributes to the growing body of literature on pivoted experimental designs (see e.g. Hensher and Rose 2007; Hess and Rose 2009). Secondly, we propose a generalization of the SPoffRP estimation procedure (Train and Wilson 2008; 2009). This Generalized SPoffRP estimation procedure has both the standard logit and the original SPoffRP estimation procedure proposed by Train and Wilson as a special case. We compare performances of these three estimation procedures.

The remainder of this paper is arranged as follows. Section 4.2 discusses the methodology taken to model vacation choice behaviour. Next, sections 4.3 and 4.4 present respectively the data collection and the Generalized SPoffRP estimation procedure. Section 4.5 provides the model estimation and results. Lastly, section 4.6 provides conclusions and a discussion.

4.2 Methodology: the portfolio vacation choice model

To investigate vacation behavior under high travel cost conditions we adopt the widely used discrete choice modeling approach (McFadden 1974; Ben-Akiva and Lerman 1985; Train 2003). Following Lancaster (1966) we assume that a vacation choice can be conceived as a choice between bundles of attributes. From the literature we have identified the following generally applying attributes which we use to conceptualize a vacation alternative, see Table 4-1 (e.g. Morley 1994; Dellaert et al. 1997; Huybers 2003; Grigolon et al. 2012).

Accordingly, a vacation alternative is conceptualized to consist of a specific combination of Destination (*D*), Length of stay (*L*), Accommodation type (*Acc*), Mode of travel (*M*), and associated Travel cost and Travel time.

The attribute levels are listed in the third column of Table 4-1. We distinguish destinations based on their distance. Although distance is just one out of the many attributes of a destination (others include local climate, food, atmosphere, safety, facilities, etc. see e.g. Lyons et al. 2009), distance is the only attribute of a destination we can easily and objectively observe in our choice experiment. Length of stay is divided into four levels with one week intervals. Accommodation types are grouped such that accommodation types within the same level share a substantial part of characteristics (hence utility). Furthermore, regarding modes of transport we limit our study to the three main modes of transport of Dutch vacationers: private car, train or bus coach, and aircraft (CBS 2011). Travel cost is conceptualized as the total expenditure associated with travel to reach the vacation destination and return to home. In our experiment, travel cost is pivoted of the reference value: travel cost is varied within the range of 150% to 300% of the current travel cost. Lastly, in a vacation choice context, total door-to-door travel time is more likely to be relevant than e.g. in vehicle travel time. Therefore, we conceptualize travel time as the total door-to-door one way travel time to reach the vacation destination.

Table 4-1: Vacation portfolio

Attribute	Attribute labels	Attribute levels	
Destination	D1	dist. ≤ 200 km	"Domestic"
	D2	200 < dist. ≤ 700 km	"Near abroad"
	D3	700 < dist. ≤ 1500 km	"Intermediate abroad"
	D4	dist. > 1500 km	"Intercontinental"
Length of stay	L1	D ≤ 7 days	
	L2	7 < D ≤ 14 days	
	L3	14 < D ≤ 21 days	
	L4	D > 21 days	
Type of accommodation	Acc1	Hotel, Hostel, Bed & Breakfast, apartment	
	Acc2	Vacation homes, vacation village, privately owned homes	
	Acc3	Tent	
	Acc4	Caravan, motor home, camper	
Principle mode of transport	M1	Car	
	M2	Train or bus	
	M3	Airplane	
Travel costs	x_c	Interval variable [euro]	
Travel time	x_t	Interval variable [hours]	

In a vacation choice situation the choice over one dimension is unlikely to be independent of the choice over other dimensions. For instance, choosing for accommodation type tent can be expected to increase the utility of going by car. Specifically, to model this type of choice behaviour, portfolio choice models have been proposed. The key idea behind the portfolio choice model is that the utility of a portfolio (in our case a vacation) is a function of the structural components (the principle attributes) plus additional portions of utility that stem from specific combinations of these structural components- called interaction effects (Wiley and Timmermans 2009). Given that in the choice situation we aim to model such interaction effects are likely to exist, we adopt a portfolio choice utility specification. Similarly, additional portions of utility may be derived from triples or even quadruples of structural components. However, to keep complexity at a reasonable level we a priori omit higher order interactions effects.

Our portfolio utility specification of a vacation alternative is given in Eq. 4-1. The constant *Go* in the first part of the right hand side of Eq. 4-1 captures the utility associated with going on vacation – as opposed to staying at home - when controlling for the attributes mentioned in Table 4-1. The second part of Eq. 4-1 captures the utility associated with the structural components of a vacation alternative. Lastly, as we expect additional portions of utility to be derived from combinations of structural components, the third part of Eq. 4-1 captures the interactions between all possible pairs[21] of the structural components: destination and length of stay, destination and accommodation type, destination and mode of transport, length of stay and accommodation type, length of stay and mode of transport, and accommodation type and mode of transport. Similarly, additional portions of utility may be derived from triples or even quadruples of structural components. However, to keep complexity at a reasonable level we a priori omit higher order interactions effects.

In this study special interest goes to travel costs as in our experiment travel costs are varied within considerably larger ranges than is common in the travel behaviour literature. In this context, the notion of diminishing marginal disutility is likely to be important (Koppelman 1981). Therefore, instead of using the tradition linear-in-parameter utility specification for travel cost (and travel time), we adopt two-parameter power function specifications for travel cost (and travel time) of the form: $V = ax^b$ where a and b are estimates (see Eq. 4-1). Finding $0<b\text{'s}<1$ implies behaviour consistent with the notion of diminishing marginal disutility.

$$V_j = \underbrace{Go}_{\text{Utility derived from going on vacation}} + \underbrace{V_{\mathrm{D}} + V_L + V_{\mathrm{Acc}} + V_{\mathrm{M}} + V_{TrCost} + V_{TrTime}}_{\text{Utility derived from structural components of the vacation}} + \underbrace{V_{DL} + V_{DAcc} + V_{DM} + V_{LAcc} + V_{LM} + V_{AccM}}_{\text{Utility derived from first order interactio n terms}} \qquad \textbf{Eq. 4-1}$$

$$\text{where} \quad V_{TrCost}(x_c) = a_{TrCost} \cdot x_c^{b_{TrCost}}, \; V_{TrTime}(x_t) = a_{TrTime} \cdot x_t^{b_{TrTime}}$$

4.3 Data collection

Before introducing the SPoffRP estimation procedures, in this section we present the free format SPoffRP vacation choice experiment we conducted.

[21] Similarly, additional portions of utility may be derived from triples or even quadruples of structural components. However, to keep complexity at a reasonable level we a priori omit second order interactions effects.

4.3.1 Data collection approach

To elicit vacation choice behavior under high travel cost conditions poses a serious challenge regarding data collection. Stated Preference (SP) techniques have the advantage that the analyst can carefully design the choice tasks and thereby allow for a design that enables a relatively straightforward identification of effects (McFadden 2000; Rose et al. 2008). Given the complexity of the vacation choice process we aim to model this is a highly desirable feature.

However, SP choice data are also known to potentially suffer from hypothetical bias i.e. the inconsistency between SP data and real market evidence (see e.g. Brownstone and Small 2005). Such hypothetical bias is particularly on the lure in our context as respondents inherently face choice tasks to which they are unfamiliar. One way to reduce this bias is by increasing the realism of the choice task (Hensher 2010). An increasingly popular way to enhance realism in choice experiments is by pivoting the choice tasks around the knowledge base of a respondent (Caussade et al. 2005; Hensher 2006; Hensher and Rose 2007; Train and Wilson 2008; see for a critical review: Hess and Rose 2009)[22].

Pivoting of alternatives however requires that the analyst has knowledge concerning the alternatives considered by the decision-maker. Clearly, pivoting of an irrelevant alternative does not enhance the realism of the choice task and hence may rather provoke hypothetical bias than reduce it. Yet, contrary to a situation in which the number of relevant alternatives is confined to just a few trivial ones such as for example in the commute mode choice, or to situations in which the analyst may reasonably be able to infer which alternatives are considered by the decision-maker, in a vacation choice context the set of considered alternatives is typically unknown to the analyst. As such, we cannot readily adopt a standard pivoting approach.

In this regard the notion that the vacation choice involves a multi-stage process is of practical use. The vacation decision is by many believed to be a decision process that involves multiple stages in which vacationers narrow down their alternatives (e.g. Woodside and Sherrell 1977; Woodside and Lysonski 1989; Crompton 1992; Sirakaya and Woodside 2005). The final decision is made from what is typically referred to as the late consideration set. This late consideration set constitutes a set of alternatives which are considered probable within a given time period (Crompton 1992). Considerable empirical evidence shows that the number of alternatives in vacationers their late consideration sets for any given vacation is limited; on average in the order of four (see Crompton 1992 for an extensive overview).

Accordingly, to set up a pivoted vacation choice experiment we make use of the concept of a late consideration set. The experiment we propose consists of two parts. In the first part, the RP part, we aim to elicit alternatives from respondents their late consideration sets. To do so, respondents are asked to compose six alternatives which they consider for a given vacation

[22] Besides reducing the hypothetical bias, enhancing the realism may also reduce the response error variance and accordingly enables more efficient preference elicitation.

period. After that, in the SP part, alternatives are constructed by pivoting of these RP alternatives. All attributes are varied except for the destinations. As a result, the realism of the SP choice task is enhanced; at least to the extent that SP choice tasks only consist of destinations which are – under normal conditions – considered by the decision-maker. Using this approach – which to the best of our knowledge has not been adopted before – we aim to reduce hypothetical bias as much as possible and avoid the need to make unrealistic assumptions on the consideration sets of the respondents e.g. such as the common assumption in choice modeling that all respondents share the full universal set of alternatives.

However, as a result of this experimental design endogeneity may be present. Unobserved utilities associated with the RP alternatives can be expected to carry over to the SP experiment. As a result, assumptions under standard estimation procedures may be violated. To accommodate for this source of endogeneity, we use SPoffRP estimation procedures (Train and Wilson 2008; 2009). We discuss these estimation procedures in in section 4.4 , after presenting the choice experiment we conducted. In addition, endogeneity might also stem from the use of self-reported alternatives. That is, suppose that respondents have more than six alternatives in their late consideration set. Then, to the extent that respondents do not report a *random* subset of their late consideration set, choice sets contain preference information – potentially leading to bias. Although we acknowledge this possibility, we believe that our approach is likely to yield more accurate results than an approach which for instance assumes that all respondents share the full universal choice set (see Thill 1992 for a discussion).

4.3.2 The free format SPoffRP portfolio choice experiment

RP part

The RP part consists of two sub parts. The first sub part collects information on the respondent and on his previous travel experiences. This information is used to set relevant vacation (choice) contexts for the respondent under which the respondent later on is asked to compose vacation alternatives. Questions relate to: the city of residence, the planned number of vacations coming year, the intended travel period for these vacations and the travel party for a specific (randomly selected) travel period. After that, previous travel experiences to destinations categories (domestic, European, intercontinental) conditional on the earlier selected travel party are elicited.

In the second sub part respondents are asked to compose six vacation alternatives they consider for a given coming travel period. Figure 4-1 depicts the screen in which the respondents composed the vacation alternatives. The screen consists of three parts. On the top left is the vacation (choice) context. Below the vacation (choice) context, on the bottom left, is the ‘free format’. At the right of the screen, is a Google map that pinpoints the destination filled in by the respondent on a map.

The free format is designed so that respondents can compose their own vacation alternatives, yet in accordance with the attributes and attribute levels of Table 4-1. To elicit the destination we used a Google map application. Cities, regions, and countries are accepted as vacation destinations. The Google map application allowed us to infer the distance between the city of residence of the respondent and the picked destination. Respondents selected the accommodation type and the mode of transport using list boxes. For the total travel costs per person and for the door-to-door travel time respondents could enter any positive numerical value. Furthermore, by navigating their mouse pointer over blue-colored texts respondents could acquire further explanation on the item: a mouse-over with textual explanation appeared.

To ensure that our results are independent of the period in which the survey is conducted (i.e. June), in case a respondent indicated to go more than once on vacation in the coming year (e.g. July and October), we randomly picked one of these intended travel periods. Subsequently, this travel period is used in the vacation choice context throughout the whole choice experiment. Since we do not consider substitution over travel party, fixing the travel period also fixes the travel party.

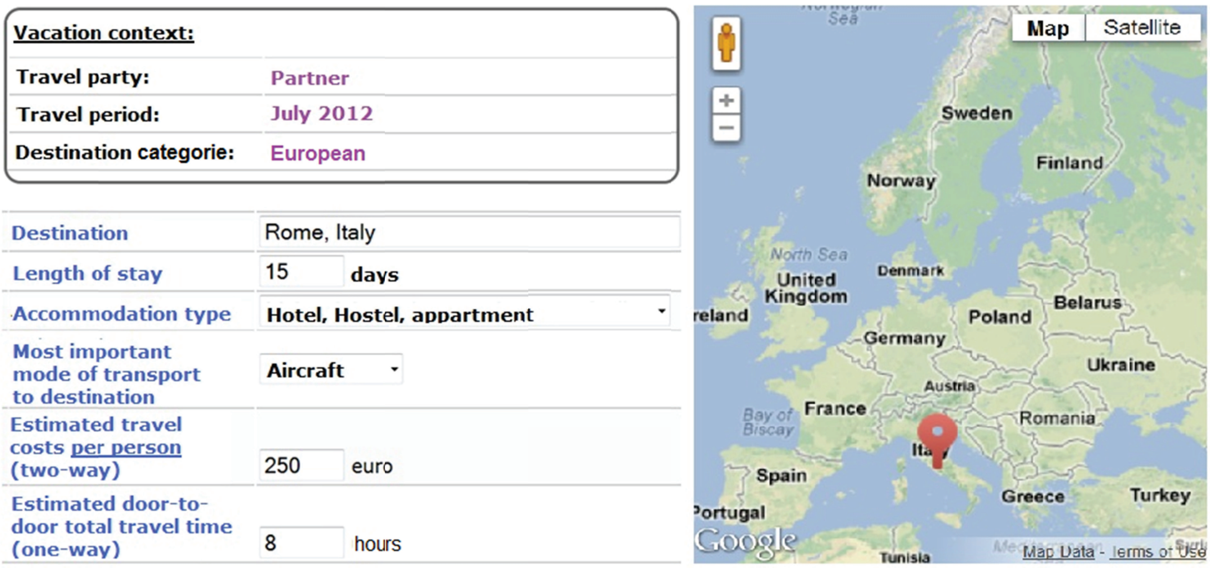


Figure 4-1: Screen shot of vacation alternatives elicitation

For the first three alternatives, respondents are provided a destination category condition (see vacation context box in Figure 4-1). By providing this condition, we assured that there is variation in the composed vacation alternatives in terms of the distance to destinations. Thereby, we ensured that in the SP setting, assigned choice sets consisted of alternatives that allow for substitution in all vacation choice dimensions; including the destination (hence distances). We differentiated between three destination categories, namely: Domestic, European, and Intercontinental. Yet, to warrant that respondents are not forced to compose a vacation alternative to a destination category that is not considered relevant by the respondent, only destination categories are asked for to which the respondent has previously been to –

with the selected travel party. For the subsequent three vacation alternatives no specific conditions on the distance category are given: respondents are simply asked to compose for them potential vacation alternatives.

After having composed in total six vacation alternatives, each respondent is presented his/her composed alternatives side-by-side and is asked to indicate the vacation which he or she actually intends to take. Henceforth we refer to this alternative as the 'RP chosen alternative'.

SP part

The SP part consists of eight consecutive choice tasks. Each of the presented choice sets consisted of one or two alternatives pivoted of the RP chosen alternative, two alternatives pivoted of randomly selected non-chosen RP alternatives and a No-Go alternative. Respondents were informed that the No-Go alternative implied that they would not go on vacation in the assigned travel period.

To pivot of the RP alternatives, a double random procedure was used. First, for each alternative to pivot of randomly one or more attributes were selected to vary e.g. travel cost and length of stay. If travel cost was selected to be varied, then it was multiplied by a random number in between respectively 1.25 and 3, and rounded respectively to the nearest multiple of 10 euros. If travel time was selected to be varied, then it was multiplied by a random number in between respectively 1.25 and 2.5 and rounded respectively to the nearest multiple of 0.5 hours. If length of stay was selected to be varied, then it was multiplied by a random number in between 0.5 and 2 and rounded to the nearest integer. In case the vacation attribute to alter concerned the accommodation type, one of the non-chosen accommodation types was assigned randomly.

It gets somewhat more complicated when the mode of travel is picked to alter. Randomly one of the non-chosen, yet feasible, modes of transport was assigned. For destinations closer than 300 km, only the car and train are considered feasible alternatives, in between 300 km and 1500 km, car, train and aircraft are considered feasible alternatives. For destinations further than 1500 km away, only the aircraft is considered feasible. Accordingly, when the distance to a destination exceeded 1500 km (and the originally preferred mode of transport by the respondent was aircraft), then another vacation attribute was (randomly) selected to alter.

Changing the travel mode implies that new travel costs and times corresponding to the new travel mode needed to be assigned. To calculate travel costs and travel times associated with the new mode of travel under a high travel cost scenario, we used a simple procedure. First, we calculated the average travel cost and travel time based on distance, mode of transport, and the number of passengers (for cars) using simple empirical rules of thumb[23]. After that, these average travel cost and travel time are multiplied by a random number in between respectively 1.25 and 3 and 1.25 and 2.5 and rounded.

[23] Available from the authors upon request.

4.3.3 The experiment

The experiment was conducted online in June 2012. Respondents were recruited using a panel company[24]. The panel consisted of respondents of 18 years and older. The panel company rewarded 4 euro for each completed survey. Participants[25] were selected such that a by and large representative sample of the Dutch population that went at least once on vacation in 2010 in terms of gender, income, age and educational level was obtained (CBS 2011). Table 4-2 presents the sample characteristics. The second column gives the obtained frequencies in the sample. The third column gives the frequencies of a fully representative sample of a population with the size of the sample. The last column provides the obtained percentages of the sample frequency relative to the fully representative sample.

Table 4-2: Sample characteristics (*N = 419*)

Variable	Sample frequency	Frequency in representative sample of the population	Percentage [%]
Gender			
Female	197	210	94%
Male	222	210	106%
Age			
18 < y < 24	44	40	109%
25 < y < 34	57	57	100%
35 < y < 44	80	73	110%
45 < y < 54	89	82	108%
55 < y < 64	95	88	108%
65 < y < 74	48	49	97%
y >75	6	28	22%
Completed education			
Elementary school	12	23	51%
Lower education	99	90	110%
Middle education	160	159	100%
Higher education	99	96	104%
University education	49	50	97%
Discretionary household income			
I < 10 000	22	18	125%
10 000 ≤ I < 20 000	84	79	107%
20 000 ≤ I < 30 000	86	90	96%
30 000 ≤ I < 40 000	80	76	105%
40 000 ≤ I < 50 000	63	61	103%
50 000 ≤ I < 75 000	69	70	98%
I ≥ 75 000	15	25	60%

As can be seen, the sample is by and large representative for the 2010 Dutch on vacation going population except for the '75 years and older' segment and for the 'elementary school' segment. Due to the online nature of the survey, people of 75 years and older were more difficult to recruit. This may explain the lag of this segment. The difference in the elementary

[24] See www.panelclix.nl
[25] Only participants that intended to take a vacation in the coming year were allowed to conduct the experiment.

school' segment is well explained by its correlation with age being below 18 years old. Since all respondents were 18 years or older, the elementary school education lags. Lastly, the relatively low response in the 75 000 euro and more income segment can be explained by the relatively low reward compared to the household income and value of time of this group.

4.4 SPoffRP estimation procedures

This section discusses the SPoffRP estimation procedures. SPoffRP estimation procedures have recently been proposed by Train and Wilson (2008) to accommodate for the endogeneity in pivoted choice experiments such as the one we have conducted. Subsection 4.4.1 presents the SPoffRP estimation procedure as proposed by Train and Wilson (2008). This subsection draws heavily on Train and Wilson (2008). Next, in subsection 4.4.2 we propose a generalization of this estimation procedure. The proposed Generalized SPoffRP estimation procedure has both the standard logit and the SPoffRP estimation procedure proposed by Train and Wilson (2008) as a special case.

4.4.1 The SPoffRP estimation procedure

In free format SPoffRP choice experiments for each decision-maker n we observe J individual specific alternatives of from his or her late consideration set. In our experiment J equals six (recall that respondents are asked to compose six alternatives). To denote the difference between the RP setting and the SP setting we earmark alternatives (and unobserved utilities) in the SP by a tilde. So, alternative $\tilde{j}$ in the SP setting is pivoted of RP alternative j .

In the RP setting we suppose that utility is given by Eq. 4-2. We assume that the unobserved utility is independent and identically (*i.i.d*) type I extreme value distributed across the RP alternatives (with a variance of $\pi^2/6$). Consequently, the RP choice probabilities obtain the well-known closed form expression, see Eq. 4-3.

$$U_{jn} = V_{jn} + \varepsilon_{jn} \qquad \text{where } \varepsilon_{jn} \sim iid \text{ extreme value} \qquad \textbf{Eq. 4-2}$$

$$\mathrm{P_n}\left(\mathrm{Y_{RP}} = i\right) = e^{V_{in}} \Big/ \sum_{j=1}^{J} e^{V_{jn}} \qquad \textbf{Eq. 4-3}$$

Suppose free format alternative i is the RP chosen alternative, then it follows that - from the analyst's perspective - Eq. 4-4 holds.

$$V_{in} + \varepsilon_{in} > V_{jn} + \varepsilon_{jn} \qquad \textbf{Eq. 4-4}$$

Note that RP alternative j and SP alternative $\tilde{j}$ are likely to share a considerable portion of unobserved utility. Therefore, we allow the unobserved utility (ε_{jn}) associated with RP alternative j to carry over to SP alternative $\tilde{j}$. Hence, ε_{jn} enters the utility specification of alternative $\tilde{j}$ in the SP-setting. The utility of alternative $\tilde{j}$ in the SP-setting *given* that alternative i is the RP chosen alternative is given by Eq. 4-5. Lastly, to account for quixotic aspects in the SP setting an additional *i.i.d.* extreme value term $\eta_{\tilde{j}n}$ is added in Eq. 4-5. In order to normalize the scale of utility, we include a scaling parameter α so that $\eta_{\tilde{j}n}$ can have a variance of $\pi^2/6$. Hence, the scale of utility is normalized to the error variance in the RP choice data.

$$U_{\tilde{j}n}\left(\varepsilon_{jn} \mid V_{in}+\varepsilon_{in} > V_{jn}+\varepsilon_{jn}\right)=V_{\tilde{j}n}+\varepsilon_{jn}+\eta_{\tilde{j}n} \qquad \textbf{Eq. 4-5}$$

Clearly, the ε_{jn}*'s* are unknown to the analyst. However, since the analyst does observe the RP choice he may infer that the set of ε's are distributed across the alternatives such that Eq. 4-4 holds. Accordingly, from the analyst's perspective the distribution of the ε's is conditional on the RP choice. Choice probabilities can be obtained by integration over the conditional distribution of ε. The probability of a choice for $\tilde{k}$ in the SP setting conditional on i being the RP choice is given in Eq. 4-6. Note that the subscript n for the decision-maker is dropped for legibility.

$$\begin{aligned} P_{\tilde{k}|i} &= \text{Prob}\left\{\alpha\left(V_{\tilde{k}}+\varepsilon_k\right)+\eta_{\tilde{k}} > \alpha\left(V_{\tilde{j}}+\varepsilon_j\right)+\eta_{\tilde{j}} \mid V_i+\varepsilon_i > V_j+\varepsilon_j\right\} \\ &= \int \frac{e^{\alpha\left(V_{\tilde{k}}+\varepsilon_k\right)}}{\sum_{\tilde{j}} e^{\alpha\left(V_{\tilde{j}}+\varepsilon_j\right)}} f\left(\varepsilon \mid V_i+\varepsilon_i > V_j+\varepsilon_j\right) d\varepsilon \end{aligned} \qquad \textbf{Eq. 4-6}$$

Lastly, Eq. 4-6 can be extended for in case a sequence of SP choices is observed. We denote $t = 1\ldots T$ the identifier of the choice task so that the chosen alternative in choice task t is denoted $\tilde{k}_t$. The sequence of SP choices is collected in the vector $\Gamma = [\tilde{k}_t \ldots \tilde{k}_T]$. The probability that RP choice i and the sequence of SP choices Γ are chosen is given in Eq. 4-7.

$$P_{\Gamma i} = \int\left[\mathrm{L}_{t|i}(\varepsilon)\ldots\mathrm{L}_{T|i}(\varepsilon)\right] f\left(\varepsilon \mid V_i+\varepsilon_i > V_j+\varepsilon_j\right) d\varepsilon \cdot \frac{e^{V_i}}{\sum_j e^{V_j}}$$

where

$$\mathrm{L}_{t|i}(\varepsilon) = \frac{e^{\alpha\left(V_{\tilde{k}_t}+\varepsilon_{k_t}\right)}}{\sum_{\tilde{j}} e^{\alpha\left(V_{\tilde{j}t}+\varepsilon_{jt}\right)}} \qquad \textbf{Eq. 4-7}$$

The probability in Eq. 4-7 is has a mixed logit form, and can be simulated by taking draws of ε from its conditional density. Draws from the conditional densities of ε are straightforward to obtain. Feng and Anas (1988) show that the density of ε_i – *i* being the chosen alternative – is extreme value type I with the mean shifted up by *–ln(P$_i$)*. A draw for ε_i – *i* being the chosen alternative – is obtained as follows: Eq. 4-8. The densities of the ε_j*'s* of the non-chosen alternatives conditional on ε_i are extreme value, truncated above $(V_i+\varepsilon_i)-V_j$. A draw for ε_j – conditional on ε_i – is obtained as follows: Eq. 4-9, see also Train (2003).

$$\varepsilon_i = -\ln\left(P_i\right) - \ln\left(-\ln\left(u\right)\right) \quad \text{where } u \text{ is a draw from the uniform between 0 and 1} \qquad \textbf{Eq. 4-8}$$

$$\begin{aligned} &a_n\left(\varepsilon_i, V_i, V_n\right) = \left(V_i + \varepsilon_i - V_n\right) \\ &z_n = u \cdot \exp\left(-\exp\left(-\left[a_n\right]\right)\right) \quad \text{where } u \text{ is a draw from the uniform between 0 and 1} \\ &\varepsilon_n = -\ln\left(-\ln\left(z_n\right)\right) \end{aligned} \qquad \textbf{Eq. 4-9}$$

4.4.2 The Generalized SPoffRP estimation procedure

Under the SPoffRP model all unobserved utility carries over from the RP setting to the SP setting, see Eq. 4-5. However, this may behaviorally be unrealistic. A decision-maker may 'lose' or ignore some of the unobserved utility he previously assigned to an alternative, or the SP alternative is changed such that the unobserved utility associated with the RP alternative is changed. To accommodate for that only a fraction of the unobserved utility carries over from the RP to the SP setting, we introduce fraction parameter λ. Under the Generalized SPoffRP procedure $\lambda\varepsilon_{jn}$ carries over (instead of ε_{jn}). The utility of alternative $\tilde{j}$ in the SP-setting *given* that alternative *i* is the RP chosen alternative becomes Eq. 4-10. The probability of observing RP choice *i* and the sequence of SP choices Γ under this procedure becomes Eq. 4-11. Similar as under the SPoffRP specification (Train and Wilson 2008), this probability is also of a mixed logit form and can be simulated by taking draws of ε from its conditional density.

$$U_{\tilde{j}n}\left(\varepsilon_{jn} \mid V_{in}+\varepsilon_{in} > V_{jn}+\varepsilon_{jn}\right) = \alpha\left(V_{\tilde{j}n} + \lambda\varepsilon_{jn}\right) + \eta_{\tilde{j}n} \qquad \textbf{Eq. 4-10}$$

$$P_{\Gamma i} = \int \left[\mathrm{L}_{t|i}\left(\varepsilon\right) \ldots \mathrm{L}_{T|i}\left(\varepsilon\right)\right] f\left(\varepsilon \mid V_i + \varepsilon_i > V_j + \varepsilon_j\right) d\varepsilon \cdot \frac{e^{V_i}}{\sum_j e^{V_j}}$$

where

$$\mathrm{L}_{t|i}\left(\varepsilon\right) = \frac{e^{\alpha\left(V_{\tilde{k}_t} + \lambda\varepsilon_{k_t}\right)}}{\sum_{\tilde{j}} e^{\alpha\left(V_{\tilde{j}_t} + \lambda\varepsilon_{j_t}\right)}} \qquad \textbf{Eq. 4-11}$$

By including the fraction parameter λ we generalize the original SPoffRP estimation procedure (Train and Wilson 2008). If λ is estimated to be not significantly different from one, then we have the original SPoffRP estimation procedure. Moreover, if λ is estimated to be not significantly different from zero, then the estimation procedure collapses to a standard logit estimation procedure with α now being the commonly used scaling parameter to account for differences in error variance between two data sets (see e.g. Ben-Akiva and Morikawa 1990; Ben-Akiva et al. 1994). This type of scaling parameter is usually denoted by μ in the literature. To avoid misinterpretation we also adopt this notation in our tables in the results section. Hence, both estimation procedures are a special case of this generalized estimation procedure.

Lastly, note that Eq. 4-7 and Eq. 4-11 are non-random coefficient specifications. Both models can be generalized to include random coefficients or error components. In our models we use two error components: φ_{Go} and $\varphi_{RPchosen}$. Both error components capture correlations across SP alternatives (so, not across the RP alternatives). Accordingly, the most general model to estimate becomes Eq. 4-12 .

$$P_{\Gamma i} = \int \left[\mathrm{L}_{t|i}(\varepsilon,\varphi) \ldots \mathrm{L}_{T|i}(\varepsilon,\varphi) \right] f\left(\varepsilon \mid V_i + \varepsilon_i > V_j + \varepsilon_j\right) d\varepsilon \cdot \frac{e^{V_i}}{\sum_j e^{V_j}}$$

where

$$\mathrm{L}_{t|i}(\varepsilon,\varphi) = \int \frac{e^{\alpha\left(V_{\tilde{k}_t} + \lambda\varepsilon_{k_t} + \delta^{Go}_{\tilde{k}_t}\varphi_{Go} + \delta^{RP}_{\tilde{k}_t}\varphi_{RPchosen}\right)}}{\sum_{\tilde{j}} e^{\alpha\left(V_{\tilde{j}_t} + \lambda\varepsilon_{j_t} + \delta^{Go}_{\tilde{j}_t}\varphi_{Go} + \delta^{RP}_{\tilde{j}_t}\varphi_{RPchosen}\right)}} f(\varphi \mid \sigma) \qquad \textbf{Eq. 4-12}$$

where $\delta^{Go}_{\tilde{j}} = 1 \; \forall \; \tilde{j} \neq$ the No Go alternative, $\delta^{RP}_{\tilde{j}} = 1 \; \forall \; \tilde{j} = i$

4.5 Model estimation and results

4.5.1 Model estimation

We estimated two model specifications: 1) a model without interaction terms, and 2) a model with interaction terms. As alluded before, both specifications encompass two error components. These aim to capture correlations between alternatives that share unobserved utility. The first error component $\varphi_{Go} \sim N(0,\sigma_{Go})$ aims to capture the correlation between alternatives associated with going on vacation (as opposed to the No Go alternative). The second error component $\varphi_{RPchosen} \sim N(0,\sigma_{RPchosen})$ aims to capture the correlation between the RP chosen alternative across choice observations of respondents[26]. This is presumably relevant since one respondent may be very sticky to the RP chosen alternative whereas another may be not at all.

[26] To avoid interference with the extreme value term, the panel term is only added across the SP choices.

Both model specifications are estimated using three estimation procedures; namely the standard logit estimation procedure (λ is fixed to zero), the SPoffRP estimation procedure (λ is fixed to one), and the Generalized SPoffRP estimation procedure (λ is estimate). The estimation procedures were coded in Matlab R2009. For the maximum simulated likelihood estimation, a built-in quasi Newton line search optimization algorithm was used. In the SPoffRP estimation procedures we had to take draws from the conditional distribution of ε. Theoretically, one draw of ε from its conditional density is sufficient (Train and Wilson 2008). However, by taking a few more draws and averaging the results the log-likelihood is improved (for our models log-likelihood was improved on average by around 20 points). For each draw of the random terms, eight draws were taken for the extreme value term. Since we used 500 draws for the random terms, in total for each choice observation 500 x 8 = 4 000 draws were taken. To obtain draws, variance reduction methods were used. Because of the relatively low number of draws, we opted for Modified Latin Hypercube Sampling (MLHS) draws (e.g. instead of the more widely used Halton draws). MLHS performs relatively well with low numbers of draws (Hess et al. 2006). More importantly, estimation results proved stable when doubling the number of draws.

In portfolio choice models for each attribute one attribute level needs to be fixed to allow for identification. We fixed the following attribute levels to zero: Destination 'domestic', Length of stay 'one week or shorter', Type of accommodation 'hotel, hostel, B&B, apartment', and Mode of transport 'car'. Theoretically, the portfolio vacation choice model encompasses 84 (first order) interaction terms. However, as a result of our pivoted approach and random choice set design, not all interactions are sufficiently present in the data to allow for statistical identification. Therefore, to identify interaction terms we started with a model without interaction terms which we gradually extended by including interaction terms. For this we used a model without error components because of the higher computational times associated with the error component model. Interactions terms were kept or removed depending on their level of significance. In the final model (without error components) the set of interactions terms was such that all interaction terms were statistically significant at a significance level of $\alpha = 0.10$.

Parameter estimates cannot be identified separately from the error variance. Therefore, to be able to compare estimates across estimation procedures we have to normalize the scale of utility to the error variance of one data set: either the RP or SP data. We choose to set the error variance in the SP data to unity because the SP data is the larger data set of the two. Because in the SPoffRP estimation procedures the scale of utility is normalized to the error variance in the RP (see Eq. 4-2), parameter estimates need to be multiplied with the scaling parameter α (except for the powers: *b_TrCost* and *b_TrTime* since they are scale invariant). All tables in the results section report estimates after this scaling.

4.5.2 Results

Before presenting our empirical results on vacation travel choice behaviour, we discuss the general performance of the portfolio vacation choice models. The last subsection reports results on differences in performance between the standard logit, SPoffRP and Generalized SPoffRP estimation procedures.

Portfolio vacation choice model performance

Table 4-3 & 4-4 show respectively the estimation results of the models without and with interaction terms. We see that signs and relative sizes of all estimates are in the a priori, intuitively expected directions under both model specifications. Therefore, we may infer that we have been able to capture rationality behind the vacation choice process. Comparing the estimates of the two models we see that the estimates of the structural components are generally persistent. Hence, the interaction terms do not interfere with the identification of the structural components. Furthermore, most estimates of the structural components are significant at a significance level of $\alpha = 0.05$.

To see whether the interaction terms improve the models in the statistical sense as compared to the models without interaction terms, we applied the log-likelihood ratio test statistic (e.g. Ben-Akiva and Lerman 1985). The log-likelihood of the model with and without interaction terms is improved by more than 22 log-likelihood points under all estimation procedures: exceeding the critical χ^2 value with nine degrees of freedom at a significance level of $\alpha = 0.01$. Hence, in terms of model fit, the model with interaction terms statistically outperforms the model without interaction terms.

The relatively low rho-squares tell that – despite the nine interaction terms – there is a substantial amount of unobserved variation in utility still present. This does however not come unexpected. Vacation choice is likely to involve various relevant attributes that we simply did not observe and therefore did not entered our utility specification, for instance local climate, presence of specific local infrastructure, presence of beaches, lakes or mountains, whether friends or family reside at a specific destination, etc.

Error component model without interaction terms

Estimation procedure:	Standard			SPoffRP			Generalized SPoffRP		
Final Log-likelihood	-4825.9			-4924.0			-4818.5		
Number of parameters	19			19			20		
ρ^2	0.146			0.129			0.147		
Number of draws	500			8 x 500			8 x 500		
Variable	Coefficient	Std error	*t*-stat	Coefficient	Std error	*t*-stat	Coefficient	Std error	*t*-stat
Structural components									
Go on holiday	4.331	1.08	9.25	3.290	0.33	9.97	4.392	0.49	9.06
Domestic	0.000	--fixed--	--fixed--	0.000	--fixed--	--fixed--	0.000	--fixed--	--fixed--
Near abroad	0.256	0.12	2.08	0.255	0.07	3.60	0.261	0.12	2.17
Interm. abroad	0.440	0.19	2.31	0.450	0.10	4.59	0.474	0.19	2.51
Intercontinental	0.830	0.32	2.61	0.770	0.12	6.30	0.885	0.31	2.85
D ≤1 wk	0.000	--fixed--	--fixed--	0.000	--fixed--	--fixed--	0.000	--fixed--	--fixed--
1 wk < D ≤ 2 wk	0.333	0.14	2.45	0.269	0.07	4.14	0.331	0.13	2.58
2 wk <D ≤ 3 wk	0.744	0.27	2.71	0.655	0.09	7.05	0.736	0.25	2.90
D > 3 wk	1.683	0.54	3.14	1.039	0.13	7.96	1.710	0.50	3.45
Hotel, Hostel, B&B,...	0.000	--fixed--	--fixed--	0.000	--fixed--	--fixed--	0.000	--fixed--	--fixed--
Vacation homes	0.125	0.09	1.43	0.101	0.06	1.70	0.135	0.09	1.55
Tent	-0.636	0.22	-2.89	-0.387	0.11	-3.65	-0.639	0.21	-3.09
Caravan, Motor home,	-0.188	0.12	-1.56	-0.071	0.10	-0.72	-0.186	0.12	-1.54
Car	0.000	--fixed--	--fixed--	0.000	--fixed--	--fixed--	0.000	--fixed--	--fixed--
Train, bus	-0.347	0.13	-2.67	-0.298	0.07	-4.45	-0.365	0.13	-2.90
Aircraft	0.211	0.11	1.90	0.140	0.08	1.86	0.194	0.11	1.85
Non-linear parameters									
a_TrCost [b]	-1.647	0.57	-2.89	-1.332	0.21	-6.45	-1.663	0.52	-3.18
b_TrCost	0.366	0.12	6.93	0.380	0.06	6.03	0.372	0.05	7.10
a_TrTime [c]	-1.754	0.68	-2.57	-1.050	0.28	-3.75	-1.891	0.69	-2.75
b_TrTime	0.271	0.14	4.38	0.341	0.08	4.47	0.263	0.06	4.52
Scaling parameters									
μ	2.304	0.73	1.78 [a]						
α				0.453	0.04	-15.6 [a]	2.145	0.61	1.87 [a]
λ	0.000	--fixed--	--fixed--	1.000	--fixed--	--fixed--	0.063	0.03	2.52
Random parameters									
σ_{Go}	1.668	0.35	10.97	1.670	0.16	10.69	1.677	0.15	10.9
$\sigma_{RPchosen}$	1.385	0.19	16.85	1.602	0.10	15.4	1.343	0.08	16.6

[a] *t*-test for difference from one
[b] measured in thousands of euros
[c] measured in tens of hours

Table 4-4: Estimation results of error component portfolio vacation choice model without interaction terms

Error component model with interaction terms

Estimation procedure:	Standard			SPoffRP			Generalized SPoffRP		
Final Log-likelihood	-4803.1			-4900.9			-4796.1		
Number of parameters	28			28			29		
ρ^2	0.150			0.133			0.151		
Number of draws	500			8 x 500			8 x 500		
Variable	Coefficient	Std error	*t*-stat	Coefficient	Std error	*t*-stat	Coefficient	Std error	*t*-stat
Structural components									
Go on holiday	4.188	0.47	8.94	3.196	0.33	9.75	4.242	0.49	8.74
Domestic	0.000	--fixed--	--fixed--	0.000	--fixed--	--fixed--	0.000	--fixed--	--fixed--
Near abroad	0.382	0.15	2.61	0.360	0.08	4.58	0.399	0.15	2.72
Interm. abroad	0.511	0.19	2.62	0.481	0.11	4.40	0.537	0.19	2.74
Intercontinental	0.836	0.29	2.87	0.772	0.14	5.54	0.875	0.29	3.00
D ≤1 wk	0.000	--fixed--	--fixed--	0.000	--fixed--	--fixed--	0.000	--fixed--	--fixed--
1 wk < D ≤ 2 wk	0.197	0.11	1.82	0.176	0.07	2.40	0.201	0.11	1.84
2 wk <D ≤ 3 wk	0.728	0.23	3.11	0.644	0.10	6.70	0.728	0.23	3.20
D > 3 wk	1.137	0.43	2.65	0.861	0.23	3.72	1.177	0.43	2.74
Hotel, Hostel, B&B,...	0.000	--fixed--	--fixed--	0.000	--fixed--	--fixed--	0.000	--fixed--	--fixed--
Vacation homes	0.178	0.09	1.93	0.152	0.06	2.46	0.186	0.09	2.01
Tent	-0.995	0.30	-3.31	-0.764	0.16	-4.71	-0.982	0.29	-3.43
Caravan, Motor home,	-0.450	0.19	-2.39	-0.341	0.14	-2.36	-0.431	0.18	-2.35
Car	0.000	--fixed--	--fixed--	0.000	--fixed--	--fixed--	0.000	--fixed--	--fixed--
Train, bus	-0.278	0.12	-2.27	-0.181	0.09	-1.94	-0.296	0.12	-2.41
Aircraft	0.436	0.16	2.64	0.295	0.10	3.07	0.418	0.16	2.64
Non-linear parameters									
a_TrCost [c]	-1.650	0.48	-3.43	-1.334	0.20	-6.83	-1.667	0.46	-3.62
b_TrCost	0.390	0.05	7.46	0.408	0.06	6.59	0.394	0.05	7.59
a_TrTime [d]	-1.744	0.61	-2.87	-1.052	0.28	-3.71	-1.866	0.63	-2.98
b_TrTime	0.266	0.06	4.37	0.340	0.08	4.43	0.262	0.06	4.46
Scaling parameters									
μ	1.959	0.52	1.85 [a]						
α				0.454	0.03	-16.1 [a]	1.892	0.47	1.90 [a]
λ	0.000	--fixed--	--fixed--	1.000	--fixed--	--fixed--	0.070	0.03	2.73
Random parameters									
σ_{Go}	1.679	0.30	10.94	1.684	0.16	10.71	1.697	0.16	11.0
$\sigma_{RPchosen}$	1.370	0.16	17.02	1.596	0.10	15.4	1.319	0.08	16.5
Interaction effects									
Domestic __ 1 wk < D < 2 wk	0.393	0.19	2.02	0.287	0.13	2.24	0.401	0.19	2.07
Near abroad __ Train or bus	0.001	0.14	0.01	-0.150	0.13	-1.19	0.003	0.15	0.02
Near abroad __ Aircraft	-0.406	0.21	-1.98	-0.319	0.15	-2.19	-0.417	0.20	-2.03
D > 3wk __ Vacation homes,	-0.506	0.34	-1.47	-0.452	0.24	-1.90	-0.528	0.35	-1.51
1 wk < D < 2 wk __ Train or bus	0.214	0.16	1.32	0.199	0.13	1.48	0.204	0.16	1.28
2 wk < D < 3 wk __ Train or bus	-0.414	0.29	-1.42	-0.605	0.26	-2.36	-0.434	0.29	-1.48
D > 3 wk __ Aircraft	0.764	0.38	2.03	0.353	0.25	1.43	0.772	0.37	2.06
Tent __ Car	0.645	0.26	2.49	0.601	0.18	3.38	0.636	0.25	2.55
Caravan, Motor home, __ Car	0.483	0.22	2.18	0.427	0.16	2.65	0.464	0.21	2.16

Table 4-3: Estimation results of error component portfolio vacation choice models with interaction terms

Estimates of travel cost and travel time utilities

Now we turn to the parameter estimates for travel cost and travel time. For travel cost and travel time we used non-linear utility specifications, see Eq. 4-1. Looking at the parameter estimates associated with travel cost and travel time in Table 4-3 & 4-4, we see that both powers: *b_TrCost, b_TrTime* are substantially smaller than 1: about 0.4 and 0.3 respectively. This indicates considerable diminishing marginal disutility of vacation travel costs and travel times. The diminishing marginal disutility is strongest for travel time: *b_TrTime* < *b_TrCost*. To give an impression of the extent to which diminishing marginal disutility is present in our data, Figure 4-2 shows plots of the estimated non-linear utility functions. The substantial deviation from a linear specification shows that for the large ranges of cost and time we considered, a non-linear specification provides an important increase in realism.

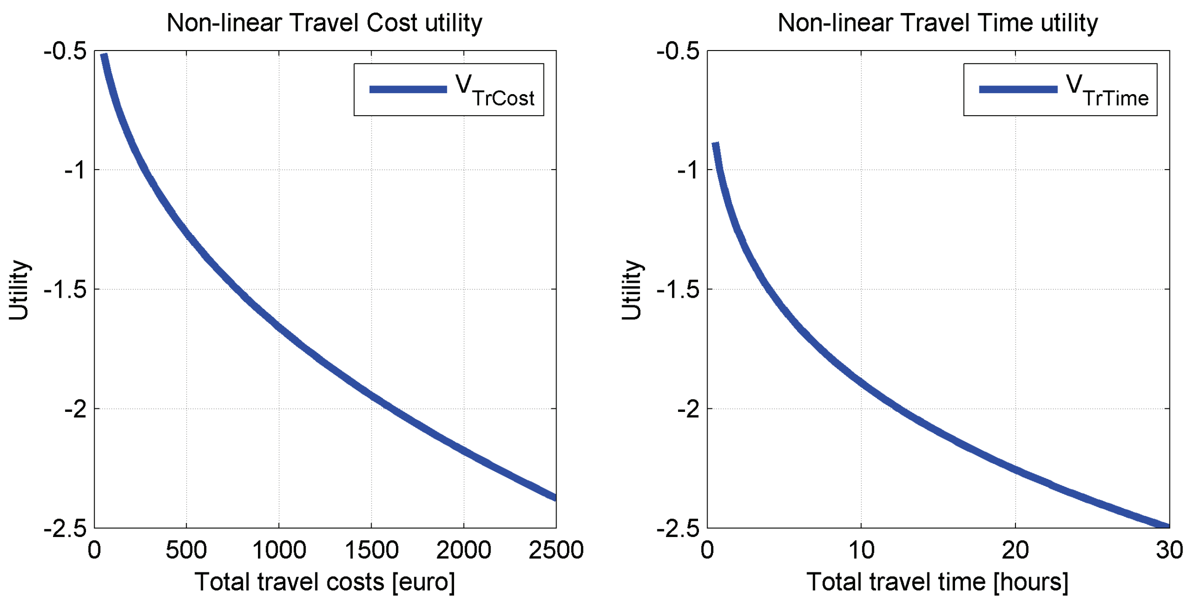


Figure 4-2: Non-linear utility functions associated with travel cost and travel time

As a result of the non-linear utility associated with travel cost and travel time the value of time (VoT) is not constant, but a function of travel cost and travel time. This can easily be derived, see Eq. 4-13. Since b_c and b_t are estimated to be unequal to one, x_c and x_t do not chancel out (as they would do in an linear specification). The contour plot of Figure 4-3 illustrates this. The x-axis shows the travel cost, the y-axis shows the travel time. Isolines in Figure 4-3 display travel cost - travel time combinations with constant value of time. The obtained shape of the value of time function is in line with intuition. In choice situations with low travel cost and high travel time, the value of time is relatively low: an increase or decrease of one hour of travel time is relatively low valued. In contrast, in choice situations with high travel cost and low travel times, the value of time is relatively high: an increase or decrease of one hour of travel time is relatively highly valued.

$$VoT = \frac{\partial V/\partial x_t}{\partial V/\partial x_c} = \frac{\frac{\partial}{\partial x_t}\left[a_t x_t^{b_t}\right]}{\frac{\partial}{\partial x_c}\left[a_c x_c^{b_c}\right]} = \frac{a_t b_t x_t^{b_t-1}}{a_c b_c x_c^{b_c-1}} \qquad \textbf{Eq. 4-13}$$

Furthermore, on top of the contour plot of is a scatter plot. The blue dots in the scatter plot display the travel cost - travel time combinations presented to decision-makers in the SP part of the choice experiment. Purple dots correspond with the travel cost travel - travel time combinations of chosen alternatives (in the SP part of the choice experiment). The blue and purple dots reveal in which area most choice observations are made. This is important as it shows where the model provides the best description of the value of time. To analyse this in more detail, Figure 4-4 shows a histogram and the cumulative density of value of times (calculated using the estimated parameters) for the chosen travel cost - travel time combinations in the SP part of the experiment (hence for each purple dot in Figure 4-3). It shows that the majority of choice observations are made in the value of time range below 35 euros per hour. The implicit resulting distribution of the value of time seems realistic – although on the upper side of expectations.

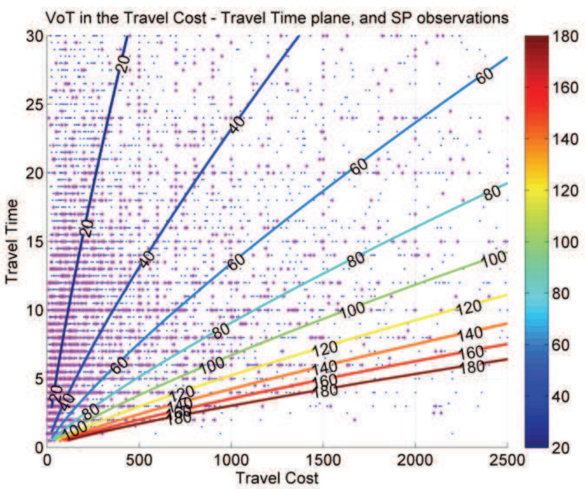


Figure 4-3: VoT in the travel cost – travel time plane

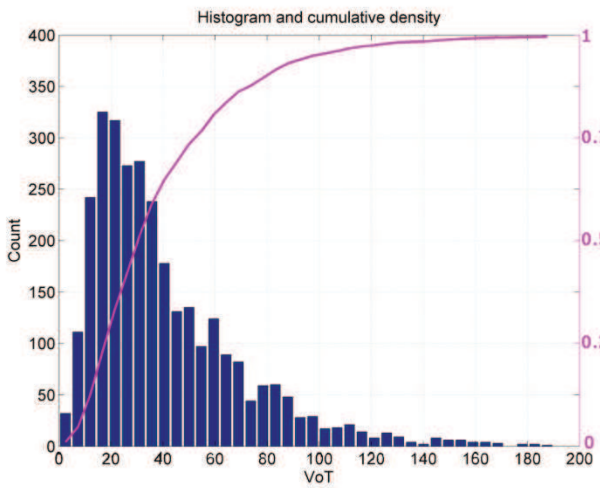


Figure 4-4: Histogram and cumulative density of the resulting VoT

Estimates of structural components

With regard to the structural components the following inferences can be made. Going on vacation (as opposed to staying at home) is relatively highly valued when controlling for all other vacation attributes (travel cost, travel time, etc.). Furthermore, we see that destinations at larger distances are associated with higher utility (*D1* < *D2* < *D3* < *D4*) (when controlling for all other vacation attributes). Similarly, we see that longer lengths of stay yield higher utility (*L1* < *L2* < *L3* < *L4*). The utility associated with 'vacation homes' is significantly larger than the utility associated with 'hotel, hostel, B&B, apartment', while 'tent' and 'caravan, motor home, camper' obtain significantly lower utilities. As expected, relative to 'car' the utility associated with 'train or bus' is significantly negative. Air travel on the other hand is associated with a significantly higher utility than 'car'.

Estimates of partial interaction terms

Nine interaction terms are identified at a significance level of $\alpha = 0.10$ using a model without error components (not depicted). In Table 4-4 we see that five of these interactions terms are also found to be significant at a significance level of $\alpha = 0.05$ ($|t\text{-stat}| \geq 1.96$) under the error component specification under our best fitting estimation procedure. These interactions include: Destination 'domestic' and Length of stay 'between 1 and two weeks', Destination 'near abroad' and Mode 'aircraft', Length of stay of 'three weeks or longer' and Mode 'aircraft', Accommodation type 'tent' and Mode 'car', and Accommodation type 'Caravan, Motor home, camper' and Mode 'car'. Hence, there are significant interactions effects across all in this study considered choice dimensions.

The identified partial interaction terms all seem to be in the intuitively expected directions. We could elaborate on the possible explanations for all of these interaction terms; however, for reasons of succinctness, we limited ourselves to a discussion of just two: one positive interaction term and one negative interaction term:

1) We see a substantial and significant positive partial interaction between 'tent' and 'car'. This can be due to various reasons. For example, camp sites are often remotely located. Therefore, they often lack good accessibility by other modes than 'car'. As a result, additional utility is associated with the combination of 'car' and 'tent'. An alternative explanation may be that vacationers may want to bring a considerable amount of baggage when camping. Yet, travelling by train or aircraft with considerable amounts of baggage may be considered a hassle, resulting in an addition portion of utility associated with the combination of 'car' and 'tent'.

2) We see a substantial and significant negative partial interaction for the combination 'near abroad' and 'aircraft'. One explanation may be that travel times by car to near abroad destinations (distance < 700 km) are generally considered acceptable. Therefore, the inconvenience associated with aircraft such as strict time tables, airline check-ins and custom formalities can relatively easy be avoided by going by car. An alternative rationale behind the negative partial interaction may be due to that near abroad destinations are typically booked closer in advance. Therefore, vacationers may be less flexible in their agendas and the flexibility of car is relatively highly appreciated.

However, we have to be careful with interpreting the interaction terms. As alluded above, the estimated interaction terms give the *partial* effect of the interaction – as opposed to the marginal effect. As shown by Norton et al. (2004) to get the *marginal* effect of an interaction also cross derivatives need to be taken into account: see Eq. 4-14 where $F(\cdot)$ is the cumulative distribution function. For instance, strictly speaking finding a positive partial interaction term, e.g. 'tent__car' > 0, only implies that the partial effect of the interaction is positive (since *f(u)* is strictly positive). The marginal effect of the interaction may however (for some alternatives) be negative i.e. if the cross derivative term dominates the partial effect and is of the opposite sign. As can be seen, the cross derivative term depends on the estimates of the associated structural components (in this case β_1 and β_2), the partial interaction term (β_{12}), and on the distribution function. Therefore, Greene (2010) argues that partial interaction terms (thus β_{12}) ultimately are neither coefficients nor elements of the specification of the model; but implications of the specified and estimated model.

$$\frac{\partial F(u)}{\partial x_1 \partial x_2} = \underbrace{\underbrace{\beta_{12} f(u)}_{\text{Partial effect}} + \underbrace{(\beta_1 + \beta_{12} x_2)(\beta_2 + \beta_{12} x_1) f'(u)}_{\text{Cross derivatives}}}_{\text{Marginal effect}} \qquad \textbf{Eq. 4-14}$$

Estimation procedure performance

To assess the added value of SPoffRP estimation procedures, this subsection discusses the performances of three estimation procedures. We discuss the estimates of SPoffRP specific parameters: α and λ, compare model fits, and see for evidence of bias stemming from the pivoted experimental design.

First, we look at the scaling parameter α. This parameter scales the variance of the unobserved utilities between the RP and SP data sets. For the SPoffRP estimation procedure (λ is fixed to one) α is estimated to be in the order of 0.45 - for both model specifications (see Table 4-3 & 4-4). This implies that the standard deviation of the *additional* unobserved portion of utility in the SP choices is about two times larger than the standard deviation of the unobserved utility in the RP setting. Finding relatively small α is in contrast with earlier empirical findings of Train and Wilson (2008). In their study on route and mode choice among agricultural shippers they reported an α of about 5.6 for their fixed parameters model specification and even an unidentifiably high α for their random parameters model. However, considering the large ranges in which we varied travel costs and travel times in our experiment substantial additional unobserved portions of utility in the SP setting is to be expected. Under the Generalized SPoffRP estimation procedure however, α is estimated to be in the order of two. This implies that under the Generalized SPoffRP estimation procedure the *additional* unobserved portion of utility in the SP choices is two times smaller (instead of larger) than the standard deviation of the unobserved utility in the RP setting.

The λ parameter under the Generalized SPoffRP estimation procedure is the fraction of the unobserved utility in the RP setting that carries over to the RP setting. If λ is estimated to be significantly different from zero and one, then the Generalized SPoffRP estimation procedure is significantly different from its special cases. Tables 4-3 & 4-4 show that λ is indeed significantly different from zero and one – under both model specifications. Interestingly, λ is far closer to zero than to one: about 0.07. This is remarkable, as it means that only a very small, yet significant, fraction of the unobserved utility of RP alternatives seems to carry over.

With regard to the model fit we see that the Generalized SPoffRP estimation procedure outperforms the standard logit estimation procedure (λ is fixed to zero) and the SPoffRP estimation procedure (λ is fixed to one). Under both model specifications the log-likelihood is improved by at least 7 log-likelihood points: exceeding the critical χ^2 value with one degree of freedom at a significance level of $\alpha = 0.01$. Therefore, since λ – when estimated – turns out to be relatively close to zero and α is smaller than one under the SPoffRP estimation procedure, it seems that the SPoffRP model (λ is fixed to one) imposes that a too large amount of unobserved utility carries over.

The rationale for using SPoffRP estimation procedures has been to reduce potential bias stemming from the pivoted structure of our experiment. To evaluate to what extent the SPoffRP estimation procedures may have reduced bias, for both model specifications we compared parameter estimates across the three estimation procedures using *Z*-tests (not depicted). Remarkably, none of the estimates are significantly different from one another at a 5% level of significance. Therefore, we have no empirical evidence for bias caused by endogeneity stemming from unobserved utilities potentially carrying over to the SP setting in our choice data. Nor do we have evidence for the effectiveness of SPoffRP estimation procedures in reducing such bias – if endogeneity would be present in our data.

4.6 Conclusions and discussion

In this study we explored vacation behavior under high travel cost conditions. To capture the vacation choice process, we conducted a free format SPoffRP choice experiment, and developed and estimated portfolio vacation choice models. In our choice experiment travel cost was varied within a range of 125% to 300% of the current figures (as estimated by the respondents): a range considerably larger than is common in the choice modeling literature.

Our findings suggest that vacationers exhibit considerable diminishing marginal disutility of vacation travel costs over this range of costs. This finding implies that vacationers will be relatively less sensitive to changes in travel costs under a high travel cost scenario than under a business-as-usual scenario. Moreover, it implies that the marginal rate of substitution between travel costs and other dimensions of the vacation is not constant across the travel cost domain. This suggests that marginal rates of substitution previously found in the context of small changes in travel costs may not be appropriate for forecasting tourism demand and substitution patterns under high travel cost conditions.

Yet, our findings need to be interpreted with care. Although it is clear from the intuitively correct signs and relative sizes of the estimates that we have been successful in capturing rationality behind the vacation choice, it needs to be acknowledged that choice behavior in real life may differ from choice behavior as observed under our experimental conditions (e.g. Brownstone and Small 2005) – despite the substantial efforts from our side to minimize this so-called hypothetical bias. Therefore, the extent to which marginal disutility of vacation travel costs is found to be diminishing in this study can be regarded as an upper bound estimate of the extent to which the sensitivity to costs is likely to diminish in real life. More research efforts are needed to find additional evidence for this phenomenon.

Our findings have relevant practical implications – reaching beyond the transportation side of tourism demand only. As a result of the complex structure of the vacation choice, it is not possible from the estimates itself to straightforwardly see what would be the impacts of for instance a doubling of (air) travel costs (e.g. on the share of air travel to intermediate distance destinations). Nevertheless, because substantial and significant interactions effects are identified spanning across all in this study considered vacation choice dimensions (i.e. destination, length of stay, accommodation type, and mode of transport) it seems that a substantial increase in travel costs is likely to change market shares across all these dimensions. To gain more detailed insights on the impacts of a substantial increase in travel costs on aggregate market shares in the tourism industry however, a next natural step for future research would be to conduct scenario studies building on our findings.

Besides the above substantive contributions, a key methodological contribution of this paper is that we have proposed a generalization of the recently proposed SPoffRP estimation procedure (Train and Wilson 2008) and illustrated its application. The proposed Generalized SPoffRP estimation procedure has both the standard logit and the SPoffRP estimation procedure (Train and Wilson 2008) as a special case. We found that the Generalized SPoffRP estimation procedure does not collapse to either the standard logit or the SPoffRP estimation procedure when estimated on our vacation choice data, and that it significantly improved model fit as compared to its two special cases. Our results therefore suggest that only a fraction of the unobserved utilities associated with RP alternatives carries over to the SP setting in pivoted choice experiments. However, more applications of SPoffRP estimation procedures are needed to draw general conclusions regarding the added value of (Generalized) SPoffRP estimation procedures.

Lastly, there are a number of limitations to our study that leaves room for future research efforts. Firstly, by using self-reported alternatives it is implicitly assumed that the late consideration sets of vacationers are unaffected by the substantial increase in travel costs, at least in terms of destinations. Future research may be directed at consideration set formation under substantially changed conditions. Secondly, to the extent that respondents did not report a random subset of their late consideration set in the RP part of the experiment, choice sets may contain preference information, and estimation bias may be present. Thirdly, whereas our study focused on short term impacts, future research may explore long-term impacts of substantial increase in travel costs. Unquestionably, exploring such long-term impacts poses an important challenge. Fourthly, in our study we focused on substitution behaviour within the context of a given vacation period: we did not accommodate for inter-vacation substitution effects such as for example that vacationers may substitute one long-haul vacation for two nearby vacations. Future research efforts may want to address inter-vacation substitution effects. Fifthly, whereas we considered vacation choices to be made by an individual, future research may be targeted at understanding intra-household vacation decision making dynamics and social interactions, inspired by previous papers that have stressed that a vacation decision may involve a joint choice process across members of the household and is influenced by social interactions (Davis and Rigaux 1974; Jenkins 1978; van Raaij and Francken 1984; Wu et al. 2013). Sixthly, different types of vacationers may hold strong differences in preferences across various vacation attributes across different types of vacations (Decrop and Snelders 2005; Hyde and Laesser 2009). The analyses, data collection, and methodologies presented in this paper can be considered a starting point for such more elaborate research efforts.

5 A simulation study on the impacts of a substantial increase of air travel costs – An application of the portfolio vacation choice model

5.1 Introduction

This study provides an illustrative application of the developed vacation choice model of Chapter 4. It is concerned with the scenario in which air travel costs increase substantially. Travel costs of other modes are kept at current levels. Clearly, various other scenarios could have been studied; theoretically the vacation choice model can be used to develop tourism demand forecasts under all kinds of scenarios that involve a substantial increase of travel costs. However, investigating a substantial increase of air travel costs fits may shed new insights on the on-going scientific debate on aviation CO_2 emissions and the effectiveness of such abatement policies.

Over the last three decades aviation has worldwide grown faster than any other mode of transport. Over the period 1970 to 2007 the revenue passenger kilometres (that is, the number of revenue-paying passengers times the distance travelled) increased sevenfold (Lee et al.

2009). As such, air travel is currently responsible for about 3% of the global anthropogenic CO_2 emissions (Peeters and Dubois 2010). Moreover, many foresee a continuation of the current strong growth path in the coming decades (in terms of passenger kilometres) (e.g. Olsthoorn 2001; UNWTO 2008; Owen et al. 2010).

The staggering growth of the aviation is partly the result of an almost similarly strong growth of tourism demand in combination with the increased market share of air travel in tourism travel (UNWTO 2012). In developed countries about 30% to 40% of the vacation trips are currently made by air. These vacation trips account for approximately 60% of the global air passenger kilometres (Senguttuvan 2006). Especially, the introduction of low-cost carriers has boosted the market share of air travel for vacation purposes. The availability of cheap air travel not only substituted other modes of travel, but also has generated new tourism demand (Mason 2005; Dobruszkes 2006).

However, from a climate change perspective a continuance of the current strong growth of air travel demand is undesirable. Therefore, various countries have proposed aviation fuel levies in order to curb greenhouse gas (GHG) emissions. In fact, in the EU as of 2012 aviation emissions are part of the EU Emissions Trading System[27]. So far impacts of these carbon levies in the EU on air fares have however presumably been close to nil. Since 2012 (up to the time of writing this thesis – May 2013) carbon emissions trade prices have been record low (i.e. below €10/tCO_2) – inter alia due to the economic recession. Nonetheless, it is well possible that in the near future these levies have a more substantial impact on air fares, or that new levies are being introduced. On the longer term perhaps even international jet fuel taxes might be imposed.

In this context, given the major social and economic importance of tourism, it is of great importance to have thorough insights on the effects of new abatement policies that aim to increase air fares. Several studies have recently been conducted investigating the effects of aviation levies (e.g. Olsthoorn 2001; Mayor and Tol 2007; Tol 2007). One of their principle findings is that very high fuel levies are needed if one has the objective to stabilize aviation CO_2 emissions. Furthermore, their results suggest that remote island nations of which the economy is dependent on tourism will probably be hit disproportionally as demand would shift from long distance flights to medium distance flights.

While generally comprehensive, these earlier studies leave scope for further improvements. More specifically, in previous studies it is assumed that past relationships (hence demand elasticities) persist under future conditions. While that is reasonable to assume for increases in air travel costs in the order of say 10 to 20 per cent, beyond that new substitution patterns are likely to emerge – rendering previously found elasticities unreliable. Besides that, previous studies have primarily focused the effects of an increase in air travel costs on GHG emissions i.e. in terms of number of trips, trip length, and mode of transport. To date, little attention is

[27] However, at the time of preparation of the draft manuscript (May 2013) the EU has put this policy on hold for intercontinental flights to give time for the UN airlines body to devise an alternative global scheme that could avoid a damaging trade dispute.

given to the effects of a substantial cost increase on vacation behaviour, and on the wider effects on the tourism industry. Yet, since the vacation choice involves multiple interrelated choice dimensions (see e.g. Chapter 4), impacts of a substantial increase in air travel costs are unlikely to be restricted to the transportation side of tourism. Market shares of e.g. accommodation types and length of stays can be expected to be affected too.

The present study aims to shed new insights on the impacts of aviation fuel levies on vacation behaviour. In this study the impacts on the transportation side of tourism (and hence greenhouse gas emissions) are investigated as well as the wider impacts on market shares in the tourism industry. A relatively simple scenario is considered: air fares are up to doubled – irrespective of the destination or distance. Travel costs associated with other modes are assumed to remain unchanged. Lower and upper bounds of the effects – as compared to the situation with no aviation fuel levies – are derived.

The remainder of this chapter is organised as follows. Section 5.2 presents the methodology. Next, results presented and discussed in section 5.3. Lastly, section 5.4 provides conclusions.

5.2 Methodology

5.2.1 Notation

To forecast the impacts of aviation fuel levies, the developed vacation choice model of Chapter 4 is used. This portfolio model entails four vacation attributes, namely: a destination type, a length of stay, an accommodation type, and a mode of transport, see Eq. 4-1 and Table 4-1. Each of these vacation attributes y consists of K_y attribute levels. For instance, vacation attribute ‘mode of transport’ consists of three attribute levels, namely: car, train, and airplane. The aim of the present study is to obtain market forecasts of the attributes levels across these attributes under high air travel scenarios. Throughout this section the following notation is used:

M_{yk}^{0}	Observed market share of attribute level k of attribute y
M_{yk}	Future market share of attribute level k of attribute y
$\hat{M}_{yk}^{0}$	Model outcome of market share of attribute level k of attribute y (Current situation)
$\hat{M}_{yk}$	Model outcome of market share of attribute level k of attribute y (Future scenario situation)

5.2.2 Forecasting future market shares

To obtain forecasts a standard forecasting technique is used, see Eq. 5-1. This technique ensures that independent on whether the model predicts the current market shares spot on onto the observed figures consistent forecasts are obtained. As can be seen, to use Eq. 5-1 three market shares are needed, namely: the simulated market share under the scenario conditions of interest: $\hat{M}_{yk}$, the simulated market share under current conditions: $\hat{M}^{0}_{yk}$, and the current, observed market share M^{0}_{yk} .

The nominator in Eq. 5-1 first computes the relative change in simulated market shares: $\hat{M}_{yk} / \hat{M}^{0}_{yk}$. After that, it is multiplied by the observed market share M^{0}_{yk} . Next, in order to ensure that the market shares across the attribute levels count up to a 100%, this product is divided by the sum over the forecasted relative market shares changes. The resulting market shares forecasts are consistent, and necessarily count up to a 100%.

$$M_{yk} = \frac{\left[\hat{M}_{yk} / \hat{M}^{0}_{yk}\right] \cdot M^{0}_{yk}}{\sum_{k=1..K_y} \left(\left[\hat{M}_{yk} / \hat{M}^{0}_{yk}\right] \cdot M^{0}_{yk}\right)} \qquad \textbf{Eq. 5-1}$$

Eq. 5-1 can be used to obtain market share forecasts for all but one vacation attribute level. Because the observed market share of the 'No Go alternative': M^{0}_{NoGo} is zero[28], Eq. 5-1 cannot be used to compute M_{NoGo} . In order to still be able to make inferences on the share of tourists that chooses not to go on vacation, simply the difference between the simulated market share under current conditions and the simulated market share under a high air travel cost scenario is reported: Eq. 5-2. We consider this is a proxy for the percentage point change of the vacationers that skip the vacation.

$$\Delta M_{NoGo} = \hat{M}_{NoGo} - \hat{M}^{0}_{NoGo} \qquad \textbf{Eq. 5-2}$$

The next two sections explain respectively how market shares ($\hat{M}_{yk}$ and $\hat{M}^{0}_{yk}$) are simulated and how observed market shares (M^{0}_{yk}) are calculated.

5.2.3 Simulation of market shares

Scenario

Since the purpose of this study is to explore roughly the impacts of a substantial increase in air travel costs, a relatively simple scenario is considered: all air fares are increased by the

[28] Recall that only participants were allowed for the experiment who intended to take a vacation in the coming year (see section 4.3.2 for more details)

same factor Ω – irrespective of the destination or distance. Ω is increased in two steps from one to two. Although the take-off and landing are relatively fuel-intensive compared to cruising – hence short trips use relatively more fuel per kilometre than do long trips – equal prices increases are assumed for pragmatic reasons. Furthermore, anything else[29] is assumed to be constant: ceteris paribus.

Aggregation

Typically, to obtain aggregate-level (future) market shares sample enumeration is used. That is, estimates for the (future) market shares are derived by taking the sum of the choice probabilities of each sampled vacationer, and divide this by the total number of vacationers in the sample (Train 2003). To each sampled vacationer a weight is assigned, typically denoted w_n, which represents the number of vacationers similar to him / her in the population. However, the sample of vacationers of Chapter 4 is by and large representative in terms of gender, income, age and educational level for the Dutch population that went at least once on vacation in 2010. Therefore, for this simulation study no weightings are assigned to vacationers.

Choice set

To obtain market shares using the estimated vacation choice model, choices are simulated. To do so, the analyst needs to assign choice sets to decision makers. After all, choices can only be modelled given a set of alternatives. However, essentially the same difficulty arises here as with the estimation: the set of alternatives considered by vacationers (the so-called consideration set) is presumably heterogeneous and more importantly by and large unknown to the analyst (see also subsection 4.3.1). Yet, to correctly forecast market shares the choice set needs to be correctly specified (Manski 1977; Haab and Hicks 1999).

In the context of this simulation study there are basically three approaches to deal with the lack of information regarding the vacationers' choice sets. The first is to assume that all vacationers share the same choice set. The second is to assign choice sets to vacationers on the basis of a few deterministic criteria that reflect the analyst's available information and beliefs about the behaviour. The third approach is to construct the choice sets on the basis of the self-reported alternatives.

In this study the third approach is taken. That is, the choice set assigned to each vacationer in the sample simply consists of the six self-reported alternatives by this respondent. As alluded above, if one or more of these alternatives involved air travel, then the travel costs of these alternatives are multiplied by a factor Ω. The rationale for choosing the third approach is the following. As discussed in Chapter 4, to assume that all vacationers share the same choice set is implausible. Moreover, the second approach is rendered infeasible as it requires a priori

[29] E.g. incomes, preferences, consumer confidence, transport policy.

understanding of the vacation choice set formation – which is missing. Therefore, in line with Chapter 4, the third approach is considered most appropriate.

It is important to note that as a consequence of this approach on the choice set, strictly speaking the simulations yield choice probabilities within the data set; rather, than market share forecasts. Although this is acknowledged, for the sake of readability we will refer to these as market share forecasts.

Simulation of market shares

To simulate market shares the following procedure is used. Using the estimated portfolio vacation choice model new choices for the 419 vacationers across the 6 self-reported vacation alternatives are simulated by taking draws from distribution of the unobserved utility as well as for the σ_{Go} random parameter (which accommodates for the correlation between the utilities of alternatives associated with going on vacation as opposed to the No Go alternative). Each choice is simulated 10 000 times. Market shares of attributes levels (e.g. car, hotel, etc.) are computed by counting the number of times a specific attribute level occurs in the sets of chosen alternatives, and dividing this sum by the number of vacations, averaged over the number of draws taken. Note that this is asymptotically equivalent to, yet – since we are interested in market shares of attribute levels such as car, train, and aircraft (rather than of alternatives) – in this case more convenient than direct computation of market shares via the logit choice probabilities.

To give an illustration of this procedure, consider the following self-reported choice set (Table 5-1). Firstly, it can be seen that travel costs for all alternatives involving aircraft (i.e. alternatives 5 and 6) are doubled. Hence, in this case Ω equals two. Using the vacation choice model, this choice is simulated. For each simulated choice, the occurrences of attribute levels are counted. Thus, for the depicted choice ‘Intermediate abroad’, ‘Length of stay of 1 to 2 weeks’, ‘Hotel, Hostel apartment’, and ‘Aircraft’ receive one count.

Table 5-1: Example of simulated choice

Alternative	1	2	3	4	5	6
Destination	Domestic	Domestic	Near-abroad	Intermediate-abroad	Intermediate-abroad	Intercontinental
Length of stay [days]	5	5	7	10	14	14
Accommodation type	Vacation home, bungalow	Vacation home, bungalow	Hotel, Hostel, Apartment	Hotel, Hostel, Apartment	Hotel, Hostel, Apartment	Hotel, Hostel, Apartment
Mode of transport	Car	Car	Car	Car	Aircraft	Aircraft
Travel costs [€/p]	10	15	50	80	150 x 2 = 300	650 x 2 = 1300
Travel time [h]	1.5	2	5	10	8	15
CHOICE					X	

5.2.4 The observed market shares

Observed market shares (M^0_{yp}) are directly taken from the self-reported (RP) choice sets. This is fairly straightforward. All 419 respondents in the sample constructed the self-reported choice sets and indicated which alternative they intended to take (for the randomly assigned vacation period in the coming year). Market shares across attribute levels in this RP data set are reported earlier in this thesis[30]: see Table 3-2 in Chapter 3.

5.2.5 The constant budget method

In this study an additional set of forecasts are made using the constant budgets method. This method imposes that the budget for a specific cost domain (such as mobility) is constant, despite increases in prices of specific goods within that cost domain (Geurs et al. 1998). As such, it is hypothesized that an increase in expenses on one good needs to be fully compensated by lowering expenses on other goods within that same cost domain[31].

The rationale to develop an additional set of forecasts using the constant budgets method is that the estimated model can be expected to underestimate the effects of increases of air travel costs. Underestimation of effects is expected because SP data is used to estimate the vacation choice model. Inherent to SP experiments is that respondents do not have to live up to their choices. As a result, price sensitivities computed using SP data are frequently found to be underestimated (see e.g. Diamond and Hausman 1994 in which is shown that the so-called adding-up test is violated in stated preference data).

By using this method in the vacation choice context it is imposed that aggregate vacation travel expenses are kept constant. That is, the increase in air travel costs needs to be fully compensated – on the aggregate level – by lowering vacation travel expenses on other vacations. Note that imposing constant vacation travel budgets is probably behaviourally too restrictive. While it may seem reasonable to suppose that vacationers devote – at the aggregate level – a fixed amount of their income on vacations, it is behaviourally unrealistic that expenses on the travel component of the vacations are fixed. After all, vacationers have several options within the vacation domain to make up for the increased air travel costs e.g. by reducing local spending, booking a cheaper accommodation, or by flying a cheaper airline. Therefore, this method is likely to overestimate effects. Hence, the forecasts made using the constant budget method can be regarded upper bound estimates of what can be expected to happen.

[30] In Chapter 3 a considerable discrepancy is found between self-reported RP data and figures reported by Statistics Netherlands on vacation behaviour among Dutch vacationers.

[31] This hypothesis is empirically quite strongly underpinned for general travel expenses. The proportion of the household income spend on travelling is quite robustly found to be in the order of 10% to 15% Schäfer, A. & Victor, D. G. (2000). The future mobility of the world population. *Transportation Research Part A*, *34(3)*, 171-205., despite that car fuel costs outpaced income growth, and the short-term demand elasticity for fuel is in the order of minus 0.25 Graham, D. J. & Glaister, S. (2004). Road traffic demand elasticity estimates: A review. *Transport Reviews*, *24(3)*, 261-274. Hence, apparently, travellers started buying smaller, and more fuel efficient vehicles.

The textbox below describes the operationalization of the constant budget method used.

The constant budget method involves the following consecutive steps:

1. Simulate for each sampled decision-maker choices under current air travel costs ($\Omega = 1$), and calculate the total travel expenses in the sample: S_1.

2. Simulate for each sampled decision-maker choices under the scenario conditions (i.e. all air travel costs are multiplied by a factor Ω), and calculate the total travel expenses in the sample under these conditions: S_Ω. The total travel expenses can be decomposed in two parts: air travel expenses and non-air travel expenses (hence, we can write $S_\Omega = S_\Omega^{non-air} + S_\Omega^{air}$). Calculate both terms.

3. If $S_\Omega \neq S_1$, determine the adjusted air travel costs factor $\overline{\Omega}$ such that when using this factor $S_{\overline{\Omega}} = S_1$ holds. Because in the sketched situation all air travel expenses are simply linearly increased the adjusted air travel cost $\overline{\Omega}$ that yield constant budgets can easily be determined. We presume that behavioural responses simulated when using Ω actually belong to the scenario in which air travel costs are multiplied by $\overline{\Omega}$.

   Therefore, it holds that $S_{\overline{\Omega}} = S_\Omega^{non-air} + \frac{\overline{\Omega}}{\Omega} S_\Omega^{air}$.

   After some algebraic manipulation it follows that $\overline{\Omega} = \left[\frac{S_1 - S_\Omega^{non-air}}{S_\Omega^{air}} \right] \cdot \Omega$.

5.3 Results and discussion

Table 5-2 and Table 5-3 provide a cross-section of the simulation results: it shows results for a scenario in which air travel costs double. Table 5-2 reports overall market share forecasts across vacation attribute levels. Table 5-3 reports the changes in a number of indicators of mobility such as distance travelled and greenhouse gas emissions. Both tables have four columns. This first column lists the attribute level or mobility indicator. The second column lists the current situation, the third column reports the lower bound estimates (i.e. forecasts based on the estimated model), and the fourth column reports the upper bound estimate (i.e. forecasts based on the constant budget method).

Full simulation results can be found in Appendix 6A. There graphs of market share forecasts and indicators of mobility as a function of increase in air travel costs Ω are presented. In these graphs, solid lines belong to the estimated model, (dash) dotted lines belong to the constant budget method. Using the constant budget method, forecast could be made up to $\overline{\Omega} = 1.5$.

Therefore, the leg between $\Omega = 1.5$ and $\Omega = 2$ is extrapolated (hence the dotted lines). Furthermore, since these two methods correspond respectively to lower and upper bound estimates of the effects, the enclosed areas by the solid and (dash) dotted lines can be considered the ranges in which effects can reasonably be expected.

Table 5-2 shows that a doubling of air travel costs does not seem to hold back many vacationers from going on vacation. When confronted with an increase in air travel costs, a vacationer can decide to skip the vacation (if by air), substitute the vacation for another vacation, or stick to the original vacation. The simulation study suggests that the percentage point change of the share of not going on vacation increases in between plus 0.6 and plus 2.2 percentage points. However, possibly this range is underestimated. Firstly, underestimation may be the result of a selection bias: only participants who intended to take a vacation in the coming year allowed to participate in the experiment. Secondly, underestimation may be the result of the way in which the choice situation was framed, i.e. in the context of the respondent's next vacation.

It can be seen that changes in market shares across the attribute levels are all in the intuitively expected directions. As expected, most heavily affected are intercontinental destinations (D4) and air travel (M3). When air travel costs doubles, intercontinental destinations lose in between 4 and 13 percentage points. Air travel loses even in between 4 and 16 percentage points. Air travel is mainly substituted by car travel. Not surprisingly, domestic destinations (D1) as well as short length of stays (L1) gain considerably in popularity, respectively in between 3 and 8 percentage point and 2 and 7 percentage points. Furthermore, it can be seen that accommodation market shares are by and large unaffected by the increase of air travel costs.

Also the aircraft market shares conditional on destination categories are investigated. As expected, air travel loses market share to all destination categories. The market shares of air travel to near-abroad and intermediate abroad destinations decline relatively most severely. The market share of air travel to intercontinental destinations is relatively unaffected. This is obviously due to that other modes are generally not a viable option for these destinations.

Table 5-2: Market share forecasts for doubled air travel costs

	Current market shares	Lower bound estimates of market shares and percentage point changes		Upper bound estimates of market shares and percentage point changes	
Overall market shares					
Not going on vacation share					
No Go	-	-	(+0.6%)	-	(+2.2%)
Destination categories					
Domestic	26%	28%	(+2%)	33%	(+8%)
Near-abroad	23%	24%	(+1%)	28%	(+5%)
Intermediate abroad	19%	19%	(0%)	20%	(+1%)
Intercontinental	32%	29%	(-4%	20%	(-13%)
Length of Stays					
< 1 wk	43%	45%	(+2%)	50%	(+7%)
1 wk < D < 2 wk	33%	31%	(-2%)	33%	(0%)
2 wk < D < 3 wk	19%	18%	(-1%)	15%	(-4%)
> 3 wk	5%	4%	(-1%)	3%	(-2%)
Accommodation types					
Hotel, Hostel, Apartment	61%	60%	(-1%)	58%	(-3%)
Vacation homes, bungalow	26%	26%	(0%)	28%	(+2%)
Tent	6%	6%	(0%)	6%	(0%)
Caravan, Motor home, camper	7%	8%	(+1%)	9%	(+2%)
Mode of transport					
Car	51%	55%	(+4%)	65%	(+14%)
Train, or bus	7%	8%	(+1%)	10%	(+3%)
Aircraft	41%	37%	(-4%)	25%	(-16%)
Aircraft market shares to destination categories					
Near-abroad	8%	7%	(-1%)	5%	(-3%)
Intermediate abroad	43%	39%	(-4%)	30%	(-13%)
Intercontinental	96%	95%	(-1%)	92%	(-4%)

Table 5-3 shows a number of indicators of mobility. Firstly, it can be seen that the average trip distances by car and train or bus increase only marginally. However, in line with intuition the average distance travelled by aircraft decreases substantially: in between 4 and 16 per cent. Besides that, it can be seen that average total distance travelled drops far more drastic than the average distance travelled by each mode of travel individually: in between 13 and 39 per cent. While at first glance this seems counterintuitive, it is not. The drop in average distance travelled comes from substitution of far-away destinations (mostly by aircraft) for relatively nearby destination (mostly by car). Recall that market shares of domestic destinations increase considerably. Consequently, even though average distances travelled by individual modes do not drop, on the whole average distance travelled does.

Table 5-3: Indicators of mobility for doubled air travel costs

	Current situation (in sample)	Lower bound estimates percentage change	Upper bound estimates percentage change
Indicators of mobility			
Average distance travelled by mode (one-way)			
Car [km]	420	+1%	+3%
Train, or bus [km]	450	+1%	+3%
Aircraft [km]	4200	-4%	-16%
Other indicators			
Avg. travel distance [km] *(one-way)*	2000	-13%	-39%
Avg. travel time [h] *(one-way)*	9.5	-3%	-9%
CO_2-e emissions vacation travel [tonne CO2-e] *(one-way)*	720	-15%	-47%
Avg. total vacation travel cost [k€] *(two-way)*	160	+52%	0% [32]
Avg. vacation travel cost per trip [€] *(two-way)*	380	+53%	0%

Interestingly, despite the substantial decrease in average travel distance it can be seen that the average travel time decreases less considerably; between 3 and 9 per cent. This is because a fast mode of transport (aircraft) has been substituted for slower modes of transport, mainly car. Hence, a substantial increase in air travel costs may – at least on the short term – disrupt the on-going long-term trend of increasing average travel speeds (Schäfer 2009).

Also the effects on GHG emissions caused by tourism travel are estimated. For this, CO_2-equivalents are used instead of CO_2 emissions because these give a better proxy for the contribution to anthropogenic climate change than CO_2 emissions. The contribution of aviation to anthropogenic climate change is larger than merely CO_2 emissions would suggest. Particularly contrails and NO_x emissions contribute to anthropogenic climate change too (Lee et al. 2009). For each vacationer in the sample and his or her travel party GHG emissions are calculated using the orthodromic distance between the destination and vacationer's city of residence and mode-specific GHG emission factors for tourism transport, see Appendix 6B.

Simulation results show that a substantial increase of air travel costs reduces GHG emissions caused by tourism travel substantially. A doubling of air travel costs decreases GHG emissions by 15% to 47% (as compared to the same situation but without aviation levies). The drop in GHG emissions exceeds the drop in distance travelled. This is due to the fact that mainly air travel has been substituted for car travel, and air travel produces in the order of 2.5 times more GHG emissions per passenger kilometre than car travel.

The last two rows of Table 5-3 show that the estimated model forecasts a sharp increase in total vacation travel expenses (in the sample as a whole) and vacation travel expense per trip. Both are estimated to increase by more than 50% when air travel costs doubles. Such an

[32] by definition

increase seems unlikely in real life – providing ground for that the estimated model gives lower bound estimates of the effects. Furthermore, the small difference between increase in travel expenses on the whole and increase in travel expense per trip is due to the fact that only very few vacations are skipped (see Table 5-2).

Lastly, the effects of a substantial increase of air travel costs on the markets shares in the domestic tourism market are investigated. Table 5-4 shows the simulation results for the domestic (Dutch) tourism market for doubled air travel costs. What catches the eye is that domestic market shares of ‘Length of stays’, ‘Accommodation types’ and ‘Modes of transport’ are by and large unaffected by the increase in air travel costs. This implies effectively that demand in each of these categories grows proportionally with the growth of domestic destinations (D1). So, hotel demand, car travel demand for domestic vacation purposes, etc. will increase approximately by the same percentage (in between 10% and 30% when air travel costs doubles, see Table 5-2).

Importantly, that is not to say that the net effects of a substantial increase in air travel costs are necessarily positive for the domestic tourism industry. This study only covers the vacation travel behaviour of Dutch vacationers. However, clearly, the number of tourists visiting The Netherlands from intercontinental tourist source markets will decrease markedly when air travel costs double – having a substantial adverse effect on domestic tourism demand.

Table 5-4: Domestic market share forecasts for doubled air travel costs

	Current market shares	**Lower bound estimates of market shares and percentage point changes**		**Upper bound estimates of market shares and percentage point changes**	
Domestic market shares					
Accommodation types					
Hotel, Hostel, Apartment	43%	43%	(0%)	44%	(+1%)
Vacation homes, bungalow	37%	37%	(0%)	37%	(0%)
Tent	7%	7%	(0%)	7%	(0%)
Caravan, Motor home, camper	12%	12%	(0%)	11%	(-1%)
Length of Stays					
< 1 wk	78%	78%	(0%)	79%	(+1%)
1 wk < D < 2 wk	19%	18%	(-1%)	18%	(-1%)
2 wk < D < 3 wk	3%	3%	(0%)	3%	(0%)
> 3 wk	1%	1%	(0%)	1%	(0%)
Mode of transport					
Car	85%	85%	(0%)	85%	(0%)
Train, or bus	15%	15%	(0%)	16%	(+1%)

5.4 Conclusion

This chapter presented a simulation study on the impacts of a substantial increase in air travel costs on vacation behaviour. Upper and lower bounds of the effects of an increase of air travel costs of up to a factor 2 are developed. Albeit aviation abatement policy that would increase air travel costs in the order of magnitude investigated in this study is draconic (and hence all but politically feasible), this study has provided insights that can be used in debates on aviation and tourism-related climate change.

The most important substantive findings are these. The demand for domestic destinations among Dutch vacationers gains considerably when they are confronted with a substantial increase in air travel costs. Not unexpected, air travel and intercontinental destinations are hit hardest; they lose in between 4 and 16 percentage points. This suggests that respectively airlines and economies that rely heavily on (Dutch) long-haul tourism will be most hit severely. For some of such destinations the loss of long-haul tourists will probably be compensated by the new tourist inflow from nearby source markets. Yet, for many especially the more remote vacation destinations this will unlikely be the case.

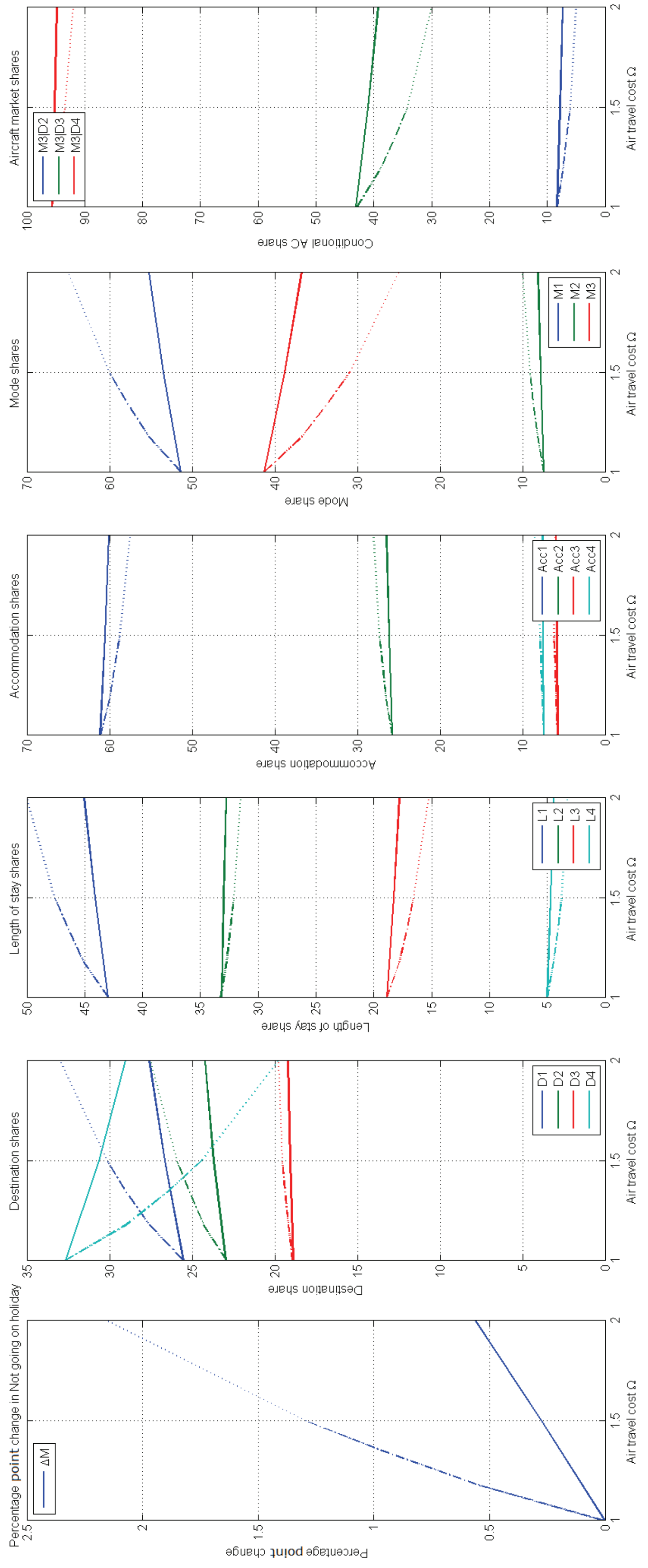
Furthermore, it is found that *domestic* tourism market shares *among* Dutch vacationers are by and large unaffected. This implies effectively that the demand of Dutch vacationers in each of these categories grows proportionally with the growth of domestic vacation demand (among Dutch vacationers). A doubling of air travel costs is estimated to increase *domestic* demand in between 10% and 30%. Yet, that is not to say that domestic tourism as a whole grows at the same rate. Clearly, the number of intercontinental tourists visiting The Netherlands can be expected to decrease markedly when air travel costs double – having an adverse effect on domestic tourism demand. Nonetheless, intercontinental tourists only account for about 20% of the total number of tourists visiting The Netherlands (NBTC 2009). Moreover, Dutch tourism is not overly reliant on air travel: about half of all the visitors arrive by car (Germany is The Netherlands largest tourist source market) (NBTC 2009). Therefore, in this context it can reasonably be assumed that a substantial increase in air travel costs rather has a net positive effect on tourism demand in The Netherlands than a net negative effect. Further research is however needed to find more conclusive evidence for this finding.

The dominant argument generally put forward to introduce aviation fuel levies or aviation carbon taxes is to reduce GHG emissions. This simulation study shows that environmental effects in terms of GHG emissions reduction are considerable. More specifically, tourism travel related GHG emissions of Dutch vacationers are estimated to drop in between 14% and 47% when air travel costs are doubled. However, although such a reduction would clearly be good news from a climate change perspective (if achieved on a global scale), adverse indirect effects can be expected too e.g. wealth transfers to many tourism-dependent developing nations would decline (Gössling et al. 2008). As such, it is advisable for policy makers dealing this topic to carefully assess aviation abatement policies in the light of their effectiveness to curb CO_2 emissions as well as on their potentially adverse indirect effects. It goes without saying that if high aviation fuel levies are overall considered beneficial, an early notice of the proposed policy and a gradual implementation of the policy may enable industries and tourism driven economies to anticipate and adapt.

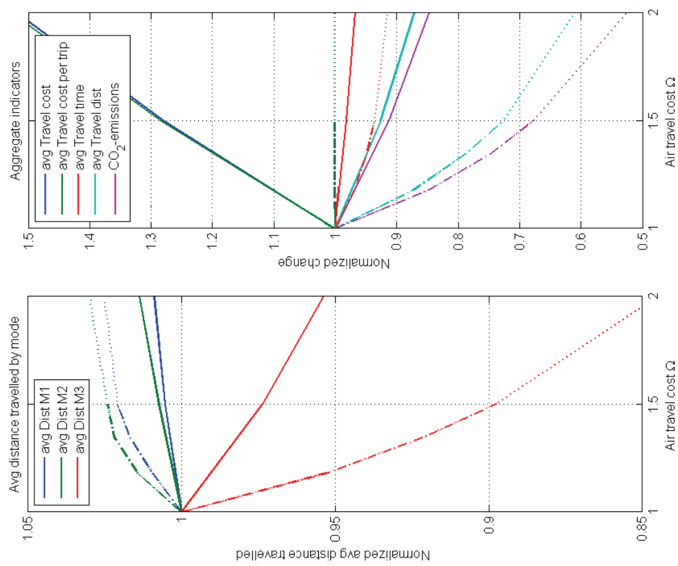
From a methodological perspective: it was found that the obtained lower and upper bound estimates are quite diverging. On the one hand this may accurately reflect the considerable inherent uncertainty which is likely to be associated with the future impacts of such a change in air travel costs. On the other hand it might indicate that the developed vacation choice model in Chapter 4 underestimates effects.

Lastly, there are a number of limitations of the simulation study that need to be addressed. Firstly, there are limitations inherent to the developed vacation choice model. These are not reiterated here, but can be found in section 4.6. Secondly, as is shown in Chapter 3 (Table 3-2), there is a considerable discrepancy between the RP market shares across attribute levels in the sample and figures reported by Statistics Netherland. This in itself is not a major problem as this study principally provides insights on changes, rather than absolute levels. However, as it may indicate selection bias (i.e. the sample may not have been representative for Dutch vacationers), or hypothetical bias (i.e. respondents may not have behaved in the experiment as they would do in real life when faced with the same situation) this needs to be acknowledged. Thirdly, by using self-reported alternatives it is assumed that the consideration sets of vacationers are unaffected by the substantial increase in air travel costs. Fourthly, using the constant budget method there has been extensive extrapolation (recall that the leg between 1.5 and 2 has been extrapolated). Fifthly, in this study only travel behaviour of Dutch vacationers is investigated. Yet, clearly, aviation abatement policy is an international affair. Therefore, to more generally assess (international) aviation abatement policy, the impacts on vacation travel behaviour of vacationers of all major tourist source markets should be taken into account. The net effect of these limitations is unknown. Future research may address these limitations.

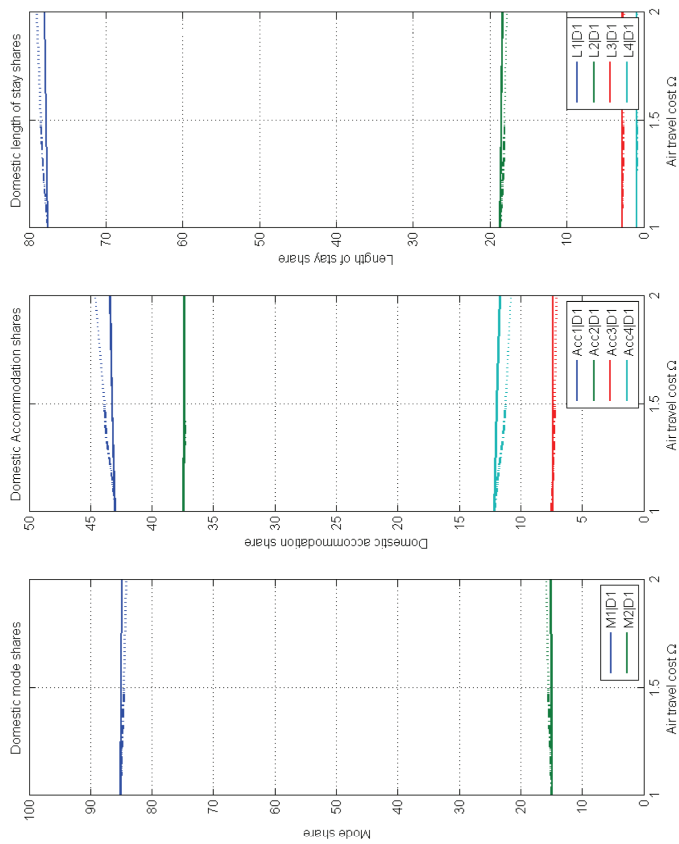
Appendix 6A



Overall market shares



Indicators of mobility



Domestic market shares

Appendix 6B

Mode of transport	**GHG** [kg CO_2-e/pkm]
Car	0.14
Train, bus	0.025
Air	0.35

Mode-specific greenhouse gas emission factors for tourism transport

based on Peeters et al. (2004)

6 Conclusions, limitations and implications

6.1 Introduction

This thesis has studied vacation travel behaviour in a very different future. Various potential substantial changes loom on the horizon. If one of these substantial changes takes place, it may bring about a very different future. Marked consequences for vacation travel can be expected. Yet, despite the apparent economic and social importance of tourism, what-if scenarios addressing such changes have not been taken very seriously in the tourism or transportation field. This lack of concern is confirmed in the literature where only rarely travel behaviour under substantially changed conditions is studied and where, not unrelated, only rarely what-if scenarios are developed. Yet, it is clear that failure to develop credible what-if scenarios (amongst other types of scenarios) hampers adequate anticipation now, or in the future, to such potential future substantial changes. This may lead non-robust long-term transport and tourism policies, and ultimately to undesirable situations in the long run.

To make inferences about vacation travel behaviour in a very different future, this thesis contains four studies (chapters 2 – 5). Each research objective postulated in the introduction is addressed in one or more of these studies. Table 6-1 shows how these studies and research objective are linked. The three research objectives are translated into six more practical research goals. For completeness Table 6-1 shows the correspondence of studies and research goals too.

Table 6-1: Chapters, research objectives and research goals

Research objective	Chapter 2	Chapter 3	Chapter 4	Chapter 5
1) To acquire thorough understanding of vacation travel behaviour under high travel cost conditions	X	X	X	X
2) To develop and empirically test a modelling tool that can be used to analyse vacation travel demand under high travel cost conditions			X	
3) To derive implications for policy makers who are concerned with designing strategic and robust long-term tourism and transport policy	X	X	X	X
Research goals				
Develop a definition and typology of substantial changes	X			
Inventory the current state-of-the-art knowledge on the impacts of past changes on vacation travel behaviour, and – more broadly – on passenger mobility	X			
Develop broad empirical insights on vacationers' responses to a substantial increase in travel costs		X		
Develop and test a model to forecast vacation travel demand under high travel cost conditions			X	
Develop and test a data collection method to collect data that allow estimation of the vacation travel demand model			X	
Conduct a what-if high scenario study using the estimated model				X

As can be seen, roughly speaking, the first research objective relates to the substantive findings of this thesis, the second research objective to the methodological findings, and the third to policy recommendations. The coming sections are organised accordingly. Section 6.2 and 6.3 discuss respectively the substantive and methodological findings of this thesis. Next, section 6.4 provides limitations and avenues for future research. After that, section 6.5 provides policy recommendations. This chapter concludes with a general reflection on this thesis (section 6.6).

6.2 Substantive findings

Chapters 2 to 5 all acquire understanding of vacation travel behaviour under high travel cost conditions. The principle substantive findings of each of these chapters are discussed below. At the end of this section findings are amalgamated in order to draw the main conclusions on vacation travel behaviour under high travel cost conditions.

Chapter 2 presented a literature review on the impacts of past substantial changes on mobility. It assessed a broad body of scholarly literature arrayed across a variety of research fields (e.g. tourism, transport, economics, energy, urban planning, etc.) on changes that impacted on passenger mobility.

To start off, a definition of what is considered to constitute a substantial change is proposed, namely: *A substantial change is an unconventional change that directly or indirectly causes an "enduring" change in at least one principal indicator of mobility of at least 5% on a supranational scale*. With this definition a substantial change is defined by its impact on mobility, and hence can only be assessed a posteriori. Furthermore, to help structure the various substantial changes described in the literature, also a typology of substantial changes is proposed; see Figure 6-1. The typology uses two dimensions, namely: the sphere in which the change takes place, and the rate of change. This categorization results in six types of substantial changes. To each category, a type name is assigned such that it constitutes to a coherent typology which is largely consistent with the prevailing, yet generally implicit, interpretation of the terminology on substantial changes in the literature.

	Technosphere	**Anthroposphere**	**Biosphere**
Abrupt change	*Incident*	*Event*	*Disaster*
Gradual change	*Development*	*Trend*	*Evolution*

Figure 6-1: Typology of substantial changes

In the literature spanning the last four decades, four past changes are identified as substantial changes, namely: the two oil crises, ICT innovations and 9/11. According to the proposed typology the oil crises and 9/11 are events: abrupt changes in the anthroposphere. ICTs innovations can be considered a gradual change in the technosphere; a development.

The enduring impacts of these four identified substantial changes are found to have been relatively minor. Based on the literature their enduring impacts are estimated to be in the order of 5–10% on various indicators of mobility. However, it should be stressed that these are only rough estimates. Estimation of the enduring impacts of substantial changes on mobility is found to be challenging because confounding effects often impede tractability, and hence the quantification of the impacts.

Furthermore, it is found that over the last four decades travel behaviour (on the disaggregate level) has been relatively stable. Past abrupt substantial changes did strongly impact on (vacation) travel behaviour, yet their impacts have only been temporarily. Enduring impacts of abrupt substantial changes are generally found to be the result of *indirect* effects; rather than directly be the result of changed travel behaviour. For instance, the oil crises have inter alia led to the introduction of the fuel economy standards – improving the fuel efficiency of the car stock; and, in the aftermath of 9/11 many airport security measures are introduced which are still in place today – reducing their relative competitiveness.

Chapter 3 presented the first empirical study of this thesis. Using a questionnaire distributed among a representative sample of Dutch vacationers, it aimed to 1) inquire how vacationers would respond when confronted with a substantial increase in travel costs, 2) explore whether vacationers intend to adapt their behaviour by taking specific bundles of responses – as opposed to opting for just one response, and 3) identify relations between socio-economic characteristics as well as attributes of the future vacation which is impaired by the high travel costs and vacationers their intended responses.

Firstly, an important – though not entirely unexpected – finding of this study is that vacationers can be expected to respond to a substantial increase in travel costs using a broad array of responses. More surprisingly, no single vacationer response is found to be far more popular than all the others. Among the most popular responses are: to seek for budget vacation deals, to seek destinations closer to home, to book a cheaper accommodation and to reduce local spending.

Secondly, it is found that responses are correlated: vacationers intend to adapt their behaviour by taking specific bundles of responses. Three of such bundles are identified, namely: 'flexible-responses', 'destination-responses', and 'budget-responses'. Their existence suggests that vacationers think in terms of these, and presumably more, underlying dimensions when dealing with a substantial increase in travel costs.

Thirdly, this study has shown that various socio-economic characteristics and attributes of the impaired future vacation are determinants of vacationer response behaviour. Not surprisingly, income is found to be a very important determinant: vacationers having higher incomes intend to respond less strongly than vacationers having lower incomes. Other interesting identified relations are that young vacationers are less inclined to seek closer-by destinations than their older cohorts and that single member households intend taking more often the train or bus than households consisting of multiple adults. Lastly, in summer vacationers are more inclined to book cheaper accommodations than in winter.

Chapter 4 presented the second empirical study of this thesis on vacation travel behaviour under high travel cost conditions. This study used a discrete choice modelling approach. Data were collected using a novel choice experiment which has been coined the free format SPoffRP choice experiment. In this experiment travel costs were pivoted of the reference value: it was varied within the range of 150% to 300% of the current travel cost as estimated by the respondent.

The first notable finding of this study on vacation travel behaviour under high travel cost conditions is that vacationers exhibit substantial diminishing marginal disutility of vacation travel costs over this range of costs (see Figure 4-2 in subsection 4.5.2). This finding implies that vacationers will probably be relatively less sensitive to changes in travel costs under a high travel cost scenario than under a business-as-usual scenario.

The second notable finding is that all vacation attributes considered in this study, i.e. destination, length of stay, mode of transport, accommodation type, interact significantly with each other in the vacation choice process. This finding confirms the view that the vacation choice is a complex choice consisting of multiple interrelated choice dimensions. Their existence suggests that the impacts of a substantial change, such as an increase in travel costs, can be expected to reach beyond the transportation side of tourism, affecting the market shares of destinations, length of stays and accommodation types. Moreover, it implies that it is challenging to model vacation behaviour, and therefore hard to predict. Five substantial and significant interactions effects are identified. Four of these interact positively: 1) Destination 'domestic' and Length of stay 'between 1 and two weeks', 2) Length of stay of 'three weeks or longer' and Mode 'aircraft', 3) Accommodation type 'tent' and Mode 'car', and 4) Accommodation type 'caravan, motor home, camper' and Mode 'car'. One interacts negatively: Destination 'near abroad' and Mode 'aircraft'.

Chapter 5 presented a simulation study in which the impacts of a substantial increase of *air* travel costs were investigated on Dutch vacation behaviour. For this study the developed vacation choice model of Chapter 4 was used. As such, it provided an illustrative application of its use, and at the same time shed new insights on the on-going scientific debate on aviation CO_2 abatement policies. Air travel costs were increased by up to a factor two. Travel costs of all other modes were kept unchanged. Upper and lower bound estimates were derived for future market shares. Not only the impacts on the transportation side of tourism and greenhouse gas emissions were investigated, but so were the wider impacts on tourism market shares. Furthermore, special interest was given to the effects on domestic tourism market shares.

It is found that impacts of an increase in air travel costs reach beyond the transportation side of tourism. When air travel costs increase substantially, then the average duration of vacations will decline. Furthermore, domestic and near abroad destinations can be expected to gain considerable in market shares among Dutch vacationers (at the expense of intercontinental destinations). The market share of intermediate distance destinations is found to remain by and large unaffected. Tourism travel related GHG emissions of Dutch vacationers are estimated to drop in between 14% and 47% when air travel costs are doubled.

Furthermore, based on the analysis, continuing the line of reasoning, it seems that a substantial increase in air travel costs will probably have a net positive effect on tourism demand in The Netherlands (i.e. the number of people vacationing in The Netherlands). It is found that a doubling of air travel costs will increase the number of Dutch vacationers vacationing in The Netherlands in between 10% and 30%. Although this study is only concerned with Dutch vacation travel behaviour of Dutch vacationers, it is clear that tourism demand from nearby tourist source markets (such as Germany) can be expected to increase too. On the other hand, tourism demand from intercontinental source markets can be expected to decrease. Specifically for the Dutch situation, the increase of demand probably outweighs the loss of demand due to declining number of intercontinental tourists.

Conclusion

In all, a number of interesting substantive insights on vacation behaviour under high travel cost conditions are derived. Yet, it is clear that no clear-cut answer can be given to the question *how does vacation behaviour look like in a high travel cost future?* In summary:
if travel costs (of all modes of transport) increase substantially it can be expected that:

- Vacationers will take a broad range of responses: e.g. book cheaper accommodations, change destination, skip the vacation, etc.
- Vacationers' responses will be correlated
- Vacationers will exhibit substantial diminishing marginal disutility of travel costs: i.e. vacationers will be relatively less sensitive to changes in travel costs under a high travel cost scenario than under a business-as-usual scenario
- Impacts will reach beyond the transportation side of tourism (e.g. affecting durations of stay, and accommodation types)

If specifically *air* travel costs increase substantially, *then* it can be expected that:

- Intercontinental destinations will be hit hardest (and obviously air travel itself)
- The number of Dutch vacationers vacationing in The Netherlands will increase markedly
- Tourism travel related GHG emission reduction will be considerable

If (air) travel costs are only temporary substantially increased, *then* it can be expected that:

- Vacation travel behaviour will revert
- Enduring impacts (if at all) will be the result of indirect effects (i.e. indirect effects are effects that are not directly the result change, but rather stem from e.g. new policy measures, or technological developments in reaction to the change, etc.)

It should also be noted that these findings are subject to limitations. These limitations are discussed in the section 6.4.

6.3 Methodological findings

To develop and test a modelling tool for analysing vacation travel demand under high travel cost conditions in this thesis four consecutive steps are taken, namely: 1) a vacation choice model is proposed, 2) data to estimate this model are collected, 3) the choice model is estimated, and 4) the model is tested. The first three steps are taken in Chapter 4. The fourth step is taken in Chapter 5. The coming four subsections discuss findings and limitations concerning these four methodologically-oriented steps. Although these steps are discussed separately, it should be noted that in the discrete choice modelling community choice model development (step 1), the experimental design (step 2), and estimation (step 3) are intertwined to a large extent. After having discussed these four steps, a brief discussion on estimation bias caused by the use of self-reported choice sets is provided. The last subsection draws the main conclusions on the methodological findings.

1) The vacation choice model

In Chapter 4 the following vacation choice model is proposed, see Eq. 6-1. In the spirit of Lancaster (1966) the vacation choice is assumed to be a choice between bundles of attributes. The vacation is conceptualized to consist of a specific combination of the following attributes: a destination (*D*), a length of stay (*L*), an accommodation type (*Acc*), a mode of travel (*M*), and associated travel cost (x_c) and travel time (x_t) (for the attribute levels, see Table 4-1). The *Go* constant in the first part of the right-hand side of Eq. 6-1 captures the utility associated with going on vacation – as opposed to staying at home. The second part captures the utility associated with the structural components of a vacation alternative i.e. the destination, the length of stay, the accommodation, and the transport mode. Lastly, the third part of Eq. 6-1 captures the utilities associated with interactions between the pairs of the structural components. Furthermore, to accommodate for diminishing marginal disutility two-parameter power function specifications for travel cost (and travel time) of the form: $V = ax^b$ are used.

$$V_j = \underbrace{Go}_{\text{Utility derived from going on vacation}} + \underbrace{V_D + V_L + V_{Acc} + V_M + V_{TrCost} + V_{TrTime}}_{\text{Utility derived from structural components of the vacation}} + \underbrace{V_{DL} + V_{DAcc} + V_{DM} + V_{LAcc} + V_{LM} + V_{AccM}}_{\text{Utility derived from first order interaction terms}} \quad \textbf{Eq. 6-1}$$

$$\text{where} \quad V_{TrCost}(x_c) = a_{TrCost} \cdot x_c^{b_{TrCost}}, \; V_{TrTime}(x_t) = a_{TrTime} \cdot x_t^{b_{TrTime}}$$

It can be concluded that the proposed vacation choice model has been successful in capturing the rationality behind the vacation choice. When estimated on the SP vacation choice data, intuitively correct signs and relative sizes of the parameter estimates are obtained. Moreover, most of the structural components are found to be significant, as well as five of the interaction effects. Lastly, since substantial diminishing disutility of travel cost and travel time is found, it can be concluded that the non-linear power function specification provides an important improvement in modelling the vacation choice. Lastly, given the complexity of the vacation choice a reasonable model fit has been obtained.

2) The data collection

To estimate the vacation choice model in Chapter 4 a rather unconventional data set was needed: choice data of vacationers under high travel cost conditions. Because revealed preference (RP) data were ‘by definition’ not available, stated preference (SP) data were collected. However, because of the unconventional character of the choice situation that was aimed model using a ‘conventional’ SP experiments was prone to yield hypothetical bias.

Therefore, in this thesis a novel type of stated choice experiment is proposed: the free format SPoffRP choice experiment. In the free format SPoffRP choice experiment hypothetical bias is minimized as much as possible by maximally enhancing the realism of the presented choice situation. This is done by a pivoting of self-reported alternatives. That is, alternatives in the SP experiment are constructed around alternatives which are composed by each individual respondent prior to the SP experiment.

It can be concluded that the free format SPoffRP experiment seems to have been successful. That is, first signs on the experiment are positive. Yet, it needs to be acknowledged that the extent to which vacation travel behaviour under high travel cost conditions has been captured remains unclear to some extent. Due to the absence of external data or other empirical studies to compare with, the SPoffRP experiment can only be evaluated based on indications from the study itself (e.g. estimates, model fit, etc.). These are however inherently confounded with the model specification and estimation. Therefore, these can only provide limited information on the extent to which the free format SPoffRP experiment has captured vacation behaviour under high travel cost conditions. Nonetheless, from the correctness of the signs and relative sizes of the estimates one may infer that the experiment has been successful. Moreover, estimates proved quite robust under different model specifications.

Lastly, in this context it is also worth mentioning that opting for a free format SPoffRP experiment brings with it considerable additional costs. Firstly, conducting a free format SPoffRP experiment is more risky than conducting a conventional approach. Due to that SP alternatives are pivoted of alternatives composed by respondents, the analyst loses the full control over the SP choice tasks. For instance, in vacation choice experiment conducted in this thesis there was very little influence on the prevalence specific interactions (e.g. accommodation type tent with mode aircraft). Besides that, malicious input in the free format part directly causes erroneous choice sets in the SP part. Secondly, not unrelated, it goes without saying that designing and testing a free format SPoffRP experiment requires substantial additional efforts as compared to a traditional experimental design.

3) Estimation

Chapter 4 presented the Generalized SPoffRP estimation procedure. This procedure was proposed to accommodate for that unobserved utilities (or more specifically a fraction of it) associated with the (self-reported) RP alternatives can be expected to carry over to the SP setting in SPoffRP choice experiments. It is important to note here that the Generalized SPoffRP estimation procedure is not confined to *free format* SPoffRP data; it can be applied on any kind of SPoffRP data[33].

The Generalized SPoffRP estimation procedure has the standard logit and the recently proposed 'original' SPoffRP estimation procedure as a special case (Train and Wilson 2008; 2009). The novelty of the proposed estimation procedure lies in that – as compared to the original SPoffRP procedure – not necessarily all unobserved utility associated with the user-composed alternatives carries over to the SP setting, but rather a fraction: λ ($0 \leq \lambda \leq 1$). Under the Generalised SPoffRP estimation procedure the utility of alternative j in the SP setting given that i is the chosen RP alternative for decision-maker n is given in Eq. 6-2 (see subsection 4.4.2 for an extensive discussion). This fraction parameter λ can be identified through maximum simulated likelihood estimation. If λ is estimated to be not significantly different from one, then the procedure is identical to the original SPoffRP estimation

[33] In fact the Generalized SPoffRP estimation procedure does *not* accommodate for potential endogeneity stemming from the *free format* part i.e. the use of self-reported choice sets.

procedure. Yet, if λ is estimated to be not significantly different from zero, then the estimation procedure collapses to a standard logit estimation procedure with α now being the commonly used scaling parameter to account for differences in error variance between two data sets (see e.g. Ben-Akiva and Morikawa 1990; Ben-Akiva et al. 1994).

$$U_{\tilde{j}n}\left(\varepsilon_{jn} \mid V_{in}+\varepsilon_{in}>V_{jn}+\varepsilon_{jn}\right)=\alpha\left(V_{\tilde{j}n}+\lambda\varepsilon_{jn}\right)+\eta_{\tilde{j}n} \quad \textbf{Eq. 6-2}$$

It can be concluded that the Generalized SPoffRP procedure is promising. Estimation results confirm the added value of the proposed generalization. It is found that indeed not all, but rather a fraction of the unobserved utilities associated with RP alternatives carry over to the SP setting. More specifically, the fraction parameter λ is estimated to be in the order of 0.05 – depending on exact model specification[34]: small, yet significantly different from zero and one. Furthermore, the model fit is found to significantly improve, especially as compared to the original SPoffRP estimation procedure. However, despite the clear theoretical rationale why SPoffRP estimation procedures should be used, no evidence for bias is found when using more conventional estimation procedures. That is, no significant differences between the estimates are found across the three estimation procedures. As such, it is clear that more applications are needed in order to draw conclusive conclusions on its added value. Lastly, it is worthwhile noting that estimation using SPoffRP procedures is more demanding – both in terms of computational power as well as in terms of efforts from the choice modeller. As standard software packages such as Biogeme and NLOGIT, do not accommodate for this type of estimation procedure, it requires the choice modeller to write custom estimation codes.

4) Testing

In Chapter 5, to test the practical value of the developed vacation choice model, it was used to forecast the impacts of a substantial increase in air travel costs. Air travel costs were up to doubled, while travel costs associated with other modes were kept unchanged. Using the vacation choice model on itself as well as in combination with the constant budget method, respectively lower and upper bounds of the effects – as compared to a situation with no aviation fuel levies - were derived.

It can be concluded that the model is moderately useful to forecast vacation travel demand under high travel cost scenarios. Meaningful insights on the range in which effects can be expected are obtained. Most of the obtained ranges of forecasts seem plausible and in accordance with intuition. Furthermore, the model has proven useful to estimate impacts on various indicators of mobility such as e.g. CO_2 emissions, and average distance travel by a specific mode, etc. Interestingly, the lower and upper bound estimates obtained in the study are quite diverging. On the one hand this may accurately reflect the considerable inherent uncertainty which is associated with the future impacts of such a change. On the other hand it might also indicate that the developed vacation choice model underestimates effects. As

[34] In a model specification without any other panel terms λ is estimated to be in the order of 0.2.

indicated by the relatively low rho square, a substantial amount of unobserved variation in utility is still present in the model. This implies that the model is relatively insensitive.

A note on estimation bias in the free format SPoffRP approach

Because estimation bias in the free format SPoffRP approach is of major concern in the view of the author, this subsection is dedicated to a discussion on this issue.

Estimation bias may be present when a free format SPoffRP approach is taken. Although SPoffRP estimation procedures do accommodate for endogeneity stemming from one aspect of the free format SPoffRP choice experiment (namely, unobserved utilities that carry over to the SP setting), they do not accommodate for a second aspect of the free format SPoffRP choice experiment that may create endogeneity, namely endogeneity stemming from the use of self-reported choice sets. Yet, it seems intuitive that a reporting process may to some extent bedriven by preferences. As a result, the assumption that the unobserved utility in the RP choice is independent and identically distributed type I extreme value may be violated.

In the traditional perspective, the choice modeller aims to specify the choice model such that all relevant attributes are captured in the utility specification *such that* the remaining portion of utility is independent and identically distributed (type I extreme value). If the choice modeller succeeds in doing so, then necessarily the unobserved utility in any choice over any choice set assigned by the choice modeller satisfies the independence assumption. If there are however relevant attributes not captured in the utility specification, then unobserved correlation may be present – violating the independence assumption –, and hence causing estimation bias. The red bus/blue bus problem is probably the most famous example showing the inability of the multinomial logit model to describe choices among alternatives with common unobserved attributes (Debreu 1960; McFadden 1980; Horowitz 1991).

In a free format SPoffRP experiment however it is not the choice modeller who assigns the choice set; rather the respondent composes the choice set him or herself. Therefore, in this context, the key question is the extent to which the unobserved utility across such self-reported alternatives violates the independent and identically distributed type I extreme value assumption – even if the choice modeller has been able to specify the model *such that* the remaining portion of utility is independent and identically distributed across the full individual consideration sets. Correlations across unobserved utility may be present. For instance, a respondent may report two alternatives – say Italy and Thailand – because he or she is keen on good cuisine. Since the attribute cuisine is not in the model specification, this implies that unobserved correlation is present and hence the independence assumption is violated. In addition, attribute ranges of the self-reported alternatives may vary substantially across respondents. As a result, the scale of utility at which these alternatives are evaluated may be different across the reported choice sets. If so, this effectively implies that the homoscedasticity assumption on the error term may be violated.

Considering the above, it seems likely that in the free format SPoffRP vacation choice data error term assumptions have to some extent been violated. After all, the relatively low goodness-of-fit indicates that the reporting of the vacation alternatives was to a relatively large extent driven by unobserved utilities. It is unclear how this may, or may not, have biased estimates in Chapter 4. A complicating factor in this regard is that in the estimation procedure the conditional error (ε) also enters the utility function of the SP choice (see Eq. 4-4). Hence, it may have propagated through the estimation.

Conclusion

In all, it can be concluded that from a methodological point of view to model vacation choice behaviour, and to capture vacation choice behaviour under high travel cost conditions using a choice experiment is challenging. In an attempt to do so, this thesis has made three methodological contributions to the choice modelling literature. It has contributed: 1) by developing an advanced vacation choice model, 2) by proposing a novel type of SP choice experiment, and 3) by advancing SPoffRP estimation procedures. Although these methodological contributions do not fully enable to meet the substantive objective of this thesis, first necessary methodological steps are taken on which future research having similar objectives can build. More generally, the approach put forward in this thesis is particularly promising in case a choice modeller has very limited information on the decision-makers' consideration sets, considerations sets are unlikely to be equal across decision-makers, and hypothetical bias is on the lure.

6.4 Limitations and Future research

In each of the four studies in chapters 2 to 5 notion is given to limitations as well as to research directions that are deemed worthwhile to pursue in the future. This section will not repeat these; rather it adds some additional thoughts on limitation and avenues for future work.

A first notable limitation of this thesis that needs to be addressed stems from the limited ability of the proposed vacation choice model – in combination with the conducted experiment – to capture the full behavioural choice process associated with the vacation choice. Despite the advanced model specification and advanced experimental design, it is clear that in real life there is much more to vacation choice than what has been captured. This is also signalled by the relatively low goodness-of-fit that has been obtained: $\rho^2 \approx 0.15$ (Chapter 4). More specifically, the model has limited ability to capture the full behavioural choice process associated with the vacation choice for four reasons. Firstly, various attributes that are very likely to be relevant for the vacation choice do not enter the utility specification of the proposed vacation choice model. Examples are local climate, the presence of specific local infrastructure, beaches, lakes or mountains, or whether friends or family reside at a specific destination[35]. Secondly, albeit the vacation choice model does accommodate for skipping a vacation, it does in general not accommodate for inter-vacation *substitution* behaviour such as for instance substitution of one long-haul vacation for two nearby vacations. Yet, in Chapter 3 it is inter alia found that vacationers do intend to respond using inter-vacation responses. Thirdly, the proposed model does not capture or accommodate for dynamic aspects of the vacation choice. Yet, in the literature there are indications that the next vacation of a vacationer is not independent of his or her earlier experiences (Jang and Feng 2007; Grigolon 2013). It is unclear how these limitations may have affected choice behaviour in the vacation choice experiment, or how these may have affected the estimated model. As such, the proposed model should rather be regarded as a first step towards a more comprehensive discrete vacation choice model. Future research may build on the work presented here and may be directed at advancing discrete vacation choice models overcoming these limitations.

A second limitation stems from the fact that only Dutch vacation behaviour has been studied. Strictly speaking this would suggest that the developed vacation choice model can only be used to analyse the impacts of a substantial increase in travel costs on Dutch vacation behaviour. Although there is little reason to believe that vacation travel behaviour of vacationers of neighbouring countries is substantially different, it goes without saying that vacation travel behaviour is cross culturally different (Pizam and Sussmann 1995). Future research efforts may therefore aim to develop a 'global' vacation model that encompasses different vacation choice models to capture all major tourist source markets. Such a global vacation model would be better suited to assess the impacts of a substantial increase in air travel costs on e.g. the redistribution of tourist flows, or on global tourism-related GHG emissions.

A third limitation concerns the ceteris paribus assumption. While it is clear that any substantial change dramatically increasing vacation travel costs can be expected to have considerable impacts on many other aspects of life, it is assumed that all else stays equal. Clearly, this is unrealistic. The limitation caused by the ceteris paribus assumption does however not render the findings of this thesis useless. By providing insights on vacation travel behaviour under the ceteris paribus assumption, it does provide insights on when all variables are changing: mutatis mutandis. Nonetheless, future research may aim to take a broader scope when studying the impacts of a substantial change on vacation travel behaviour: addressing the impacts on the economy as a whole.

[35] Although it was acknowledged that these attributes were probably relevant, they were discarded for various reasons. Firstly, some attributes were not included in the proposed model for pragmatic reasons. For instance, whether friends or family reside, or have a vacation home at a destination is difficult to observe from the analyst perspective. Secondly, some attributes were not included because they were considered not generically applying. Snow guarantee is a nice example of such an attribute. Thirdly, some attributes were not included because increasing the number of attributes may also increase choice complexity, and hence reduce choice consistency (Caussade, S., Ortúzar, J. d. D., Rizzi, L. I. & Hensher, D. A. (2005). Assessing the influence of design dimensions on stated choice experiment estimates. *Transportation Research Part B: Methodological*, *39(7)*, 621-640. Examples are e.g. waiting time, number of stopovers, departure time, etc.

Apart from these three general limitations and related research needs, there are a number of methodological findings in this thesis that are deemed worthwhile for further research. Below the two most prominent ones are discussed.

Firstly, future research may address to what extent SP experiments can be used to elicit choice behaviour under unconventional choice conditions. To date, in the choice modelling community eliciting choice behaviour under unconventional choice conditions – such as is done in this thesis – has received only scant attention. As a consequence, at present it is unclear to what extent SP methods, such as the proposed free format SPoffRP choice experiments, can be used to elicit choice behaviour under unconventional choice conditions. Since external data is – by definition – lacking, it would particularly be interesting to cross-validate results of SP methods with those of other methods of preference elicitation such as e.g. virtual reality methods, and Information Acceleration – a method which has been proposed in the marketing field to forecast consumer response to really new products (see e.g. Urban et al. 1997). In this context special interest may be given to the effectiveness, and added value of pivoted experimental designs. In the literature it is often suggested that as pivoting enhances the reality of the choice task it may reduce hypothetical bias (Hensher 2010; Fifer 2011). Currently, it is however unclear whether pivoting may indeed be effective in reducing hypothetical bias in SP choice experiment aiming to elicit choice behaviour under unconventional choice conditions.

A second prominent avenue for further research is to explore the extent to which self-reported choice sets can be used in choice modelling i.e. to what extent biased estimates can be expected. The use of self-reported choice sets is beneficial in the sense that the choice modeller avoids the need to make potentially unrealistic assumptions on the constitution of the decision-maker's choice set. However, as discussed, issues with endogeneity are present. Future research efforts may be directed to better understand the potential bias caused by using self-reported choice sets. Possibly, this may lead to the development of a model or estimation procedures that does accommodate for the endogeneity created by the use of self-reported choice sets.

6.5 Policy implications

This thesis has explored the impacts of high travel costs on vacation travel behaviour. The important question is what policy recommendations can be made based on the findings of this thesis. The future is inherently uncertain. Therefore, in this section two types of recommendations are distinguished: 1) recommendations for current policy practice, and 2) 'conditional' recommendations i.e. recommendations for in case in the future the probability on a high travel cost scenario increases considerably.

6.5.1 Recommendation for current policy practice

The essential question at hand for current policy practice is basically what to do with the large number of possible, yet improbable, substantial changes that loom on the horizon? It is clear that anticipating on all of the improbable substantial changes looming on the horizon is unfeasible. Therefore, to deal with these potential substantial changes in the context of tourism and transport policy a more pragmatic approach is needed.

We make a distinction between two categories: policy decisions having short and intermediate term impacts, and policy decisions having long term impacts.

Tourism and transport policy decisions having short to intermediate term impacts

Tourism is of major social and economic importance, yet it is not a primary necessity of life. Therefore, it is the author's view that it is probably best to take new policy measures anticipating on substantial changes only if one becomes relatively probable. Albeit it is acknowledged that this may result in suboptimal policy, it is the author's opinion that this practice is defendable – given that probabilities on the possible future scenarios are thoroughly assessed.

As such, it is strongly advised to systematically and periodically assess probabilities on substantial changes. If from this periodic assessment it follows that a specific substantial change is considered relatively likely, then a what-if scenario needs to be developed in which its impacts on tourism and transport are estimated. Subsequently, the developed what-if scenario should be taken into consideration when long-term tourism and transport policy are developed.

Furthermore, this implies that currently no new tourism or transport policies are needed anticipating on future high travel cost conditions. Although this thesis is not concerned with assessing the probabilities of substantial changes, given the recent developments on shale gas and solar energy there currently seems little ground to expect travel costs to rise sharply due to a price increase of fossil fuels in the near to intermediate future.

Tourism and transport policy decisions having long-term impacts

With regard to tourism and transport policy decisions having long-term implications (say >30 years), it is advisable to ensure that decisions are robust under a wide range of diverging futures. The further one looks ahead, the larger becomes the uncertainty associated with each scenario. As a result, in the very distant future various completely diverging scenarios become equally probable. For instance, in 2050 a high travel cost scenario is perhaps equally likely as the business-as-usual scenario. Hence, in the very distant future scenarios which are currently considered improbable become *relatively* probable. Adhering to the advocated line of reasoning, this implies that scenarios which are currently considered improbable need to be taken into consideration in current policy practice when decisions are made that have long-term implications. Stated differently, policy makers need to be *aware* of that the very distant future may look completely different from what we know today. This practically implies that it is advisable to ensure that current decisions having long-term implications are robust under a wide range of diverging futures. For instance, with regard to the topic of this thesis, this implies that for the Dutch government it is advisable to ensure that no decisions are currently taken that make a strong growth of the domestic tourism industry in the distant future impossible.

6.5.2 Conditional recommendations

This subsection provides a number of policy recommendations based on this thesis' findings for in case in the future the probability on a high travel cost scenario is considered sufficient to oblige new policy, or change current policies.

1. For governments and the tourism industry of countries that rely heavily on long-haul tourist source markets it is advisable to increase the robustness of their economies towards increases of travel costs by diversification of tourist source markets or by diversification of the economy (beyond tourism). Both Chapters 3 and 5 have found evidence for that vacationers will seek destinations closer to home when (air) travel costs increases. Both studies indicate that especially destinations that rely heavily on faraway tourist source markets can be expected to see a substantial drop in tourism demand. If such destinations have potential tourist source markets in their vicinity, they may aim to develop these new source markets e.g. through marketing campaigns. Very remote destinations that cannot resort to nearby source markets such as e.g. Hawaii, Maldives, or the Azores may need to diversify their economies beyond tourism in order to increase the robustness of their economies.

2. For the hospitality industry it seems advisable to anticipate on a shift in demand to the lower-end segment. In Chapter 3 it is found that to book cheaper accommodations is a relatively popular response. Although in Chapter 5 only air travel costs are increased (as opposed to travel costs in general), it showed that market shares of accommodation types are by and large unaffected. Therefore, it seems that this shift can principally be expected within accommodation types, rather than across accommodation types. Moreover, since booking cheaper accommodations is not found to correlate with e.g. the travel costs (or distance), this shift can be expected both for tourists from nearby source markets as well as for tourists from faraway source markets. Income and to book cheaper accommodations are however negatively correlated. Therefore, a shift towards the lower-end can especially be expected in mid-end end low-end segments (presuming a positive correlation between income and the accommodation segment).

3. It is advisable to be cautious with investments in the hospitality industry at destinations that can be expected to see tourist numbers drop. That is, investments at such destinations have relatively high risk profiles. Just as to book cheaper accommodations, also to reduce local spending is a popular vacationer response. This response can be expected in combination with the response to book cheaper accommodations. It implies that the hospitality industry as a whole (hence beyond lodging) may face declining revenues when travel costs increase substantially. Clearly, tourism flows will be geographically redistributed if travel costs increase substantially.

Therefore, for some destinations the loss in revenue caused by on average reduced spending of vacationer may be compensated for by an increase in the number of tourists. However, for many destinations this will unlikely be the case.

4. It is advisable for the aviation industry as well as for policy makers dealing with the aviation industry to be aware of the risk involved with new aviation infrastructure investments stemming from high travel costs. If air travel costs increase substantially, the impressive growth path in air travel demand of the last decades can be expected to come to a standstill, or even reverse. As such, investments in new airport terminals or new runways, may turn out to be uneconomic in specific cases.

6.6 Reflection on this thesis

In the spirit of this thesis, to reflect a what-if approach is taken. More specifically, the central question posed here is: if I was given four years (instead of three), and with the benefit of hindsight, what would I have done in addition, and or differently, and how would that have benefited results?

If I would have had one additional year, there are two additional studies that I would have conducted.

The first additional study that I would have conducted is one which would assess potential future substantial changes. The most auspicious method to have done this is by conducting a Delphi study among experts. Ideally this study would have been conducted right after the literature review. Such a study would have contributed to this thesis in two ways. Firstly, it would have enriched this thesis by providing a more complete storyline. In its present form this thesis is principally concerned with outcomes under a high travel cost scenario. It does not address the probabilities on such a scenario (or that any other scenario) to occur. In my view this is a bit unsatisfying. Secondly, and more decisive for the present thesis, the findings of the Delphi study would have been used to shape the scenario for the empirical studies. This scenario would likely have been more carefully designed than the one used in the present thesis. Admittedly, this scenario is quite blunt: travel costs and travel times are respectively increased by up to a factor 3 and 2.5. Obviously, it is hard to tell how such a 'Delphi-based' scenario would have looked like. I can only speculate on this. Most likely, a relatively more probable scenario would have been studied (from the current perspective). Probably an increase in travel time would not have been studied at all. However, I feel that it is well possible that the focus would still have been on a substantial increase in travel costs – albeit it seems unlikely that a draconic price increase of a factor three would have been studied. More likely, a scenario in which only air travel costs would increase substantially would have been studied (e.g. matching the marginal costs). In a more extreme case, it is even possible that quite the opposite scenario would have been studied, namely one in which travel costs (and travel times) would substantially drop!

The second additional study that I would have conducted is one which would aim to obtain a better a priori feeling for possible vacation responses and substitution patterns that would emerge. Such a study could also have provided insights on the choice sets and its formation under the substantially changed condition studied. This could have been done either via interviews or via focus group sessions. Ideally this study would have been conducted after the Delphi study, but before the empirical studies. There are a number of ways in which such a study could have positively impacted on this thesis. Firstly, it could have helped identifying vacation responses. In Chapter 3 vacation responses were identified through the literature and through discussions with peers. Perhaps additional vacation responses would have been identified through focus group sessions or interviews. As such, it could have enriched Chapter 3. Secondly, it could have contributed to the development of the vacation choice model in Chapter 4. More specifically, it could have helped identifying the most relevant attributes, it could have helped classifying attribute levels, and it could have helped identifying interactions effects. Because in Chapter 4 the conceptualisation of the vacation choice is based on the literature only, important attributes – especially those which may become specifically important under substantially changed conditions – may have been overlooked. Besides that, due to the lack of prior knowledge on interaction effects an exploratory approach is taken to identify interaction effects. As such, it is by no means clear that all relevant interactions present in the data were tested and identified. Thirdly, it could have provided insights on the choice set composition, and its formation under substantially changed conditions. In Chapter 4, during the design of the choice experiment considerable emphasize was put on reducing hypothetical bias. In order to reduce such bias, a pivoting approach was adopted in which the SP choice sets were pivoted of respondents their *current* consideration sets. Hence, it is basically assumed that the consideration set remains by and large the same under high travel cost conditions, at least in terms of destinations. Interviews or focus group sessions could have provided some clues on whether this is a reasonable assumption, or not. Moreover, prior insights on vacationers' choice set formation under high travel cost conditions could have been helpful in designing the part in which consideration set alternatives were elicited.

Besides adding these two studies, in retrospect, I would do number of things differently. Firstly, with regard to the data collection, I consider it a missed opportunity that I did not conduct a second choice experiment in which no self-reporting and pivoting, or pivoting of only destinations (instead of a whole vacation portfolio) is used. The additional efforts required to conduct such a second experiment would have been minor. Moreover, funds needed for addition data collection were available. By collecting multiple data sets valuable insights both from a methodological perspective as well as from a substantive perspective could have been acquired.

Secondly, I believe that it would have been better to have studied a more specific scenario. In the conducted experiment travel cost was increased over a very large range: travel costs are multiplied by a factor ranging from 1.25 up to 3. Such different price levels might provoke different substitution patterns. As such, in retrospect it would have been better to have studied a tighter range e.g. an increase of travel costs in between 1.5 and 2.

Lastly, with regard to the proposed vacation choice model, I feel that it would have been better to have put more efforts in improving the model specification. More specifically, in the experiment the GPS locations of vacation destination were inferred. By linking these to databases on e.g. climate conditions, or altitude, or vicinity of shoreline, etc. the utility specification on the destinations could have been enriched, and hence the vacation choice model could have been improved.

Summary

Background
Vacation is increasingly considered an indispensable aspect of life. Worldwide more and more people engage in tourism. In the twentieth century the tourism industry has become among the largest industries in the world. Since travel is an important aspect of tourism, travel demand associated with tourism has grown rapidly too. For instance, between 1980 and 2010 worldwide the number of international tourist arrivals more than tripled. As a consequence the societal impacts associated with vacation travel have become considerable, e.g. in terms of noise pollution and CO_2 emissions. For example, currently tourism is accountable for four per cent of the global CO_2 emissions. Moreover, many foresee tourism and its associated travel demand to continue their strong growth paths in the decades to come.

Yet, strong growth of tourism is not the only future that can be envisioned. On the horizon various unconventional changes or *substantial changes* – as they are referred to in this thesis – loom that, if one takes place, may have strong impacts on the growth of vacation travel demand. One of the most widely debated of these potential substantial changes is a peak oil event. In such an event the demand for fossil fuels exceeds supply capacity causing volatile and much higher fuel prices – leading to a substantial increase in travel costs. Besides peak oil, there are many more potential substantial changes that can be imagined which may strongly have strong impacts on the growth of tourism-related mobility e.g. political instability in large oil exporting countries or regions, pandemic outbreaks, technological developments and strong climate change policies such as (aviation) CO_2 taxes.

In that context, and given the major economic and social importance of tourism to many countries around the world, it may be advisable for governments and tourism industry to develop policies anticipating on potential future substantial changes. Common practice to assist policy-makers to anticipate on the uncertain future is to conduct scenario studies. By portraying either a snap-shot picture of some future state or a plausible evolution from the present onwards scenario studies can help policy makers with selecting specific policies, or with evaluating selected policies against a number of different futures.

Yet, strikingly, despite the importance of tourism to many countries around the world, the possibility that substantial changes may bring about a very different future has not received much attention in the tourism literature. Whilst impacts of past (substantial) changes (e.g. 9/11, SARS, avian flu, etc.) are extensively studied in the literature, the impacts of potential future substantial changes are not. In the tourism literature virtually no efforts have been devoted to develop models to forecast vacation travel demand under so-called what-if scenarios. To quote Song (2008) rega rding this knowledge gap: *"It is crucial for researchers to develop some forecasting methods that can accommodate unexpected events in predicting the potential impacts of these one-off events through scenario analysis".* Yet, failure to have thorough understanding of vacation behaviour under potential future conditions, and failure to have credible scenario studies dealing with impacts of potential substantial changes hamper governments and tourism industries to make strategic robust tourism and transport policies, for instance with regard to transport infrastructure investments.

Objectives of this thesis

The main aim of this thesis is to take the first necessary steps to fill this knowledge gap. Accordingly, three research objectives are formulated in this thesis. The first, substantive, research objective of this thesis is to acquire thorough understanding of vacation travel behaviour under high travel cost conditions. The second, more methodologically-oriented, objective is to develop and empirically test a modelling tool that can be used to forecast vacation travel demand under unconventional conditions. The third, practical, objective of this thesis is to derive implications for policy makers concerned with designing strategic and robust tourism and transport policy.

This thesis focusses on a high travel costs scenario. More precisely, in this thesis the impacts of an increase of travel costs of up to a factor three are investigated. This focus stems from the need to operationalize the very broad notion of a potential substantial change. Of course, there are many potential substantial changes one can think of that act upon vacation travel behaviour in other ways than by affecting the costs side of travel. However, as many potential substantial changes can be expected to translate into a substantial increase in travel costs (e.g. a peak oil event, political instability in large oil exporting countries, strong climate change policies, to name a few), confining to high travel cost conditions provides a tangible and relatively generally applying operationalization of a potential substantial change.

Outline of this thesis

To achieve the three main research objectives mentioned above this thesis contains four separate studies. Using different methods each study addresses one or more of the three research objectives. This thesis commences with a literature review (Chapter 2) which assesses the state-of-the-art knowledge on the impacts of past changes on vacation travel behaviour, and – more broadly – on passenger mobility. Next, two empirical studies are conducted aiming to develop empirical insights on vacation travel behaviour under high travel cost conditions. The first empirical study (Chapter 3) investigates vacationers' intended responses to a substantial increase in travel costs. For this study a self-administered vacation travel questionnaire has been conducted. The second empirical study (Chapter 4) adopts a discrete choice modelling approach to learn about vacation travel behaviour under high travel cost conditions. Once discrete choice models are estimated, they can be used for forecasting purposes. Accordingly, the final study of this thesis (Chapter 5) conducts a what-if scenario study using the developed vacation choice model of Chapter 4. As an illustrative case, vacation travel behaviour is simulated under a scenario in which air travel costs increase sharply.

Chapter 2: Substantial Changes and Their Impact on Mobility

To learn on how travellers may respond to, and what may be the impacts of, a future substantial increase of travel costs this thesis commences with assessing a broad body of scholarly literature arrayed across a variety of research fields (e.g. tourism, transport, economics, energy, urban planning, etc.) on the impacts of past changes on mobility. To do so, first a definition of what is considered to constitute a substantial change is proposed, namely: *A substantial change is an unconventional change that directly or indirectly causes an "enduring" change in at least one principal indicator of mobility of at least 5% on a supranational scale*. In addition, to help structure the various changes reported in the literature also a typology of substantial changes is proposed, see Figure 1. The proposed typology uses two dimensions, namely: the sphere in which the change takes place, and the rate of change. To each category, a type name is assigned such that it constitutes to a coherent typology which is largely consistent with the prevailing, yet generally implicit, interpretation of the terminology on substantial changes in the literature.

	Technosphere	**Anthroposphere**	**Biosphere**
Abrupt change	*Incident*	*Event*	*Disaster*
Gradual change	*Development*	*Trend*	*Evolution*

Figure 1: Typology of substantial changes (this thesis)

In the literature spanning the last four decades, four past changes are identified as substantial changes, namely: the two oil crises (events), ICT innovations (development) and 9/11 (event).

Albeit substantial, these changes did not turn mobility up-side-down. Based on the literature their enduring impacts are roughly estimated to be in the order of 5–10% on various indicators of mobility. Interestingly, while the *direct* effects of several past abrupt (substantial) changes on travel behaviour have been considerable (e.g. 9/11, SARS, Indian Ocean earthquake and tsunami), they are found to only have been temporarily. However, *indirectly* some abrupt substantial changes are found to have enduring impacts. For instance, the oil crises have inter alia led to the introduction of the fuel economy standards – improving the fuel efficiency of the car stock – lowering the cost of car travel; and, in the aftermath of 9/11 many airport security measures are introduced which are still in place today – reducing the relative competitiveness of this modality in this aspect.

Chapter3: Vacationers' intended responses to a substantial increase in travel costs

With the aim to acquire broad empirical insights on vacation behaviour under high travel cost conditions this study investigates vacationers' intended responses to a substantial increase in travel costs. For this study a self-administered vacation travel questionnaire has been conducted. In this questionnaire – which was distributed online among a representative sample of Dutch vacationers ($N = 419$) – respondents were asked how they would respond if travel costs of all modes of transport tripled. A first important, though expected, finding of this study is that vacationers intend adapting their vacation behaviour using a broad array of responses. Among the most frequently adopted responses are: to seek for budget vacation deals, to seek closer-by destinations, to book a cheaper accommodation and to reduce local spending. Surprisingly however, no single vacationer response is found to be far more popular than all the others. Furthermore, it is found that vacationers intend to adapt their behaviour by taking specific bundles of responses. Using factor analyses, three of such bundles are identified. These are interpreted as: 'flexible-responses', 'destination-responses', and 'budget-responses'. Their existence suggests that vacationers think in terms of at least these three underlying dimensions when dealing with a substantial increase in travel costs. Lastly, this study shows that various socio-economic characteristics and attributes of the impaired future vacation are determinants of the vacationer's responses. Not surprisingly, income is found to be an important determinant: vacationers having higher incomes intend to respond less strongly than vacationers having lower incomes. Further notable identified relations are that young vacationers are less inclined to seek closer-by destinations than older vacationers and that single member households intend taking more often the train or bus than households consisting of multiple adults when confronted with a substantial increase of travel costs.

Chapter 4: Modelling vacation behaviour under high travel cost conditions

This study can be considered the core of this thesis. To develop understanding of vacation behaviour under high travel cost conditions it uses a discrete choice modelling approach. A stated choice experiment is conducted in which travel costs were varied in between 1.25 and 3 times their current values. Moreover, to achieve the aims of this study, also three methodological contributions are made to the choice modelling literature.

Substantive findings of this study are twofold. Firstly, it is found that vacationers exhibit substantial diminishing marginal disutility of vacation travel costs over this range of travel costs. This finding implies that vacationers will probably be relatively less sensitive to changes in travel costs under a high travel cost scenario than under a business-as-usual scenario. Secondly, it is found that all considered vacation attributes in this study (i.e. destination, length of stay, mode of transport, accommodation type) interact significantly with one another in the vacation choice process. This confirms the view that the vacation choice is a complex choice consisting of multiple interrelated choice dimensions. More importantly, their existence indicates that the impacts of a substantial change, such as an increase in travel costs, can be expected to reach beyond the transport side of tourism.

Besides these substantive contributions, this study provides three methodological contributions to the choice modelling literature. Firstly, an advanced portfolio vacation choice model has been proposed. In the spirit of Lancaster (1966) the vacation choice is assumed to be a choice between bundles of attributes. A vacation alternative is conceptualized to consist of a combination of the following attributes: a destination, a length of stay, an accommodation type, a mode of travel, and associated travel cost and travel time. To capture that in a vacation choice the choice over one attribute may be dependent on the choice over another a portfolio choice model specification is used. Secondly, for this study a rather unconventional data set was needed: choice data of vacationers under high travel cost conditions. In order to collect such unconventional data this study has proposed a novel type of stated choice experiment: the free format SPoffRP choice experiment. In contrast to earlier pivoted choice experiments, in the free format SPoffRP experiment alternatives are constructed by pivoting of consideration set alternatives, rather than only of the chosen alternative. Thereby in this experiment pivoting is not only used to enhance realism (and hence to reduce hypothetical bias), but it is also used as an approach to deal with the limited knowledge from the analyst's perspective on the decision-makers' individual vacation consideration sets. The third methodological contribution of this study is that it proposes a generalization of the recently by Train and Wilson proposed SPoffRP estimation procedure (Train and Wilson 2008; 2009). The SPoffRP estimation procedure is put forward to capture the process that is assumed to drive endogeneity in SPoffRP experiments. The proposed generalization in this study unifies the standard logit and the recently by Train and Wilson proposed SPoffRP estimation procedure as it has these two estimation procedures as special cases.

In all, the SPoffRP modelling approach put forward in this study has been successful: intuitively correct signs and relative sizes of the parameter estimates are obtained, and given the complexity of the vacation choice a reasonable model fit ($\rho^2 \approx 0.15$) has been obtained. Although further research is needed, it can be concluded that this SPoffRP modelling approach seems promising for in case a choice modeller has very limited information on the decision-makers' consideration sets and hypothetical bias is on the lure.

Chapter 5: A simulation study on the impacts of a substantial increase of air travel costs

This study uses the developed vacation choice model of Chapter 4 to conduct a scenario study. As an illustrative case vacation travel behaviour under a high air travel cost scenario is simulated. Travel costs of all other modes are kept at current levels. As such, this study sheds new light on the on-going scientific debate on the effectiveness and impacts of pricing policies aimed at reducing aviation CO_2 emissions.

Notable findings are the following. Firstly, as expected, simulation results show that air travel loses considerable market share: up to 40% of its current market share among Dutch vacationers when air travel costs double. Air travel is mainly substituted by car travel. Secondly, not unrelated, results shows that environmental effects of a substantial increase in air travel costs in terms of greenhouse gas (GHG) emissions reductions are considerable. Tourism travel related GHG emissions of Dutch vacationers are estimated to drop in between 14% and 47% when air travel costs double. Thirdly, it is found that impacts of a substantial increase in air travel costs reach beyond the transportation side of tourism. Intercontinental destinations loose markedly in market share among Dutch vacationers. Domestic destinations on the other hand gain considerably in market share. A doubling of air travel costs is estimated to increase the number of Dutch vacationers vacationing in The Netherlands in between 10% and 30%. Near abroad destinations (200-700 km) are found to gain in market share too while the market share of intermediate distance destinations (700-1500 km) is found to remain by and large unaffected. Besides that, it is found that short vacations (i.e. < 1 week) will gain in popularity. Lastly, with regard to the domestic tourism industry, results of this simulation study suggest that a substantial increase in air travel costs will probably have a net positive effect on tourism demand in The Netherlands. That is, the number of people vacationing in The Netherlands can rather be expected to rise than to fall. Although this study is only concerned with vacation travel behaviour of Dutch vacationers, it can reasonably be expected that tourism demand from nearby tourist source markets such as Germany increases too, while demand from intercontinental source markets decreases. Specifically for the Dutch situation, the increase of demand probably outweighs the loss of demand.

General conclusions

In this thesis the first necessary steps are taken to develop unconventional scenario studies that enable governments and tourism industries to make strategic robust transport and tourism policies. The most important conclusion regarding vacation travel behaviour under high travel cost conditions are: 1) vacationers will adapt their travel behaviour using a broad range of responses, 2) vacationers' responses are correlated, 3) the relative sensitivity of vacationers to travel costs diminishes when travel costs increase (and vice versa), and 4) there are significant interaction effects in the vacation choice between the destination, length of stay, mode of transport, and accommodation type. The latter implies that the impacts of a substantial increase in travel costs (but also other substantial changes) can be expected to reach beyond the transport side of tourism. Furthermore, it can be concluded that from a methodological point of view to model vacation choice behaviour, and to capture vacation choice behaviour under high travel cost conditions using a choice experiment is challenging. To achieve the substantive objective of this thesis, also a number of methodological contributions are made on which future researchers having similar objectives can build.

Policy implications

An important question is what to do at present with the large number of possible, yet improbable, substantial changes that loom on the horizon? Making policies anticipating on all of these potential substantial changes is practically unfeasible. We make a distinction between policy decisions having short and intermediate term impacts, and policy decisions having long-term impacts.

Tourism and transport policy decisions having short to intermediate term impacts

For this category it is advisable to systematically and periodically assess probabilities of substantial changes that may occur in the near to intermediate future. If from this periodic assessment it follows that a specific substantial change is considered relatively likely, then it is recommended to develop what-if scenarios exploring its impacts on tourism and transport. It is advisable to take these scenarios into consideration when tourism and transport policy decisions are made. To give an example: if it is expected that fossil fuel prices will increase strongly, then it is advisable to make additional investments to facilitate for an increase in domestic tourism demand e.g. investments which improve the accessibility of recreational areas (by car as well as by public transport).

With regard to the findings of this thesis this implies that currently no new policies need to be developed anticipating on future high travel cost conditions. Although this thesis is not concerned with assessing the probabilities of potential substantial changes, given the recent developments on shale gas and solar energy there currently seems little ground to expect travel costs to rise sharply due to a price increase of fossil fuels in the near to intermediate future. Importantly, the assertion that currently no new tourism or transport policy needs to be developed anticipating on future high travel cost conditions does not render the findings of this thesis policy irrelevant – on the contrary. Adhering to the line of reasoning above, the findings of this thesis become policy relevant if in the future a high travel cost scenario becomes likely. Insights derived in this thesis then allow governments and tourism industries to respond more adequately to the newly emerging situation.

Tourism and transport policy decisions having long-term impacts

With regard to tourism and transport policy decisions having long-term implications (say >30 years), it is advisable to ensure that decisions are robust under a wide range of diverging futures. Since the very distant future may look completely different from what we know today for this category even substantial changes which are currently considered improbable are relevant.

Samenvatting

Achtergrond

Mensen beschouwen vakantie steeds meer als een onmisbaar aspect van het leven. Wereldwijd gaan steeds meer mensen op vakantie. In de twintigste eeuw is de toeristische sector uitgegroeid tot één van de grootste sectoren in de wereld. Omdat vervoer naar de bestemming een onlosmakelijk onderdeel is van de vakantie, is de sterke groei van toerisme gepaard gegaan met eveneens een sterke toename van toerisme-gerelateerde mobiliteit. Zo is bijvoorbeeld het aantal *internationale* toeristen wereldwijd tussen 1980 en 2010 meer dan verdrievoudigd. Als gevolg van deze groei zijn ook de maatschappelijke effecten van toerisme-gerelateerde mobiliteit, bijvoorbeeld in termen van geluidsoverlast of CO_2 uitstoot aanzienlijk geworden. Zo is momenteel toerisme-gerelateerde mobiliteit verantwoordelijk voor ongeveer vier procent van de wereldwijde CO_2 uitstoot. Velen voorzien bovendien een voortzetting van de groei van toerisme, en de daarmee gepaard gaande mobiliteit, in de komende decennia.

Echter, een voortzetting van de huidige trends is niet het enige toekomstbeeld dat werkelijkheid zou kunnen worden. Aan de horizon liggen verschillende onconventionele veranderingen – of substantiële veranderingen zoals ze in dit proefschrift worden genoemd – die een trendbreuk te weeg zouden kunnen brengen in de groeiende toerisme-gerelateerde mobiliteitsvraag. Een van de meest besproken van deze potentiële substantiële veranderingen is ‘piekolie’. In een piekolie scenario overschrijdt de vraag naar fossiele brandstoffen de aanbodcapaciteit. Dat leidt tot volatiele en veel hogere brandstofprijzen, en resulteert uiteindelijk in een aanzienlijke stijging van de reiskosten. Naast piekolie, zijn er nog tal van andere potentiële substantiële veranderingen te bedenken die een voortzetting van de huidige groei van toerisme-gerelateerde mobiliteit sterk kunnen doen wijzigen; gedacht kan worden aan politieke instabiliteit in grote olie-exporterende landen of regio's, pandemieën, technologische ontwikkelingen en vergaand internationaal klimaatbeleid zoals (luchtvaart) CO_2-belastingen.

Gezien het grote economische en sociale belang van toerisme in vele landen in de wereld kan het raadzaam zijn voor overheden en de toeristische sector om beleid te maken anticiperend op dergelijke potentiële veranderingen. De gangbare methode om beleidsmakers in staat te stellen om te anticiperen op mogelijke gebeurtenissen in de onzekere toekomst is door scenariostudies uit te voeren. Door ofwel een beeld van een mogelijke toekomstige situatie, of een plausibele evolutie van de huidige situatie naar een mogelijke toekomstige situatie te schetsen, kunnen scenariostudies helpen met het selecteren van de juiste beleidsmaatregelen of helpen beleidsmaatregelen te evalueren in het licht van mogelijke toekomsten.

In deze context is het merkwaardig te constateren dat in de toerismeliteratuur dergelijke potentiële substantiële veranderingen maar zeer weinig aandacht hebben gekregen. Terwijl de effecten van substantiële veranderingen uit het verleden juist uitgebreid zijn bestudeerd in de literatuur (bijvoorbeeld 9/11, SARS, vogelgriep, enz.), hebben de potentiële effecten van mogelijke toekomstige (substantiële) veranderingen maar zeer beperkt aandacht gekregen. Er zijn in de toerismeliteratuur nauwelijks zogeheten what-if scenario studies te vinden die de potentiële effecten van substantiële veranderingen verkennen. Song (2008) zegt het volgende met betrekking tot deze leemte in de kennis: *"Het is van cruciaal belang voor onderzoekers om methoden te ontwikkelen die voor onverwachte veranderingen kunnen accommoderen om daarmee de potentiële effecten van deze veranderingen te kunnen verkennen via scenario-analyse" (mijn vertaling)*. Gebrek aan kennis over de effecten van mogelijke toekomstige substantiële veranderingen kan uiteindelijk resulteren in verkeerde besluitvorming, bijvoorbeeld met betrekking tot transportinfrastructuur investeringen.

Doel van dit proefschrift

Het hoofddoel van dit proefschrift is om de eerste noodzakelijke stappen te nemen om deze leemte in de kennis te vullen. Hiervoor zijn drie onderzoeksdoelstellingen geformuleerd. De eerste, inhoudelijke, doelstelling van dit proefschrift is om grondige kennis te verkrijgen van vakantie-reisgedrag onder hoge reiskosten. De tweede, meer methodologisch georiënteerde, doelstelling is om een model te ontwikkelen, en empirisch te toetsen, dat gebruikt kan worden om de toerisme-gerelateerde mobiliteitsvraag te voorspellen onder onconventionele condities. De derde, meer praktische, doelstelling van dit proefschrift is om mogelijke implicaties te formuleren voor beleidsmakers die zich bezighouden met het ontwikkelen van strategisch en robuust transport- en tourismebeleid.

Dit proefschrift richt zich specifiek op een hoge reiskosten-scenario. Meer concreet, dit proefschrift onderzoekt de effecten van een stijging van de reiskosten tot een factor drie. Deze focus komt voort uit de noodzaak om het brede begrip van substantiële verandering te operationaliseren. Uiteraard zijn er verscheidene potentiële substantiële veranderingen te bedenken die op andere manieren dan via de kostenkant vakantiereisgedrag kunnen veranderen. Echter, omdat veel potentiële substantiële veranderingen waarschijnlijk wel direct of indirect in een forse stijging van de reiskosten resulteren (bv. piekolie, politieke instabiliteit in grote olie-exporterende landen, of vergaand internationaal klimaatbeleid, om er een paar te noemen), beperkt dit proefschrift zich tot hoge reiskosten. Deze afbakening zorgt voor een praktische en relatief generieke operationalisering van een substantiële verandering.

Overzicht van dit proefschrift

Om de drie bovengenoemde onderzoeksdoelstellingen te behalen, bevat dit proefschrift vier afzonderlijke studies. Met behulp van verschillende methoden richt elke studie zich op één of meerdere van de drie onderzoeksdoelen. Dit proefschrift begint met een literatuurstudie (hoofdstuk 2). Deze literatuurstudie inventariseert de state-of-the-art kennis over de effecten van eerdere veranderingen op vakantiereisgedrag, en – meer in het algemeen – op mobiliteit. Vervolgens worden twee empirische studies uitgevoerd. Beide zijn gericht op het verkrijgen van inzichten over vakantiereisgedrag onder hoge reiskosten. De eerste empirische studie (hoofdstuk 3) onderzoekt voorgenomen reacties van vakantiegangers op een forse stijging van de reiskosten. Hiervoor is een zelfontwikkelde survey uitgevoerd. De tweede empirische studie (hoofdstuk 4) gebruikt discrete-keuze modellen om inzichten over vakantiereisgedrag te verkrijgen. Een portfolio vakantiekeuzemodel is ontwikkeld en geschat op data welke zijn verkregen in een zogeheten free format SPoffRP-keuze-experiment. Als discrete keuzemodellen eenmaal geschat zijn, kan men daarmee toekomstige vraag en marktaandelen te voorspellen. De laatste studie van dit proefschrift (hoofdstuk 5) voert daartoe, gebruikmakend van het ontwikkelde vakantiekeuzemodel, een what-if scenariostudie uit. Als een illustratieve toepassing van het ontwikkelde model simuleert deze studie vakantiegedrag onder een scenario waarin de kosten van vliegreizen fors stijgen.

Hoofdstuk 2: Substantiële veranderingen en hun impact op mobiliteit

Om inzicht te krijgen in de manier waarop reizigers zouden kunnen reageren op, en wat de gevolgen zouden kunnen zijn van, een sterke stijging van de reiskosten begint dit proefschrift met het verkennen van een breed scala aan wetenschappelijke literatuur verspreid over verscheidene onderzoeksgebieden (bijvoorbeeld toerisme, vervoer, economie, energie, stadsplanning, enz.) over de effecten van eerdere veranderingen op de mobiliteit. Allereerst wordt daartoe een definitie opgesteld van wat wordt beschouwd als een substantiële verandering: *Een substantiële verandering is een onconventionele verandering die direct of indirect een 'blijvende' verandering veroorzaakt in tenminste één belangrijke indicator van mobiliteit van ten minste 5% op supranationale schaal.* Om de verschillende veranderingen in de literatuur te kunnen structuren, wordt ook een typologie van substantiële veranderingen voorgesteld, zie figuur 1. De voorgestelde typologie maakt gebruik van twee dimensies, namelijk: de sfeer waarin de verandering plaatsvindt, en de snelheid van de verandering. Zoals te zien resulteert deze indeling in zes typen substantiële veranderingen. Aan elke type hebben is een type-naam toegewezen gebaseerd op overeenkomstigheid in de voornamelijk Engelse literatuur en zodanig dat een coherente typologie ontstaat (tussen haakjes staat de Engelse vertaling).

	Technosfeer	**Anthroposfeer**	**Biosfeer**
Abrupte verandering	*Incident (Incident)*	*Gebeurtenis (Event)*	*Ramp (Disaster)*
Graduele verandering	*Ontwikkeling (Development)*	*Trend (Trend)*	*Evolutie (Evolution)*

Figuur 1: Typologie van substantiële veranderingen (deze thesis)

In de literatuur van de afgelopen vier decennia zijn vier historische veranderingen geïdentificeerd als substantiële veranderingen, te weten: de twee oliecrises (gebeurtenissen), ICT- ontwikkelingen (ontwikkeling), en de 9/11 aanslagen (gebeurtenis). Hoewel substantieel, hebben deze veranderingen niet de mobiliteit volledig op zijn kop gezet. Op basis van de literatuur worden hun blijvende effecten ruwweg geschat op in de orde van 5% tot 10% op verschillende indicatoren mobiliteit. Interessant is dat hoewel de directe effecten op reisgedrag van verschillende abrupte veranderingen uit het verleden weliswaar groot zijn geweest (bijvoorbeeld 9/11, SARS, de Indische Oceaan aardbeving en tsunami), deze van slechts tijdelijke aard zijn gebleken. Echter, indirect hebben enkele abrupte veranderingen wel voor blijvende veranderingen gezorgd. Bijvoorbeeld: 1) de oliecrises hebben onder andere geleid tot brandstofverbruiksnormen voor auto's, deze hebben geleid tot een verbetering van de brandstofefficiëntie van de autovoorraad, dat op zijn beurt weer heeft geleid tot een 'blijvende' verlaging van de kosten van autorijden; 2) in de nasleep van 9/11 zijn veel veiligheidsmaatregelen ingevoerd, deze zijn vandaag de dag veelal nog steeds van kracht, als gevolg hiervan is de relatieve aantrekkelijkheid van vliegen in dat opzicht 'blijvend' verlaagd.

Hoofdstuk 3: Voorgenomen reacties van vakantiegangers op een forse stijging van de reiskosten

Om brede inzichten te verkrijgen over vakantiereisgedrag onder hoge reiskosten onderzoekt deze studie de voorgenomen reacties van vakantiegangers op een forse stijging van de reiskosten. Data zijn verzameld door middel van een zelfontwikkelde survey. In deze survey – welke is verspreid onder Nederlandse vakantiegangers (*N = 419*) – werden respondenten gevraagd hoe zij zouden reageren op een verdrievoudiging van de reiskosten van alle vervoermiddelen (d.w.z. auto, trein of bus, en vliegtuig). Een eerste belangrijke, hoewel verwachte bevinding is dat vakantiegangers voornemens zijn hun vakantiegedrag op tal van manieren aan te passen. De meest genoemde reacties zijn: zoeken naar budgetvakanties, naar minder verre vakantiebestemmingen gaan, goedkopere accommodaties boeken, en lokale uitgaven verminderen. Verrassend hierbij is echter dat de verschillen in populariteit tussen de reacties relatief klein zijn: geen enkele reactie is veel vaker genoemd dan de andere reacties. Bovendien toont deze studie aan dat vakantiegangers voornemens zijn hun gedrag aan te passen door het nemen van specifieke bundels van reacties. Met behulp van factoranalyse zijn drie 'bundels' geïdentificeerd. Deze zijn geïnterpreteerd als: 'flexibele-reacties', 'bestemmings-reacties', en 'budget-reacties'. Het bestaan van deze bundels van reacties suggereert dat vakantiegangers denken in termen van tenminste deze drie onderliggende dimensies bij het reageren op een dergelijke forse stijging van reiskosten. Tot slot laat deze studie zien dat verschillende sociaaleconomische kenmerken verklarend zijn voor de reacties van vakantiegangers op een forse stijging van de reiskosten. Niet verrassend in deze context is dat inkomen een belangrijke verklarende factor is van de reactie. Vakantiegangers met hogere inkomens zijn voornemens minder sterk te reageren dan vakantiegangers met lagere inkomens. Opmerkelijker is dat jonge vakantiegangers aangeven minder naar bestemmingen dichter bij te gaan dan hun oudere vakantiegangers, en dat eenpersoonshuishoudens meer voornemens zijn om vaker met de trein of bus op vakantie te gaan dan huishoudens bestaande uit meerdere volwassenen wanneer ze geconfronteerd worden met een forse stijging van de reiskosten.

Hoofdstuk 4: Het modelleren van vakantiegedrag onder hoge reiskosten

Dit onderzoek kan worden beschouwd als de kern van dit proefschrift. Om inzicht te krijgen in vakantiegedrag onder hoge reiskosten wordt in dit hoofdstuk gebruik gemaakt van zogeheten discrete keuze modellen. Om deze modellen te schatten is een vakantiekeuze-experiment ontwikkeld. Hierin zijn de reiskosten van alle vervoermiddelen gevarieerd tussen 1.25 en 3 maal de huidige reiskosten. Teneinde de doelstellingen van dit onderzoek te bereiken zijn bovendien drie methodologische bijdragen gemaakt aan de literatuur over discrete keuzemodellen.

De inhoudelijke bevindingen van dit onderzoek zijn tweeledig. Ten eerste blijkt dat het zogenoemde marginale dis-nut aanzienlijk afneemt met reiskosten. Met ander woorden, de relatieve gevoeligheid van vakantiegangers ten aanzien van reiskosten neemt af naarmate de reiskosten hoger zijn, en visa versa. Deze bevinding impliceert dat vakantiegangers relatief minder gevoelig zijn voor veranderingen in de reiskosten onder een scenario met hoge reiskosten dan onder het business-as-usual scenario. Ten tweede is gevonden dat er significante interacties zijn in de vakantiekeuze tussen alle in het experiment meegenomen vakantieattributen, te weten: de bestemming, de duur van het verblijf, het vervoermiddel, en het type accommodatie. Oftewel, bij het maken van de vakantiekeuze hangen de keuze voor bijvoorbeeld het vervoermiddel en de accommodatie samen. Dit bevestigt de notie dat de vakantiekeuze een complexe keuze is bestaande uit meerdere samenhangende dimensies. Belangrijker, het bestaan van deze interacties impliceert dat kan worden verwacht dat de effecten van een substantiële verandering, zoals een stijging van de reiskosten, verder reiken dan de mobiliteitskant van toerisme.

Naast deze inhoudelijke bijdragen maakt deze studie ook drie methodologische bijdragen aan de discrete keuze literatuur. Ten eerste wordt in deze studie een geavanceerde portfolio vakantiekeuzemodel voorgesteld. In navolging van Lancaster (1966) wordt verondersteld dat de vakantiekeuze een keuze is over bundels attributen. Een vakantiealternatief wordt geconceptualiseerd als een combinatie van de volgende attributen: een bestemming, een verblijfsduur, een accommodatie type, een vervoermiddel, en bijbehorende reiskosten en reistijd. Omdat in de vakantiekeuze de keuze over het ene attribuut afhankelijk kan zijn van de keuze over een ander attribuut wordt een zogeheten portfolio modelspecificatie gebruikt. Ten tweede, voor deze studie was een nogal onconventionele dataset nodig: vakantiekeuzes onder hoge reiskosten. Om deze onconventionele data te verkrijgen, is een nieuw type keuze-experiment ontwikkeld, het zogeheten free format SPoffRP-keuze-experiment. Dit is een gepivoteerd keuze-experiment. Gepivoteerd wil zeggen dat de voorgelegde alternatieven in het keuze-experiment individueel-specifiek zijn afgestemd op respondenten hun specifieke situatie / belevingswereld: de alternatieven zijn geconstrueerd door te variëren op referentiealternatieven die door de respondent zelf zijn aangedragen. In tegenstelling tot eerdere gepivoteerde keuze-experimenten worden alternatieven in het free format SPoffRP-keuze-experiment geconstrueerd door te pivoteren vanaf alternatieven in de respondent zijn zogeheten consideration set (d.w.z. de set van overwogen alternatieven), en niet enkel vanaf een gekozen alternatief. In dit experiment wordt pivoteren niet enkel gebruikt om het realisme van de keuzesituatie te verbeteren – om daarmee hypothetische bias te verminderen – maar wordt het ook gebruikt als een manier om met de beperkte kennis – vanuit het perspectief van de analist – van de individueel-specifieke consideration sets van besluitnemers om te gaan. De derde methodologische bijdrage van deze studie is dat het een generalisatie voorstelt voor een onlangs door Train en Wilson (2008) voorgestelde schattingsprocedure. Deze zogeheten SPoffRP-schattingsprocedure is voorgesteld door Train en Wilson om het proces dat wordt verondersteld endogeniteit te creëren in SPoffRP-experimenten te ondervangen. De voorgestelde generalisatie in deze studie verenigt de standaard MNL schattingsprocedure, en de onlangs door Train en Wilson voorgestelde SPoffRP-schattingsprocedure: beide schattingsprocedures zijn speciale gevallen van de voorgestelde generalisatie.

Al met al is de voorgestelde ‘SPoffRP-aanpak’ in deze studie succesvol geweest: intuïtief juiste tekens en relatieve grootte van de modelparameters zijn verkregen, en gezien de complexiteit van de vakantiekeuze is een redelijke model fit ($\rho^2 \approx 0{,}15$) verkregen. Hoewel verder onderzoek nodig is, kan derhalve worden geconcludeerd dat deze SPoffRP-aanpak veelbelovend is in situaties waarin de keuzemodelleur zeer beperkte kennis heeft over de individueel – specifieke consideration sets van besluitnemers en hypothetische bias op de loer ligt.

Hoofdstuk 5: Een simulatie studie naar de effecten van een forse stijging van vliegkosten
Dit hoofdstuk presenteert als illustratieve toepassing van het in hoofdstuk 4 ontwikkelde vakantiekeuzemodel een what-if scenario studie. In het onderzochte scenario stijgen de vliegkosten fors, terwijl de reiskosten van andere vervoersmiddelen op het huidige niveau zijn gehouden. Daarmee werpt deze studie nieuw licht op het lopende debat over de doeltreffendheid en de effecten van prijsbeleid gericht op het verminderen van CO_2-uitstoot in de luchtvaart.

De volgende noemenswaardige bevindingen zijn gedaan. Ten eerste, zoals verwacht, tonen de simulatie resultaten aan dat reizen per vliegtuig onder Nederlandse vakantiegangers aanzienlijk in marktaandeel verliest: indien de vliegkosten verdubbelen verliest het vliegtuig tot 40% van zijn huidige marktaandeel. Vliegreizen worden vooral gesubstitueerd door autoreizen. Ten tweede blijkt dat de milieueffecten van een forse stijging van de vliegkosten in termen van een afname van broeikasgasemissies aanzienlijk is. Toerisme-gerelateerde broeikasgasemissies van Nederlandse vakantiegangers dalen naar schatting tussen de 14% en 47% bij een verdubbeling van de vliegkosten. Ten derde laten de resultaten zien dat de effecten van een forse stijging van de vliegkosten verder reiken dan de mobiliteitskant van toerisme. Intercontinentale bestemmingen verliezen sterk in marktaandeel. Binnenlandse bestemmingen daarentegen winnen aanzienlijk in marktaandeel. Een verdubbeling van vliegkosten leidt naar schatting tot een groei van het aantal Nederlanders dat in Nederland op vakantie gaat van tussen de 10% en 30%. Ook bestemmingen in het nabije buitenland (200-700 km) winnen marktaandeel. Het marktaandeel van de middel-verre bestemmingen (700 - 1500 km) blijft nagenoeg onaangetast. Daarnaast is gevonden dat korte vakanties (d.w.z. vakanties van korter dan 1 week) aan populariteit winnen. Ten slotte suggereren de resultaten van deze simulatiestudie dat een forse stijging van vliegkosten per saldo waarschijnlijk een positief effect heeft op de toeristische vraag in Nederland. Dat wil zeggen: het aantal vakantiegangers dat in Nederland vakantie viert zal eerder stijgen dan dalen. Hoewel deze studie alleen heeft gekeken naar het vakantiereisgedrag van Nederlandse vakantiegangers, kan redelijkerwijs worden verondersteld dat het aantal vakantiegangers in Nederland vanuit nabijgelegen markten zoals Duitsland ook toeneemt, en dat het aantal vakantiegangers vanuit intercontinentale markten afneemt. Voor de binnenlandse toeristische sector is het te verwachten dat de toename van vakantiegangers waarschijnlijk groter is dan de afname.

Algemene conclusies

In dit proefschrift zijn de eerste noodzakelijke stappen genomen om onconventionele scenariostudies te kunnen ontwikkelen. Dergelijke scenariostudies stellen overheden en de toeristische sector in staat om strategisch en robuust lange termijn toerisme- en transportbeleid te ontwikkelen anticiperend op substantiële veranderingen. De belangrijkste conclusies met betrekking tot vakantie-reisgedrag onder hoge reiskosten zijn: 1) vakantiegangers passen hun vakantiegedrag op tal van manieren aan, 2) de reacties van vakantiegangers zijn gecorreleerd, 3) de relatieve gevoeligheid van vakantiegangers ten aanzien van reiskosten neemt af naarmate de reiskosten hoger zijn (en visa versa), en 4) in de vakantiekeuze zijn er significante interacties tussen de bestemming, de duur van het verblijf, het vervoermiddel, en het type accommodatie. Dit laatste impliceert dat de effecten van een stijging van de reiskosten (maar ook andere substantiële veranderingen) verder reiken dan de mobiliteitskant van toerisme. Voorts, vanuit een methodologisch perspectief kan worden geconcludeerd dat het modelleren van vakantiekeuzegedrag, evenals het verzamelen van keuzedata onder een hoge reiskostenscenario, een uitdaging is. Om de inhoudelijke doelstelling van dit proefschrift te bereiken, is ook een aantal methodologische bijdragen gemaakt waarop toekomstige onderzoekers die vergelijkbare onderzoeksdoelen hebben kunnen voortbouwen.

Beleidsimplicaties

Een belangrijke vraag is: wat op dit moment te doen met het grote aantal potentiële, maar onwaarschijnlijke, substantiële veranderingen aan de horizon? Beleid maken anticiperend op al deze potentiële substantiële veranderingen is praktisch onhaalbaar. We maken onderscheid tussen beleidsbeslissingen met korte en middellange termijn impact, en beleid met lange termijn impact.

Toerisme- en transportbeleidsbeslissingen met korte en middellange termijn impact

Voor deze categorie is het aan te bevelen om systematisch en periodiek de kansen van potentiële substantiële veranderingen die zich voor zouden kunnen doen op de korte en middellange termijn te evalueren. Indien uit deze periodieke evaluatie volgt dat er een specifieke potentiële substantiële verandering relatief waarschijnlijk wordt, dan is het aan te bevelen om scenario studies uit te voeren waarin de effecten op toerisme en transport worden verkend. Vervolgens is het aan te raden deze scenario's mee te nemen bij de besluitvorming omtrent toerisme- en transportbeleid. Om een voorbeeld te geven: als verwacht wordt dat de fossiele brandstofkosten sterk kunnen gaan stijgen, dan is het raadzaam extra investeringen te doen om de waarschijnlijk groter wordende binnenlandse toeristische vraag te faciliteren. Concreet betekent dit bijvoorbeeld de ontsluitingen naar de Nederlandse recreatiegebieden te verbeteren (met de auto en met het openbaar vervoer).

Met betrekking tot de bevindingen van dit proefschrift betekent dit dat momenteel geen nieuw beleid nodig is anticiperend op toekomstige hoge reiskosten. Hoewel dit proefschrift niet gericht is op het evalueren van de kansen op potentiële substantiële veranderingen, lijkt er – gezien de recente ontwikkelingen op het gebied van schaliegas en zonne-energie – momenteel weinig aanleiding te zijn om te verwachten dat de reiskosten op de korte tot middellange termijn sterk gaan stijgen. De conclusie dat momenteel geen nieuw toerisme- of transportbeleid nodig is anticiperend op toekomstige hoge reiskosten betekent niet dat de bevindingen van dit proefschrift beleidsirrelevant zijn – integendeel. De bevindingen van dit proefschrift worden beleidsrelevant ingeval in de toekomst een hoge reiskostenscenario waarschijnlijk wordt. Inzichten verkregen in dit proefschrift stellen overheden en de toeristische sector dan in staat om meer adequaat te reageren.

Toerisme- en transportbeleidsbeslissingen met lange termijn impact

Voor toerisme- en transportbeleidsbeslissingen met lange termijn impact (zeg > 30 jaar) is het aan te bevelen om ervoor te zorgen dat huidige besluiten robuust zijn onder een breed scala van uiteenlopende scenario's. Omdat de zeer verre toekomst er volledig anders uit kan zien dan vandaag zijn voor deze categorie substantiële veranderingen die momenteel als onwaarschijnlijk worden beschouwd toch relevant.

About the Author

Sander van Cranenburgh was born in Vlaardingen on the 12th of January 1982. In 2006 he obtained his Master's degree in Aerospace Engineering at Delft University of Technology. After graduation Sander started working at a consultancy company specialised in climate mitigation and adaptation policies. In 2010 he decided it was time for a new challenge. From 2010 to 2013 he was a Ph.D. student at Delft University of Technology's Section of Transport & Logistics. During this period he presented papers at several international Transport conferences, and was involved in two B.Sc. courses. In June 2013 he started to work as a Post doc at this section. His current research involves the development of a regret-based national travel demand model.

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