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## Conference Paper

# Impacts of weather conditions on destination choice of leisure trips

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## **Impacts of weather on destination of recreational trips**

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### **Abstract**

*This paper investigates the impacts of weather on the destination choice of recreational trips made by the Dutch traveler during period 2000 to 2005. The important contribution is that locally and hourly measured weather data are used for analysis. We use all recreational trips made during summer and used binary logit model to see how weather influence the decision to go to the beach vs decision to go to other destinations for recreational activities. The results indicate that weather has influence on destination choice of recreational trips. Wind and precipitation negatively influence the decision to go to the beach as compared with recreational trips to other destinations. Whereas, the probability of going to the beach during high temperature is higher than the day during which temperature is lower.*

### **Introduction**

Weather plays an important role for most of the day-to-day activities. Recreational activities are mostly affected by weather. For example, a nice sunny day may bring thousands of people to the beach but on another time a weather warning (e.g., of storm) may cause to restrict everyone inside their houses. The importance of weather increases more with increasing knowledge about the weather forecasts and climate changes.

The climate change will change the weather of cold countries considerably. This implies that countries with extreme cold weather will have on average less extreme cold weather and their summer will be longer. This may increase the tourism activities in those countries during summer period as weather may have strong influence for recreational trips and its destination, especially trips made within a country because it can be rescheduled easily as compared with abroad trips.

The literature addressing these issues in quantitative aspect is little. There are some studies from tourism literature, which do address the issues of destination choice for recreational trips or for holiday trips. However, these studies are undertaken with some

limitations. For example, Bigano et al., (2006) analyzed the impact of climate, distance, political stability and poverty on the destination choice of tourist from 45 countries of all continents. They find that tourists are attracted to sunny yet mild climate. Additionally, they suggest that the average temperature of optimal destination is equal to  $16.2 \pm 2.05$  °C . However, their study is based on yearly mean temperature for climate, which is not a good proxy for temperature conditions of a big country (e.g. India, china, USA, UK etc, which are part of their study). Even if a country is small, but it has a lot of weather variation within, or if weather is subject to change in short period of time (such as Netherlands) then this proxy is not much suitable.

Hamilton (2004) also studies the destination choice of German tourist while considering the climate of the destinations of the travelers. He found that European countries become more attractive during summer. However, the northern European countries become relatively more attractive than the southern European countries. Similar kind of study has been done by Maddison (2001). However, these studies have also certain limitations. To sum up, the above studies use monthly or annual averages of the weather, which may be good proxy for some of the countries but not good enough for each country. Additionally, the focuses of these studies are international trips. Thus, they focus on more than one destination while at the same time they have to use broader climate proxies for each country, which make the analysis less attractive, if the purpose is responsiveness to weather variation.

The current, study tries to bridge up this gap by considering the recreational trip's destination choice. The study considers recreational trips made during summer months by Dutch travels during 6-year period (2000 to 2005) within the Netherlands. The usage of such a long period and detailed data will provide more insight to the interrelationship of weather and destination choice for recreational trips. Finally, the use of hourly and locally measured weather conditions make it an improvement over the previous studies.

The rest of the paper is organized as follows: Section 2 provides a theoretical model and its specification. Section 3 contains empirical data, details of the explanatory variables included in the model. Section 4 presents the estimation results and discusses the result. Section 5 concludes the paper and gives direction for the future work.

## 2. Theoretical Model

Let assume that individual  $i$  have to choose between a destination  $j$  (going to the beach) and destination  $k$  (non-beach destination) for a recreational trip. Let assume that the utility he will derive from these two choices is given as;

$$U_{ij} = V_{ij} + \varepsilon_{ij} \quad (1)$$

$$U_{ik} = V_{ik} + \varepsilon_{ik} \quad (2)$$

Where  $V_{ij} = V_{ik} = W\alpha + X\beta$ . Furthermore,  $W$  is a vector of weather variables and  $X$  is a vector of non-weather variables. Now if an individual chose  $j$  it means that  $U_{ij} > U_{ik}$  given that an individual,  $i$  maximizing his utility. This implies that.

$$P(U_{ij}) > P(U_{ik}) \quad (3)$$

$$P(V_{ij} + \varepsilon_{ij}) > P(V_{ik} + \varepsilon_{ik}) \quad (4)$$

$$P(\varepsilon_{ik} - \varepsilon_{ij}) < P(V_{ij} - V_{ik}) \quad (5)$$

Let assume that  $\varepsilon_i$  follows the logistic distribution. This implies that the probability of a random variable  $X$  can be written as;  $F(X) = Pr(X \leq x) = \frac{1}{1 + e^{-x}}$ . In current case, this implies that the probability of making choice  $i$  can be obtained as,

$$P(V_{ij} - V_{ik}) = \frac{1}{e^{-(\varepsilon_{ik} + \varepsilon_{ij})}} \quad (6)$$

$$P(V_{ij} - V_{ik}) = \frac{e^{\varepsilon_{ij}}}{e^{\varepsilon_{ij}} + e^{\varepsilon_{ik}}} \quad (7)$$

Equation (7) is the binary logistic model for the decision of making a recreational trip to the beach vs recreational trip to non-beach destination. The reference category is the non-beach recreational destinations.

### 3. Data and its sources

This study use data from three sources. First, we make use of the Transportation Surveys of Dutch Central Bureau of Statistics (OVG Survey) for the year 2000 until 2003. Over the course of an entire a year, large numbers of individuals in the Netherlands were asked to fill out a questionnaire on their travel behavior during a certain day.<sup>1</sup> Second, we use MON transportation survey (MON) for 2004 to 2005. The Directorate-General Public Works and Water Management for the Ministry of Transport, Public Works and Water Management (Rijkswaterstaat Dienst Verkeer en Scheepvaart) conduct the MON survey. MON survey is similar to OVG survey, but it contains some additional variables. However, MON survey consists of fewer reported trips and individuals than the OVG survey.

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<sup>1</sup> It may be noted that the number of recorded trips and number of individuals are different in each year. However, it reduces in every next year.

The weather data is provided by Royal Netherlands Meteorological Institute (KNMI) for period 2000 until 2005. It contains weather conditions measured on the hourly basis by 32 weather stations spread all over the Netherlands. It may be noted that weather conditions referred to temperature, wind strength and precipitation.

We first combined the OVG and MON data sets to get transportation data for 6 years. This provides us transportation data for the 6-year period starting from 2000. However, the combining of these two data sets are not straightforward because some variables are removed from the MON data set, which were part of the OVG data set, also some variable categories have been changed over a period. For these reasons, some of the variable categories (such as age) are defined such that they become consistent with the next year survey in order to merge them.

After merging the two-transportation surveys, it was then matched with weather data set. Transportation and weather data sets were matched in such a way that each trip observation was assigned the weather conditions of the same day during which the trip took place and from the weather stations, which are nearest to individual *places of arrival*. The average distance to a weather station is about 12 to 13 km, which means that our measurement of weather conditions is local. Since, for recreational trip, aggregate weather measure will be more suitable than hourly weather measure because whole day weather is more relevant for a trip on beach as compared with weather of hour during which the trip is made or during which the person arrived to that destination. Therefore, we took average weather conditions instead of using just hour of arrival weather conditions.

We only know the municipality of arrival (destination) and municipality of departure of every person. Consequently, the central point of a municipality of the arrival is used as a measuring distance to the weather station. Hence, by combining these two data sources, we are able to measure for each trip maker the local and hourly weather conditions of the day during which he took his trip and from the nearest weather station to his place of arrival.

After linking the transportation and weather data, we select all the recreational trips made within Netherlands during summer months (May, June, July, August) of 6 years period starting from year 2000. The final sample consists of about 120 000 recreational trips. The descriptive of the variables are presented in Appendix A. It may be noted that only 977 beach recreational trips are made (out of total trips), while the rest are non-beach recreational trips. This implies that the probability of making a beach trip is 0.0075.

The explanatory variables we use in our analysis can be divided in two main categories. These are weather and non-weather variables. The weather variables consist of temperature, wind strength and precipitation. The influence of temperature conditions is measured by three dummy variables. First, a dummy variable for temperature lower than 16 °C. We select lower than 16 °C as a base because this is the average temperature of the summer months. Second, a dummy variable for temperature between 16 °C to 20 °C . Third, a dummy variable for temperature greater than 20 °C . The wind strength is measured in meter per second. A dummy variable is use to measure the effects of wind speed. A dummy variable is use for wind speed equal to or higher than 2 m/s (or 7.2 km/hour). In order to control for precipitation, a dummy variable is used for the presences of precipitation.

Besides weather variables, we include other variables such as income, gender, age, car ownership and work status of individuals for obvious reasons. We use dummy variables for different days of the week to observe the influence of weather on the beach recreational trips during different days of the week. In addition, dummy variables are used for different months of summer seasons so that we can observe the decision of going to the beach vs no-beach for recreational trips during different months. Finally, we use a distance variable, which shows the mean distance to the beach from the municipality of departure. Since, there may be few possibilities to go to the beach from one municipality, so we took average distance to the beach from every municipality and then use that as a distance to the beach for every person traveling from that municipality to the beach. This means that every person from a same municipality has same distance to the beach no matter which beach he/she select for a recreational trip.

#### **4 Estimation and results**

The dependent variable in our model is a binary variable, which has only two possible outcomes i.e., the dependent variable will be 1 if the recreational trip is made to the beach, it will be 0 otherwise (if trip is to non-beach destination). We employed simple binary logit model. We control for all the weather and non-weather variables. We tried many specifications for weather variables to find the best model. The result of the estimation is presented in Table 1. The results are plausible and almost all the variables are with correct signs. Since, we estimated the logistic regression, so the exponential of the coefficient represents the effects of relevant variable on the odds ratio of the dependent variable.<sup>2</sup> For example, the coefficient of wind variable is -0.30 where as its exponent is 0.74. This shows that the odds ratio in favor of going to the beach decreases by 0.74 times (or 26 %) if average wind speed is higher than 7.2 km/hour as compared with average wind speed lower than 7.2 km/hr.

The coefficient of temperature variable shows that if the temperature is higher than 20 °C then the odds ratio in favor of going to the beach increases by 1.19 times (or 19% ) as compared with temperature lower than 16 °C. This is plausible finding, as one would expect more people going to the beach for recreational trips during higher temperature as compared with lower temperature. If the temperature stays between 16 to 20 °C, the odd increases in favor of going to the beach as compared with the temperature lower than 16 °C but these effects are statistically not significant.

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<sup>2</sup> odds refer to the ratio of the probability of going to the beach to the probability of not going to the beach.

Table 1: Results of logistic regression <sup>a,b</sup>

Variables	Coefficients	Exp(B)
Wind greater than 2m/s (7.2 km/h)	<b>-0.30</b> (0.08)	.74
Temperature between 16 °C to 20 °C	0.07 (0.07)	1.07
Temperature > 20 °C	<i>0.18</i> (0.10)	1.19
Precipitation (Dummy)	<b>-0.24</b> (0.07)	.79
Saturday	<b>0.31</b> (0.12)	1.36
Sunday	<b>0.94</b> (0.11)	2.56
Monday	0.06 (0.13)	1.07
Tuesday	0.04 (0.12)	1.04
Wednesday	<i>-0.22</i> (0.13)	.81
Thursday	<b>-0.38</b> (0.14)	.68
June	<i>-0.04</i> (0.09)	.96
July	<i>-0.14</i> (0.10)	.87
August	<i>-0.17</i> (0.10)	.85
Distance	<b>-0.03</b> (0.002)	.97
Age less than 18 years	0.11 (0.15)	1.12
Age between 30 to 60 years	<i>-0.17</i> (0.10)	.84
Age greater than 60 years	0.15 (0.12)	1.16
Gender (Male)	0.08 (0.17)	1.08
Worker	<i>-0.14</i> (0.08)	.87
Income	<b>0.04</b> (0.02)	1.04
Household Car ownership	<b>0.69</b> (0.11)	1.99
Constant	<b>-4.83</b> (0.24)	.01

<sup>a</sup> The bold coefficient are significant at 5% where as italic are significant at 10 % level of significance.

<sup>b</sup> The reference categories for wind, temperature, precipitation, days of the week, months, age are wind lower than 2 m/s, temperature lower than 16 °C, no precipitation, Friday, May and age between 18 to 60 years, respectively.

The effects of precipitation presences are strong and negative as expected. The odd ratio (or the ratio of the probability of going to the beach to going to the other destination) for going to the beach decreases by 0.79 times ( or 21%) as compared with no precipitation. This is also plausible finding. These findings imply that wind and precipitation has stronger and negative influence on beach recreational trips as compared with temperature, which has positive but yet smaller effects.

The dummy variables for the days of the week show an interesting pattern. The probability of going to the beach is higher on a weekend as compared with other days of the week. Sunday has the highest recreational trips on the beach followed by Saturday. However, on other days of the week its mixed pattern but most of them are statically not significant.

The monthly variable dummy shows that there is less probability of making beach trip in June, July and August as compared with month of May. However, these effects are not significant for the months of June and July but are statistically significant for the month of August. These findings are unexpected. The reason of this may be that in the month of June, July and August, mostly people go for vacations to the south of Europe for beach instead of staying in the Netherlands. So these effects may be because only those people are in the sample whom stayed at home and who normally not go to (or like) beach for recreational trips.

Individual characteristics show that the probability of a recreational trip to the beach is higher for people older than 60 years and people between 18 to 30 as compared with other age groups. However, not all these age effects are statistically significant. The worker variable, which shows if a person is working, shows that the ratio of probability of going to the beach to the probability of not going to the beach decreases by 13 % as compared with non-worker. This is also plausible finding, as one would expect a worker having less flexibility to making a trip to the beach normally. The effect of gender variables is not significant statistically. This implies that male and female has equal probabilities of going to the beach. Income and household car ownership effects are positive and statistically significant. These findings are also plausible.

## **5 Conclusion and future work**

In this paper, the main focus is to investigate the influence of weather on the destination choice of the recreational trips. The choice decision of individual has been investigated for going to the beach for the recreational trip vs going to the other places for a recreational trip while controlling for the weather and individual characteristics.

The data use in the analysis are consist of the travel survey of dutch travelers for a period of six years starting from 2000. The weather data is also obtained on hourly basis and at a very local level. These two independent data sets are linked in such a way that each traveler is assigned the weather data from a weather station nearest to his place of arrival.

A binary logit model is used while controlling for weather and non weather variables. The results indicate that strong wind and presences of precipitation strongly discourage going to the beach. Whereas, during warmer days more people are going to the beach. The next step is to develop this basic analysis and to specify a nested model structure. The aim will be to address destination choice and mode choice decision simletiously. Another

extension will be to investigate the value (or importance) of weather for weather forecasting for destination choice of recreational trips by including the weather information of the previous and future days.

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### **Appendix A**

<b>Variables</b>	<b>Mean</b>	<b>S. D</b>
Wind strength (< 7Km/hr)	0.19	0.39
Wind strength (≥ 7km/hr)	0.81	0.39
Temperature <16 C	0.50	0.50
Temperature 16 to 20 C	0.37	0.48
Temperature 20 to 23C	0.10	0.30
Temperature >23 C	0.03	0.17
Precipitation (Dummy)	0.56	0.49
Saturday	0.14	0.35
Sunday	0.10	0.30

Monday	0.14	0.34
Tuesday	0.16	0.36
Wednesday	0.15	0.36
Thursday	0.15	0.36
Friday	0.15	0.36
May	0.26	0.44
June	0.26	0.44
July	0.23	0.42
August	0.24	0.43
Distance mean (km)	41.15	51.85
Age < 18 years	0.18	0.39
Age between 18 to 30 years	0.14	0.35
Age between 30 to 60 years	0.50	0.50
Age greater than 60 years	0.17	0.40
Male	0.48	0.50
Worker	0.46	0.50
Income	8.99	3.41
Household car ownership	0.86	0.35
Total observations	<b>129463</b>	

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