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VALUING THE ENVIRONMENT

AN ANALYSIS OF THE ENVIRONMENTAL COSTS OF RAISING THE SPEED LIMIT ON DUTCH MOTORWAYS

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Abstract – This research aims to explore the local environmental costs of an increase in the speed limit on Dutch motorways by means of the Contingent Valuation method. Sixty-five households from the villages of Breukelen and Loenen aan de Vecht participated in this study. Results show that mean household distance to the motorway, presence of chronic respiratory diseases, and traffic noise annoyance are the most salient determinants of WTP and WTA for air pollution. Additionally, this research shows that household valuations of air quality –WTP = € 66.91 per year– exceed valuations for traffic noise reduction –WTP = € 29.82 per year–.

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1. Introduction

As a consequence of high levels of air, water, and soil pollution problems in the second half of the twentieth century, many Western governments have increasingly scrutinised the effects that policy has on the environment (Mazmanian and Kraft, 2009, p. 3). Environmental cost-benefit analysis (ECBA) is often adopted as a tool to investigate whether the adverse environmental effects of policy measures weigh up against the expected benefits. However, the main difficulty with ECBA lies in the fact that the environment, due to its non-rivalrous and non-excludable nature, is considered to be a pure public good (Perman et al., 2003, p. 127). As a result, no readily available valuation exists for many environmental products, such as clean air and the world’s wildlife stock.

In practice, several methods are used in order to value the environment in monetary units. These methods can be distinguished into two categories, namely revealed preference and stated preference methods (Atkinson and Mourato, 2008, pp. 319-324). Revealed preference methods apply empirical data from associated markets in order to estimate the value of a public good. Stated preference methods, on the other hand, are questionnaire-based methods in which respondents are asked to value a public good through a hypothetical market. One of the most widely used methods within this category is the Contingent Valuation (CV) method. As part of the CV method, respondents are asked to indicate their willingness-to-pay (WTP) to avoid an adverse effect from occurring, or alternatively, their willingness-to-accept (WTA) a certain amount of money as compensation for an adverse effect (Perman et al., 2003, p. 421).

Applying the Contingent Valuation method

The purpose of this paper is to further explore the CV method by applying it to a case study in the Netherlands. More specifically, this paper looks into the incumbent Dutch cabinet’s desire to increase the speed limit on Dutch motorways to 130 kph (NOS, 2010). Currently, the speed limit on Dutch motorways is 120 kph. However, over the course of the past decades, this speed limit was reduced to 100 kph and 80 kph on several motorway sections, in order to decrease particulate matter concentrations and traffic noise production. For this reason, the speed limit on the A2 motorway section between the cities of Utrecht and Amsterdam was also decreased to 100 kph. This measure was mainly introduced in order to avoid more pollution as a result of widening this motorway section from eight to ten lanes in 2010 (Rijskwaterstaat, 2009, pp. 10-11).

If the Dutch government were to decide to increase the speed limit on this A2 motorway section, inhabitants of the cities and villages adjacent to the motorway will face more air pollution. This pollution can be distinguished into four main categories. For one, an increase in the speed limit will result in more carbon dioxide emissions from traffic. Secondly, individuals living along the A2 motorway will face a significant increase in nitrogen oxide emissions. Moreover, particulate matter concentrations will also rise slightly as a result of an increase in the speed limit. Lastly, residents will face more noise originating from the A2 motorway (Goudappel Coffeng, 2010).

This research is aimed at valuing the adverse environmental effects from an increase in the speed limit on the A2 motorway. As the focus of this study is on negative local environmental effects, carbon dioxide and nitrogen oxide emissions have been omitted from this study. Carbon dioxide has been omitted as this substance accumulates in the atmosphere. The environmental effects of an increase in carbon dioxide emissions will therefore have global rather than local consequences. Various studies, on the other hand, indicate that nitrogen oxides do not have adverse health effects (Jongeneel et. al., 2008, p. 9). Nitrogen oxide emissions are only used in practice as a proxy for measuring air pollution. For this reason, nitrogen oxide emissions have also been omitted from this study.

In order to quantify the additional air pollution from raising the speed limit on Dutch motorways in the form of increased particulate matter concentrations and traffic noise production, a small case study is adopted. In fact, this study aims to reveal the preferences of households that are located nearby the A2 motorway section between the cities of Utrecht and Amsterdam using the CV method. As this study focuses on households from the villages of Breukelen and Loenen a/d Vecht, I propose the following research question:

> *How do inhabitants of Breukelen and Loenen a/d Vecht value the environmental effects of an increase in the speed limit of 30 kph on the A2 motorway?*

As the CV method plays an important role in answering this research question, the following section will further elaborate on its theoretical and empirical background. In light of this background, four hypotheses will be presented in support of the research question. Subsequently, the methodological aspects of this study will be presented as well as a brief description of the accumulated data. Finally, the main findings from this research will be discussed in the results section.

2. Literature review

As mentioned before, the Contingent Valuation method applies the concepts of willingness-to-pay and willingness-to-accept in order to determine the valuation of a non-market good. WTP refers to respondents' willingness to pay a certain amount of money in order to prevent an adverse effect from occurring. WTA, on the other hand, refers to respondents' willingness to accept a certain amount of money as compensation for the occurrence of an adverse effect. Both WTP and WTA can be derived from Hicksian demand functions. Hicksian and the conventional Marshallian demand functions show the relationship between the quantity demanded and the price of that good. However, the main difference between these demand function is that the former assumes utility levels and other product prices to remain constant. Thus, the income effect from a price change is filtered out by Hicksian demand functions leaving only the substitution effect (Perman et. al., 2003, p. 405).

The concepts of WTP and WTA are based on two Hicksian welfare measures, namely the compensating variation and the equivalent variation. The compensating variation represents the change in income that is necessary to keep utility constant after a price change. A positive income difference represents a household's WTP, whereas a negative income difference corresponds to a household's WTA. Alternatively, the equivalent variation represents the additional income that a household requires in the initial situation to attain the same utility level as after the price change. If this amount of additional income is positive, it represents a household's WTA. A negative amount, on the other hand, corresponds to a household's WTP (Ahlheim and Buchholz, n.d., p. 3). Willingness-to-pay and willingness-to-accept measurements, thus, allow one to quantify the compensating variation and equivalent variation. These Hicksian welfare measures theoretically correspond to the more commonly used Marshallian welfare measure of consumer surplus. In fact, Marshallian consumer surplus is situated in between the values of the compensating variation and equivalent variation (Perman et. al., 2003, p. 407).

The WTP/WTA disparity

Both willingness-to-pay as well as willingness-to-accept can be used in order to estimate the value of changes in environmental quality. However, research indicates that these measurement tools do not produce similar valuations for an identical change in environmental quality (Ahlheim and Buchholz, n.d., p. 3). In fact, several studies have provided theoretical and empirical evidence in support of the claim that valuations that are based on willingness-to-accept measurements tend to be larger than those based on willingness-to-pay measurements (Venkatachalam, 2004, p. 92). Additional research has provided several explanations for the disparity between willingness-to-pay and willingness-to-accept measurements. Among other factors, this disparity has been attributed to the income effect (Willig, 1976). The income effect is thought to constrain individuals' willingness-to-pay, but not individuals' willingness-to-accept. As a consequence, willingness-to-pay valuations for public goods tend to be smaller than willingness-to accept valuations.

Additionally, different studies have attributed the WTP/WTA divergence to learning effects, endowment effects, respondents' imprecise preferences, and good substitutability. Research conducted by Morrison (1998, p. 193) indicates that the divergence persists and remains significant when controlling for substitutability, learning effects, and imprecise preferences. Based on these results, Morrison concludes that the endowment effect, which refers to an individual's tendency to demand more money to give up a good compared to the amount that he would offer to acquire it, is most likely the cause of the WTP/WTA disparity (Kahneman et. al., 1991, p. 194).

Although the endowment effect appears to be a plausible cause for the WTP/WTA disparity, other research provides convincing evidence in support of the substitutability argument. Hanemann (1991, p. 635) argues that the disparity between willingness-to-pay and willingness-to-accept measurements are due to substitution effects in addition to the income effect. In fact, Hanemann's analysis shows that when controlling for the income effect, the WTP/WTA disparity is inversely related to the number of available substitutes for a product. As a result, public goods with imperfect substitutes consistently exhibit large WTP/WTA divergences.

Shogren et. al. (1994) have tested the robustness of the substitutability argument in an experimental setting, whereby respondents' willingness-to-pay and willingness-to-accept were measured for a market and non-market good. Results from this experiment show that the discrepancy between WTP and WTA measurements for a market good, i.e. candy bars, are not significant. On the other hand, non-market goods with imperfect substitutes, such as reduced health risk, show large discrepancies between willingness-to-pay and willingness-to-accept measurements (Shogren et. al., 1994, p. 266).

Research conducted by Horowitz and McConnell (2002) also indicates that the WTP/WTA discrepancy is related to the substitutability of the good in question. As part of their research, Horowitz and McConnell compared the results from 45 Contingent Valuation studies that have been conducted over the course of three decades. Based on the empirical data from these 45 studies, Horowitz and McConnell come to the conclusion that CV studies involving forms of money exhibit the smallest WTP/WTA divergence followed by ordinary market goods. Experiments involving non-market goods exhibit the largest WTP/WTA divergence.

The CV method in practice

Although the Contingent Valuation method has been criticised because of the significant divergence between willingness-to-pay and willingness-to-accept measurements, it has been widely applied in the past to value changes in environmental quality. Lee and Han (2002), for example, have applied the CV method in order to estimate the value of Korean national parks. This study showed that Koreans were willing to pay more admission fees if the government were to cut the budget of Korean national parks in order to prevent the degradation of these parks. Moreover, the collected data suggests that the valuation of national parks varied depending on their location and attractiveness. That is, national parks that were attractive to visitors and located nearby urban areas were valued at a higher amount than those that were considered unattractive and located further away.

Tyrväinen and Väänänen (1998) have conducted similar research in Finland. Using the CV method, these researchers investigated the valuation of urban forests in Finland. The results of this study show that respondents are willing to pay a certain amount of money in order to preserve an urban forest. By the same token, other studies have used Contingent Valuation to attach a value to the environment. Interestingly, however, many of these studies have mainly focused on the valuation of environmental spaces that have amenity value, such as national parks and urban forests.

Additionally, the CV method has also been applied in order to investigate air pollution originating from traffic. Duarte (2008), for example, investigated the effect that an extension of the airport in Barcelona –Spain– would have on the noise level faced by the residents of adjacent neighbourhoods. The results of this study show that respondents' willingness-to-pay is positively correlated with an individual's noise annoyance, income level, and household distance to a social activist group that opposes the expansion of the airport.

Other researchers have specifically looked into the negative externalities of road traffic. Lambert et. al. (n.d.) adopted the CV method in order to investigate how individuals that live nearby a motorway value a noise free environment. Households from the Rhône-Alpes region in France were asked to participate by indicating their willingness-to-pay for a noise free environment. Even though a significant proportion of respondents, i.e. 83%, supported a governmental programme that would eliminate traffic noise, only 38% indicated that they have a positive willingness-to-pay. Soguel (1996) has conducted similar research in Neuchâtel –Switzerland– by analysing how much respondents were willing to pay for a traffic noise reduction of 50%. This study suggests that the main factors that influence WTP are income level, the presence of children in a household, gender, and noise sensitivity.

Contrary to these studies, Wardman and Bristow (2004) and Strazzera et. al. (2003) have not singled out traffic noise in their analysis. In fact, these researchers have studied both noise as well as air pollution originating from road traffic. More specifically, Strazzera et. al. (2003) have investigated how much the inhabitants of three villages in North East England value a traffic-calming scheme. Using telephone surveys, respondents were asked to indicate their willingness-to-pay for the enforcement of a traffic-calming scheme that would effectively decrease traffic noise and pollution. The results of this study show that younger people and drivers tend to value this programme more. Moreover, households with children that are driven to school also indicate a higher WTP. These factors have also been identified as the main influencers of household WTP by Wardman and Bristow (2004), who have conducted similar research in Edinburgh –Scotland–.

These and other studies suggest that the CV method can be applied in order to reliably estimate the value of a non-market good (Hanemann, 1994; Schkade and Payne, 1994; Cameron and James, 1987). By carefully designing the administered survey, researchers can decrease the number of biased and protest responses obtained. Several researchers have argued that the reliability of the CV method can be improved by adopting a double-bounded dichotomous choice setting. This entails that respondents are posed a hypothetical scenario after which they are asked to indicate whether they would pay a specified amount of money to prevent the proposed scenario from occurring. If the respondent accepts (rejects) this number he will be asked whether he is willing to pay a higher (lower) amount. Hanemann et. al. (1991) have provided evidence in support of the notion that usage of the double-bounded dichotomous choice model yields a smaller valuation interval and therefore a more accurate estimation of the value of a public good. Moreover, they argue that this model allows researchers to better control for starting-point biases, as respondents are only posed one follow up bid in the double-bounded dichotomous choice setting. Furthermore, this bias can also be controlled for by randomly determining which bids are posed to respondents.

<u>Research hypotheses</u>

Based on the above findings from previous research, several expectations relating to the research question can be formulated. For one, an increase in the speed limit on the A2 motorway will result in more air pollution, causing the inhabitants of Breukelen and Loenen a/d Vecht to face higher particulate matter concentrations and more traffic noise. It only seems logical to expect individuals to prefer to live in a noise free environment with clean air. Therefore, it can be expected that inhabitants of Breukelen and Loenen a/d Vecht will value the effects of raising the speed limit negatively.

> *H1: Inhabitants of Breukelen and Loenen a/d Vecht value the environmental effects of an increase in the speed limit negatively.*

Moreover, higher particulate matter concentrations and noise levels tend to have local effects on the environment. Due to this, individuals living nearby the source of these types of pollution will face more pollution than do those situated further away. As a result, it can be expected that households that are situated near the motorway will value the effects of a higher speed limit more negatively.

H2: Households that are situated nearby the motorway will value the environmental effects of an increase in the speed limit more than households located further away from the motorway.

As mentioned above, several studies suggest that income is an important determinant of household willingness-to-pay and willingness-to-accept. If we assume that individuals are rational and have downward sloping parabolic indifference curves, individuals with higher disposable income will value any amount of money relatively less than those with lower disposable income. Therefore, households with high disposable income will be willing to pay more money to prevent an adverse environmental effect from occurring or accept more money for compensation.

H3: Households with higher disposable incomes will value the environmental effects of an increase in the speed limit more than households with lower disposable incomes.

Lastly, a large divergence exists between willingness-to-pay and willingness-to-accept valuations of public goods. As individuals tend to overestimate a burden when they are offered compensation, it is likely that respondents will overstate the environmental consequences of an increased speed limit when asked for their willingness to accept. Conversely, individuals are also likely to understate their burden when asked for their willingness to pay. However, I expect this latter effect to be much smaller than the former.

H4: Willingness to pay is a better measure of environmental valuation than willingness to accept.

3. Method

In order to value the environmental consequences of an increase in the speed limit on the A2 motorway, a sample of households from the villages of Breukelen and Loenen a/d Vecht was invited to participate in this study. These households were selected based on their location, i.e. situated in one of the two villages being studied. Potential respondents were approached applying the door-to-door technique. Each household was given a card with a link to the website on which they could fill out the survey. In total, 265 cards were distributed to households in the villages of Breukelen and Loenen a/d Vecht. Of this group, 73 households visited the website and 65 households completed the online survey.

The administered survey contained questions relating to respondents' willingness-to-pay and willingness-to-accept for the environmental consequences of an increase in the speed limit of 30 kph on the A2 motorway. In order to prevent confusion and biased responses, each household was referred to either the willingness-to-pay or the willingness-to-accept survey. Both surveys described the situation in which the speed limit on the A2 motorway is increased to 130 kph. In the willingness-to-pay survey, respondents were told that an increase in the speed limit would cause a deterioration of air quality, which is consistent with a decrease in average life expectancy of several days to a week for individuals living nearby the motorway (NSL, 2009, p. 44). Respondents were subsequently told that the government could capture and store the additional emissions of particulate matter in order to keep life expectancy stable. However, this would require an investment from the government. Respondents were asked to indicate whether they would be willing to pay a randomly generated amount between 5 and 20 euros per month to capture and store the additional particulate matter emissions. Respondents were first posed a bid between 5 and 20 euros, as previous research has indicated that a similar deterioration in air quality is valued at approximately 15 euros per month (Levinson, 2009, p. 16). Applying the double-bounded dichotomous choice setting, respondents were posed twice the amount of the first bid if they were willing to pay the first amount and half the amount of the first bid if they declined the first amount. Finally, respondents were allowed to indicate the maximum amount that they would be willing to pay in order to avoid a deterioration of their life expectancy.

By the same token, respondents were asked to indicate the amount of money that they would accept as compensation for a lower life expectancy in the willingness-to-accept survey. As in the willingness-to-pay survey, respondents were first posed a randomly assigned bid between 5 and 20 euros per month. Respondents that accepted the first bid were subsequently posed a second bid that amounted to half the first bid. Those that rejected the first bid were asked whether they would accept double the amount as compensation. Lastly, respondents were also required to indicate the minimum amount of money that they would accept as compensation for a lower life expectancy.

Moreover, both surveys also included questions relating to respondents' WTP or WTA for an increase traffic noise production as a consequence of a higher speed limit. Respondents were informed that an increase in the speed limit would result in more traffic noise, which might lead to them facing more stress, insomnia, and cardiovascular diseases (Jongeneel et. al., 2008, pp. 17-18). In the willingness-to-pay survey, respondents were told that the government could heighten the noise barriers along the A2 motorway. However, this would require additional tax revenues. Applying the double-bounded dichotomous choice model, respondents were asked to indicate their willingness-to-pay. The first bid also consisted of a randomly generated number between 5 and 20 euros per month, as previous research has indicated that a similar increase in traffic noise levels is valued between 7 and 18 euros per month (Duarte, 2008, p. 3). By the same token, the willingness-to-accept survey asked respondents to indicate their willingness to accept a certain amount of money as compensation for the additional traffic noise.

Furthermore, the administered surveys contained descriptive questions relating to a household's location, disposable income, size, composition, and educational level. As respondents were allowed to remain anonymous, questions relating to household location and disposable income remained optional. In order to determine which factors play a role in a household's valuation of the environmental consequences of an increased speed limit, additional questions were included in the survey. These questions mainly addressed current traffic noise and annoyance levels, the presence of respiratory diseases, and environmental apprehension. All data were collected by means of online surveys over the course of three weeks.

4. Data

The administered surveys were filled out by 65 households, whilst 265 were invited to do so. This amounts to a response rate of approximately 25 percent. Of the 65 households that participated in this study, 33 households filled out the willingness-to-pay survey, whereas 32 households filled out the willingness-to-accept survey. This division suggests that all households were correctly referred to either one of the two surveys in a random fashion. In total, eight respondents did not fill out one or both of the non-obligatory questions relating to household location and monthly disposable income.

Of the 59 respondents that filled out their location, 47 indicated that they are from the village of Breukelen and 12 respondents stated that they live in the village of Loenen. The respondents from the village of Breukelen were situated 800 metres (SD = 273.218) from the A2 motorway on average. The distance between respondent households and the A2 motorway vary as much as 370 metres to 2260 metres. As the village of Loenen is located further away from the A2 motorway, the average distance to the motorway is larger, namely 2036 metres (SD = 106.041). However, household distances to the A2 motorway vary less for the village of Loenen a/d Vecht, as respondent households are located between 1880 and 2200 metres from the A2 motorway.

Monthly disposable household income was measured using five categories, varying from less than 1000 euros per month to more than 4000 euros per month. In total, 60 respondents indicated what their household's monthly disposable income level is. Of these 60 households, most fall in the category 2000 to 3000 euros per month and over 4000 euros per month, namely 17 and 21 households respectively. Results also show that respondents from Breukelen have an average monthly disposable income of approximately 2000 to 3000 euros per month. Respondents from Loenen indicate that they have a higher disposable income on average, namely 3000 to 4000 euros. Nonetheless, for both villages the mode lies in the highest category, i.e. more than 4000 euros disposable income per month. The collected data also shows that a large majority of the households that participated, i.e. 55 households, own their house, whilst a small minority of 10 households reside in a rental house.

As described in Table 1, additional descriptive data were collected relating to household size, composition, and educational level. Household sizes vary from one to five individuals per household. The collected data show that most households consist of four individuals, as this is the overall mode. This corresponds with the mode number of children per household, which amounts to two. Results also show that households with younger children, i.e. in the age categories zero to four years old and five to nine years old, tend to have fewer children than those with older children. Moreover, the highest educational level present within the households that participated in this research also varies greatly. Most respondents indicate that at least one person in the household has attended either a university of applied sciences (HBO) or university, i.e. 27 and 20 respondents respectively.

Table 1 – Descriptive statistics categorical variables

	description	N	minimum	maximum	mode	frequency mode
income	total household monthly disposable income level	60	< € 1000	> € 4000	> € 4000	21
education	highest level of education present in the household	65	secondary school	university	university of applied sciences	27
household size	number of individuals that are part of the household	65	1	5	4	22
children	total number of children that are part of the household	65	0	3	2	23
children4	number of children aged 0-4 years old	65	0	3	0	49
children9	number of children aged 5-9 years old	65	0	2	0	46
children14	number of children aged 10-14 years old	65	0	3	0	49
children15	number of children aged 15+ years old	65	0	3	0	50
charity	number of times household donated money to nature foundations last year	65	never	> 10 times	1-5 times	29
waste separation	types of waste separated on a regular basis	65	2	6	6	31
speed limit	dummy variable for household support or opposition against raising the speed limit	65	oppose	support	support	43
annoyance	level of annoyance from traffic noise	37	not annoying	annoying	somewhat annoying	15
respiratory disease	dummy variable for presence of respiratory diseases in household	65	no	yes	no	47
house	dummy variable for house ownership	65	rental	bought	bought	55

Furthermore, respondents were also asked for their opinion relating to an increase in the speed limit and the environmental consequences of this policy. Interestingly, a majority indicated to be in favour of an increase in the speed limit. More specifically, 43 households stated that they are in favour of an increase in the speed limit, whereas only 22 households oppose the implementation of this policy. For the purpose of investigating which factors influence respondents' willingness-to-pay and willingness-to-accept, data was also collected relating to whether a person within the household suffered from a respiratory disease and whether households were faced with traffic noise from the A2 motorway. A majority of 37 respondents answered that they could hear traffic noise from the A2 motorway from within their homes. Most of these 37 households also stated that they were somewhat to reasonably annoyed by this traffic noise. Moreover, only 18 households indicated that at least one person within their household suffered from a chronic respiratory disease.

Finally, respondents were asked for four Contingent Valuation measurements, namely WTP for air pollution, WTP for traffic noise, WTA for air pollution, and WTA for traffic noise. Including protest responses and zero valuations, average willingness-to-pay for air pollution is 5.576 euros per month (SD = 10.000). For the additional traffic noise, average WTP amounts to 2.485 euros per month (SD = 4.317). Conversely, average WTA for the additional air pollution stands at 254.844 euros per month (SD = 404.604). Lastly, mean WTA for the additional traffic noise is somewhat lower, namely 250.688 euros per month (SD = 406.825). This data is summarised in Table 2, which also shows the number of respondents per measurement.

Table 2 – Descriptive statistics willingness-to-pay and willingness-to-accept measurements

	WTP				**WTA**			
	N	Protest or zero	mean	std. dev.	N	Protest or maximum	mean	std. dev.
Air quality	33	12 (19%)	5.576	10.000	32	7 (11%)	254.844	404.604
Traffic noise	33	19 (29%)	2.485	4.317	32	7 (11%)	250.688	406.825

5. Results

As mentioned above, the main aim of this research is to investigate how the inhabitants of the villages of Breukelen and Loenen a/d Vecht value the environmental effects of an increase in the speed limit on the A2 motorway. By investigating the sign of these valuations, a foundation can be established for further analysis. In other words, a good starting point for this analysis is to determine whether the respondents and population value the aforementioned environmental effects negatively.

In case of normally distributed data, a z-distribution can be adopted in order to estimate a 95% confidence interval. A confidence interval shows the range within which the population mean is likely to be located. However, usage of a z-distribution in order to estimate a 95% confidence interval requires normally distributed data. Due to a limited number of observations, both the willingness-to-pay as well as the willingness-to-accept measurements for a deterioration of air quality exhibit non-normal distributions. In fact, the Shapiro-Wilk normality test shows that the distribution of willingness-to-pay for air quality is not normally distributed, i.e. $W(33) = 0.572$, $p < 0.001$. This might be due to several observations which are likely to reflect protest responses. In fact, a number of respondents ($n = 3$) indicated that they oppose an increase in the speed limit, whilst they were not willing to pay any amount to prevent deterioration in air quality. Unfortunately, these protest responses cannot be eliminated from the dataset, as they cannot be easily distinguished from true zero valuations. In order to account for the small sample size and non-normal distribution, a 95% confidence interval can be constructed by adopting a t-distribution, which yields an interval of [2.030 ; 9.122]. This confidence interval indicates that the mean WTP for air quality is likely to be positive and lie in between the upper and lower boundary with 95% certainty.

Additionally, the distribution of willingness-to-accept observations for air quality also exhibits a non-normal distribution, i.e. the Shapiro-Wilk null hypothesis of normality is rejected ($W(32) = 0.604$, $p < 0.001$). Protest responses are also likely to skew the distribution of WTA for air quality, as several respondents ($n = 7$) indicate that they would like to receive the maximum amount of compensation of 1000 euros per month. As demonstrated above, non-normally distributed data require the adoption of a t-distribution in order to determine the confidence interval. A 95% confidence interval of [108.969 ; 400.719] shows that respondents are likely to have a positive willingness-to-accept for a deterioration in air quality. In other words, willingness-to-pay and willingness-to-accept measurements indicate that respondents value the deterioration in air quality negatively, as mean willingness-to-pay and willingness-to-accept are positive.

In line with these findings, willingness-to-pay and willingness-to-accept for an increase in traffic noise production is also positive, i.e. respondents value an increase in traffic noise production negatively. A t-distribution is used for both WTP and WTA for traffic noise production, as the Kolmogorov-

Smirnov and Shapiro-Wilk normality tests shows that the distribution of WTP ($W(33) = 0.644$, $p < 0.001$) and WTA ($W(32) = 0.597$, $p < 0.001$) observations for traffic noise are non-normally distributed. Therefore, based on a t-distribution, a 95% confidence interval shows that the mean value for willingness-to-pay lies within the range [0.954 ; 4.015] and the mean value for willingness-to-accept between the boundaries [104.011 ; 397.364].

The aforementioned 95% confidence intervals for WTP and WTA for air quality and traffic noise reduction have a positive lower and upper boundary. Thus, mean WTP and WTA values for air pollution are very likely to be positive. This translates to a negative valuation of the additional particulate matter emissions and traffic noise production, as respondents would only be willing to pay or accept money in case they would suffer from the additional air pollution. In other words, the first hypothesis is supported by the data and therefore not rejected.

Influence of distance on WTP and WTA

As individuals living alongside the A2 motorway will face more air pollution in the form of additional traffic noise and particulate matter emissions, it is reasonable to expect that distance will have an effect on a household willingness-to-pay and willingness-to-accept. The effect that distance might have on willingness-to-pay and willingness-to-accept can be investigated by means of the Kendall tau rank correlation coefficient, as this measure of correlation does not require large sample sizes or normally distributed data. Moreover, due to a high proportion of protest responses and/or zero valuations, WTP and WTA distributions for air quality and traffic noise are skewed. For this reason, usage of a straightforward scatter plot might yield the wrong conclusions. In fact, when measuring the correlation between willingness-to-pay for air quality and distance to the A2 motorway, a very weak positive relationship can be observed ($\tau = 0.103$, $n = 30$). This implies that households that are located further away from the A2 motorway, and therefore face less air pollution, value the environmental consequences of an increase in the speed limit more. This result is counterintuitive and suggests that protest responses have strongly biased the correlation measure. In the absence of protest responses and zero valuations, a weak negative correlation exists between WTP for air quality and distance to the A2 motorway ($\tau = -0.075$, $n = 20$).

By the same token, a weak negative correlation exists between willingness-to-pay for traffic noise reduction and distance to the A2 motorway ($\tau = -0.100$, $n = 30$). This negative relationship is strengthened in the absence of protest responses and zero valuations ($\tau = -0.477$, $n = 14$). This result indicates that households that are located nearby the highway are more likely to protest to an increase in the speed limit by indicating a zero valuation for the environmental consequences of an increase in the speed limit. Conversely, this tendency cannot be observed for the correlation between distance to the A2 motorway and willingness-to-accept for the environmental effect of an increase in the speed limit. The Kendall tau correlation coefficient for the relationship between distance and WTA for air quality increases from -0.101 (n = 29) to -0.005 (n = 22) when filtering out protest responses. This can also be observed for the relationship between distance and WTA for traffic noise reduction ($\tau = -0.059$, n = 29 ; $\tau = 0.071$, n = 22).

These correlations show that distance is likely to have an effect on a household's valuation of the environment in case of willingness-to-pay measurements. However, distance does not appear to play a significant role in affecting household willingness-to-accept valuations. Moreover, a stronger negative correlation can be observed for traffic noise reduction valuations. This is most likely due to the fact that distance to the motorway greatly influences how much traffic noise a household faces, whereas particulate matter emissions tend to also reach households located further away from the motorway. Ergo, the second hypothesis is not rejected for willingness-to-pay measurements of air pollution, i.e. distance affects household willingness-to-pay for air quality and traffic noise.

Influence of monthly disposable income on WTP and WTA

As monthly disposable income can constrain a household's willingness-to-pay for the environmental consequences of an increase in the speed limit, the influence of this factor has to be further scrutinised. Given that monthly disposable income was measured on an ordinal level, whilst the Contingent Valuation measurements are denoted on a ratio level, the best suitable method to investigate the relationship between these two variables is analysis of variance (ANOVA). However, the collected data relating to monthly disposable income and environmental valuations is not normally distributed for three income groups, namely 1000 to 2000 euros per month ($W(6) = 0.705$, $p = 0.007$), 2000 to 3000 euros per month ($W(6) = 0.741$, $p = 0.016$), and more than 4000 euros per month ($W(11) = 0.742$, $p = 0.002$). Additionally, the assumption of homogeneity of variances is also violated ($F(3,24) = 4.345$, $p = 0.014$). Therefore, the best available alternative, i.e. the non-parametric Kruskal-Wallis test, should be adopted instead of an ANOVA test.

Applying the Kruskal-Wallis test to investigate the effect that monthly disposable income has on household willingness-to-pay for air quality results in a test statistic value of 5.343 ($p = 0.254$). Thus, the null hypothesis is not rejected, i.e. monthly disposable income level does not significantly affect willingness-to-pay for air quality. As can be expected, this result is also obtained when analysing the relationship between disposable income and willingness-to-accept for air quality ($H(3) = 1.486$, $p = 0.685$). Ergo, monthly disposable income does not appear to affect household valuations of air quality. This is likely to be the case because mean willingness-to-pay for air quality is relatively low and therefore affordable to all income groups.

In line with these findings, monthly disposable income does not appear to affect household willingness-to-pay and willingness-to-accept for traffic noise reduction. In other words, the null hypothesis of the Kruskal-Wallis test is not rejected in case of WTP for traffic noise reduction ($H(4) = 4.041$, $p = 0.400$) nor in case of WTA for traffic noise reduction ($H(3) = 0.643$, $p = 0.886$). Thus, the third hypothesis is rejected, i.e. households with higher disposable income levels do not value the environmental consequences of raising the speed limit more than households with lower disposable income levels.

Other factors influencing WTP and WTA

It is unlikely that household valuation of the environment is merely determined by proximity to a pollution source, as monthly disposable income does not appear to have a significant effect. For this reason other variables, such as household size and composition, have also been measured and recorded. In order to test whether these factors influence WTP and WTA valuations, a regression model could be adopted, however, parametric regression tests, such as ordinary least squares, are not suitable in this case as several assumptions are not satisfied, e.g. normally distributed data. In order to apply ordinary least squares regression, the data can be transformed, such that the assumptions for regression analysis are satisfied.

By omitting protest responses/zero valuations as well as high outliers from the dataset, an approximately normal distribution is obtained for willingness-to-pay for air quality ($W(18) = 0.899$, $p = 0.055$). This data can be used to run a regression analysis. In fact, regressing the adjusted willingness-to-pay for air quality observations against a dummy variable for chronic respiratory disease, waste separation, donations to nature foundations, and the total number of children in a household shows that none of the independent variables are significant. However, results also show that the dummy variable for chronic respiratory diseases is nearly significant. A simple regression function with only the dummy variable for chronic respiratory diseases ($p = 0.019$) indicates that this independent variable does have a significant effect on household willingness-to-pay for air quality. Moreover, results also show that the presence of chronic respiratory diseases alone explains 25.4 percent of the variance in willingness-to-pay for air quality.

By testing the assumptions for regression analysis, we can establish whether the regression function of willingness-to-pay for air quality against chronic respiratory disease is valid. Firstly, the Durbin-Watson test statistic ($d = 2.520$) shows that the error terms in this model are only slightly negatively correlated. Additionally, a residual plot shows that the error terms have a mean of zero and do not violate the assumptions of linearity and homoscedasticity. Finally, the residuals are roughly normally distributed.

Subsequently, the relationship between the presence of chronic respiratory diseases and household willingness-to-accept for air quality can also be investigated. However, household willingness-to-accept for air quality is highly skewed due to protest responses and outliers. As the exclusion of protest responses does not result in an approximately normal distribution ($W(19) = 0.892$, $p = 0.003$) a Kruskal-Wallis test can be adopted to scrutinise whether household willingness-to-accept for air quality differs in the presence of chronic respiratory diseases in a household. Results show that the null hypothesis of no relationship between the presence of respiratory diseases and household willingness-to-accept is not rejected ($H(1) = 3.566$, $p = 0.059$). Willingness-to-accept for air quality is thus less affected by factors, such as distance, income, and the presence of respiratory diseases compared to household willingness-to-pay for air quality.

As demonstrated above, distance appears to have an effect on household willingness-to-pay for traffic noise reduction. However, it is unlikely that merely this factor influences household valuation of traffic noise reduction. Other factors that might influence the valuation of traffic noise reduction are the level of annoyance related to traffic noise and the number of children present in a household. The most straightforward manner to test whether these independent variables affect household valuation of traffic noise reduction is to apply multiple regression analysis. However, this requires normally distributed data and as mentioned before, both willingness-to-pay and willingness-to-accept for traffic noise reduction are not distributed normally. By excluding protest responses/zero valuations and one outlier from the willingness-to-pay for traffic noise dataset, a significantly normal distribution is obtained ($W(13) = 0.941$, $p = 0.464$).

Regressing WTP for traffic noise against the independent variables waste separation, donations to nature foundations, number of children in the household, and annoyance relating to traffic noise shows that only annoyance is a significant factor ($p = 0.031$). In fact, using a simple regression function with only one independent variable, i.e. annoyance, shows that this factor accounts for 75.5 percent of the variance in the dependent variable. The Durbin-Watson test statistic ($d = 2.275$) indicates that the error terms are nearly uncorrelated. Finally, the residual plot shows that the error terms have an approximate mean of zero and do not violate the assumptions of linearity, normality, and homoscedasticity.

Lastly, the distribution of willingness-to-accept observations cannot be adjusted such that normality is approached. That is, even in the absence of protest responses, the Shapiro-Wilk test statistic still indicates a non-normal distribution of observations ($W(25) = 0.667$, $p < 0.001$). Applying the non-parametric Kruskal-Wallis test shows that household willingness-to-accept for traffic noise reduction differs among different annoyance groups (H(3) = 9.202 , p = 0.027). More specifically, the Jonckheere-Terpstra test indicates that the median is ascending in higher annoyance groups (J(20) = 89.500 , p = 0.020). In other words, households that experience more annoyance tend to have a higher willingness-to-accept. This finding is consistent with expectations and indicates that the level of annoyance from traffic noise plays an important role in determining willingness-to-pay and willingness-to-accept measurements for traffic noise reduction. Table 3 summarises which independent variables influence willingness-to-pay and willingness-to-accept valuations of air quality and traffic noise reduction.

Table 3 – Determinants of WTP and WTA valuations

	WTP				**WTA**			
	air quality		traffic noise		air quality		traffic noise	
	sig.	sign	sig.	sign	sig.	sign	sig.	sign
distance	yes	–	yes	–	no		no	
respiratory disease	yes	+			no			
annoyance			yes	+			yes	+

<u>The influence of opinion on protest responses</u>

As discussed before, the collected data is likely to be skewed as a result of several protest responses. Table 2 shows that protest responses might range from 11 to 29 percent of observations. However, it is difficult to say whether protest responses are as high as 29 percent, as several observations might also be zero valuations in case of willingness-to-pay measurements. Another difficulty lies in the fact that supporters of this policy measure might not have revealed their exact valuation of the additional air pollution from raising the speed limit. That is, a group of supporters indicates that they are not willing to pay any amount in order to prevent an increase in air pollution. However, it is unlikely that their actual willingness-to-pay is zero, as this translates to them being indifferent between a situation in which they face more air pollution as opposed to a scenario in which they face less air pollution.

In order to further investigate the influence that support or opposition against raising the speed limit has on WTP and WTA measurements, a Mann-Whitney test is required. This non-parametric test allows one to compare two independent groups, i.e. compare environmental valuations of supporters of the policy measure against those that oppose it. Of the 33 respondent that filled out the WTP survey, 9 oppose an increase in the speed limit and 24 respondents support it. Alternatively, 13 respondents that were posed the WTA survey oppose this policy measure against 19 supporters. Results show that willingness-to-pay valuations of air quality (p = 0.983) and traffic noise (p = 0.605) do not differ among households in favour and against an increase in the speed limit. Conversely, the Mann-Whitney test shows that there is a significant difference in willingness-to-accept valuations between households that support and oppose this policy measure. More specifically, households that oppose an increase in the speed limit have a higher willingness-to-accept compared to households that support it. This comparison is summarised in Table 4.

Table 4 – Mann-Whitney test statistics

		N	protest response	mean rank	sum of ranks	Mann-Whitney U	sig.
WTP for air quality	oppose	9	3	16.94	152.50	107.50	0.983
	support	24	9	17.02	408.50		
WTP for traffic noise	oppose	9	6	15.72	141.50	96.50	0.605
	support	24	13	17.48	419.50		
WTA for air quality	oppose	13	7	24.92	324.00	14.00	0.000
	support	19	0	10.74	204.00		
WTA for traffic noise	oppose	13	7	24.38	317.00	21.00	0.000
	support	19	0	11.11	211.00		

One would expect households that oppose an increase in the speed limit to value the environmental effects of this policy measure more than supporters. This intuition can be identified in willingness-to-accept valuations, as opposing households indicate a higher mean WTA than supporting households. Willingness-to-pay measurements, on the other hand, show no significant difference between the two groups. These results, however, do not contradict the aforementioned claim that protest responses bias the distribution of WTP and WTA measurements. In case of WTP measurements, respondents can protest by indicating a willingness-to-pay amount of zero, which decreases mean willingness-to-pay. As a consequence, the difference between mean WTP of supporting an opposing households decreases. As illustrated by Table 4, this might be the reason why the Mann-Whitney tests for willingness-to-pay measurements indicate that there is no difference between supporting and opposing households. WTA measurements are also biased by protest responses. Of the 13 households that oppose an increase in the speed limit, 7 households protest by indicating a willingness-to-accept of 1000 euros per month, which is the maximum number allowed in the survey. Thus, protest responses bias mean willingness-to-accept of opposing households upwardly, causing the significant difference in WTA valuations between supporting and opposing households.

6. Conclusion

Based on empirical data from a small case study, this research has attempted to apply the Contingent Valuation method to gain insights into how the inhabitants of the Netherlands value the environmental consequences of the proposed increase in the speed limit on Dutch motorways. Although one would expect households that are located nearby a motorway to object to an increase in the speed limit, this study has provided evidence to the contrary. In fact, a significant majority of respondents (66.2%) indicated that they are in favour of an increase in the speed limit on the A2 motorway. Moreover, mean willingness-to-pay valuations for deterioration in air quality and traffic noise levels are substantially below findings from other studies.

In fact, the collected data suggests that mean willingness-to-pay for air quality lies between the values of 2.03 and 9.12 euros per month per households. This is the equivalent of 66.91 euros per household on a yearly basis. Mean willingness-to-accept for air quality stands at a yearly rate of 3,058.13 euros per household. Traffic noise reduction, on the other hand, is valued at a yearly willingness-to-pay of 29.82 per household and willingness-to-accept at 3,008.26 euros per household. These findings are consistent with previous Contingent Valuation studies, which have consistently proven that willingness-to-pay valuations tend to greatly differ from willingness-to-accept valuations for public goods.

Furthermore, results from this study show that distance to the source of pollution, in this case the A2 motorway, is inversely related to willingness-to-pay for air quality and traffic noise reduction. This relationship is much stronger for the latter, as distance has more direct consequences for the level of traffic noise that a household faces. Moreover, willingness-to-pay for air quality is also highly affected by the presence of chronic respiratory diseases within a household. In fact, this factor alone accounts for a significant proportion of the variation in willingness-to-pay for air quality. Lastly, willingness-to-pay and willingness-to-accept for traffic noise reduction are both positively related to the level of annoyance that a household faces from traffic noise.

Willingness-to-pay for air quality and traffic noise reduction can, thus, be explained better by the measured independent variables, whilst willingness-to-accept measurements do not appear to be affected by most independent variables. Moreover, willingness-to-accept measurements tend to be more skewed due to protest responses and overstated compensation values. In fact, the estimated WTP valuation for air quality and traffic noise reduction is more consistent with the finding that a large majority of respondents is in favour of an increase in the speed limit and does not face annoyance from traffic noise. As a result, I recommend usage of willingness-to-pay measurements on a larger scale in order to accurately estimate the environmental costs of an increase in the speed limit on Dutch motorways.

7. Discussion

Although this research has produced several interesting findings, it is important to underline the drawbacks of this case study. For one, this case study was conducted using a small sample (n = 65) which was not based on probability sampling. As a result, it may be the case that this research lacks external validity, i.e. research findings may not be applicable on a provincial or national level. Moreover, several observations reflect protest responses, which have caused the collected valuation measurements to be skewed. Due to this, more reliable parametric tests could not be applied in all instances to investigate the relationship between independent variables and environmental valuations.

Nonetheless, this case study has provided stable ground for more extensive research into the environmental consequences of an increase in the speed limit on Dutch motorways. Based on the findings from this report, future research could further scrutinise the magnitude of the effect that traffic noise annoyance, chronic respiratory diseases, distance, and other independent variables have on environmental valuations. More interestingly, the relationship between support for or opposition against an increase in the speed limit and environmental valuations could be investigated, as this research indicates that significant support exists for an increase in the speed limit. Such a study, however, faces additional challenges, as protest responses could highly bias results.

Finally, this study has emphasised the need for more research into how protest responses can be circumvented. Indeed, Contingent Valuation methods allow for straightforward measurements of public good valuations. However, as these methods are also very dependent on respondents' co-operation and interpretation, researchers should invest in producing a more robust version of the CV method.

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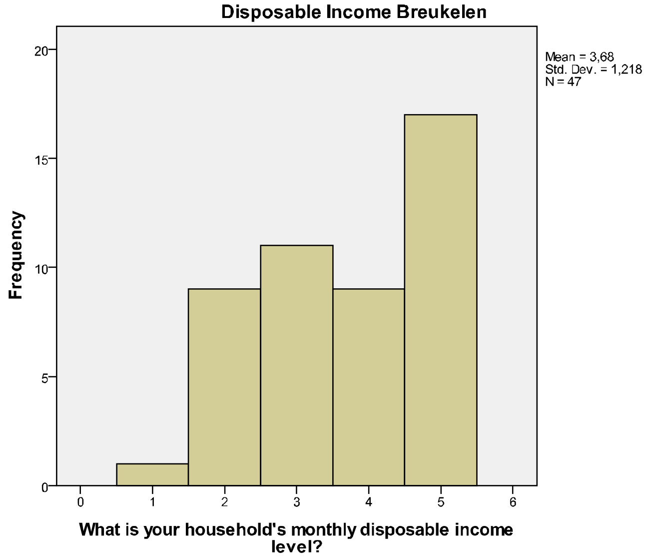
9. Appendix A: Data

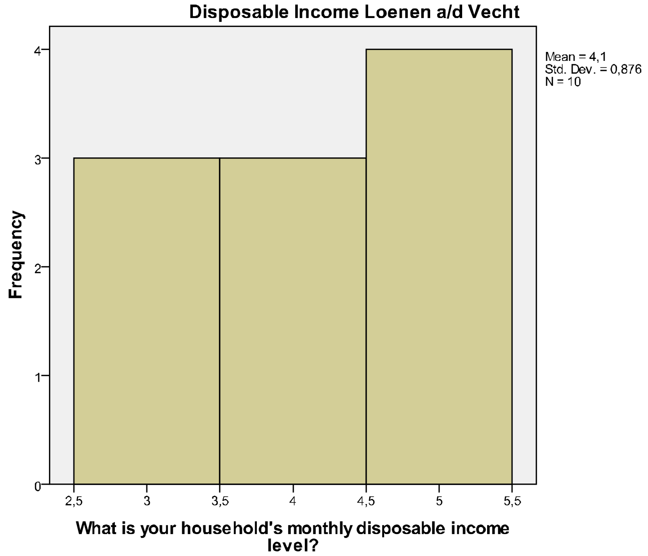
What is your household's monthly disposable income level?

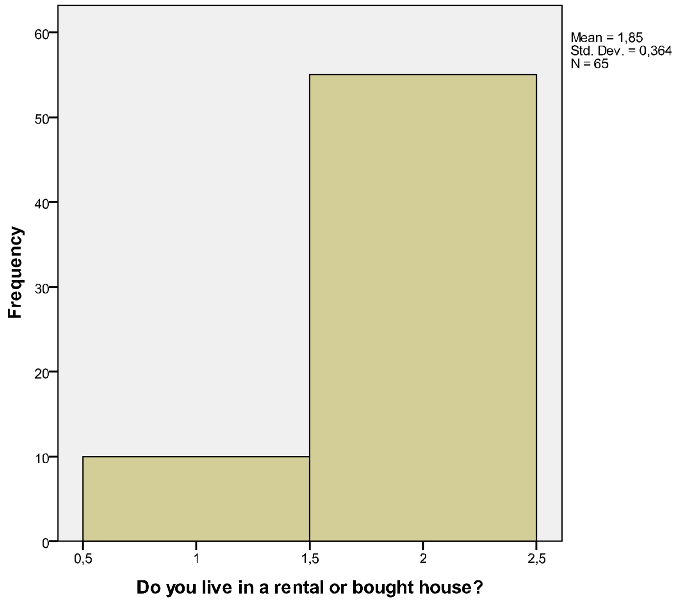
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	<1000 EUR	1	1,5	1,7	1,7
	1000 -< 2000 EUR	9	13,8	15,0	16,7
	2000 -< 3000 EUR	17	26,2	28,3	45,0
	3000 -< 4000 EUR	12	18,5	20,0	65,0
	>4000 EUR	21	32,3	35,0	100,0
	Total	60	92,3	100,0	
Missing	System	5	7,7		
Total		65	100,0		

Disposable Income Breukelen



Disposable Income Loenen a/d Vecht





What is the size of your household?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	2	3,1	3,1	3,1
	2	14	21,5	21,5	24,6
	3	17	26,2	26,2	50,8
	4	22	33,8	33,8	84,6
	5	10	15,4	15,4	100,0
	Total	65	100,0	100,0	

How many children are part of your Household?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	,00	17	26,2	26,2	26,2
	1,00	15	23,1	23,1	49,2
	2,00	23	35,4	35,4	84,6
	3,00	10	15,4	15,4	100,0
	Total	65	100,0	100,0	

How many children aged 0-4 y.o. are part of your household?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	49	75,4	75,4	75,4
	1	14	21,5	21,5	96,9
	2	1	1,5	1,5	98,5
	3	1	1,5	1,5	100,0
	Total	65	100,0	100,0	

How many children aged 5-9 y.o. are part of your household?

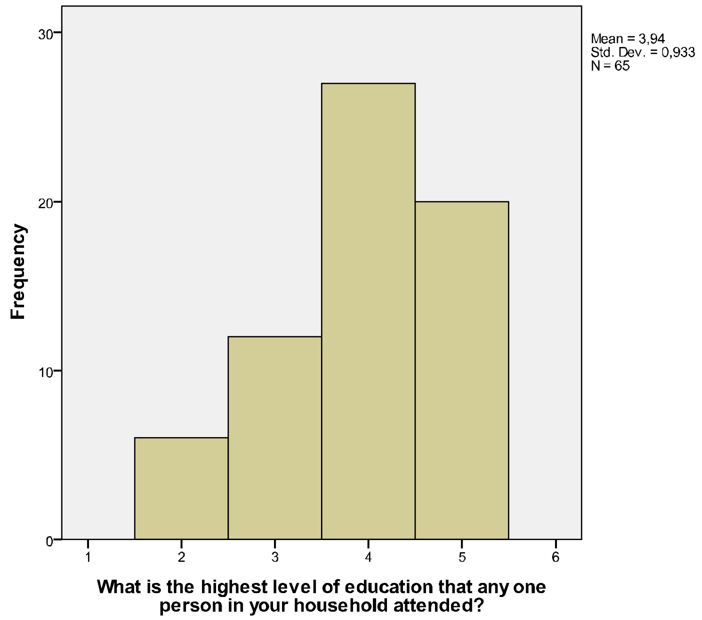
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	46	70,8	70,8	70,8
	1	14	21,5	21,5	92,3
	2	5	7,7	7,7	100,0
	Total	65	100,0	100,0	

How many children aged 9-14 y.o. are part of your household?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	49	75,4	75,4	75,4
	1	8	12,3	12,3	87,7
	2	6	9,2	9,2	96,9
	3	2	3,1	3,1	100,0
	Total	65	100,0	100,0	

How many children aged 15+ y.o. are part of your household?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	50	76,9	76,9	76,9
	1	9	13,8	13,8	90,8
	2	5	7,7	7,7	98,5
	3	1	1,5	1,5	100,0
	Total	65	100,0	100,0	



How annoying does your household consider this traffic noise to be?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	not annoying	6	9,2	16,2	16,2
	somewhat annoying	15	23,1	40,5	56,8
	reasonably annoying	12	18,5	32,4	89,2
	annoying	4	6,2	10,8	100,0
	Total	37	56,9	100,0	
Missing	System	28	43,1		
Total		65	100,0		

10. Appendix B: Results

Tests of Normality[b]

	What is your household's monthly disposable income level?	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
wtp particulate matter - final household offer	1000 -< 2000 EUR	,398	6	,003	,705	6	,007
	2000 -< 3000 EUR	,317	6	,060	,741	6	,016
	3000 -< 4000 EUR	,141	5	,200*	,979	5	,928
	>4000 EUR	,280	11	,016	,742	11	,002

a. Lilliefors Significance Correction

*. This is a lower bound of the true significance.

b. wtp particulate matter - final household offer is constant when What is your household's monthly disposable income level? = <1000 EUR. It has been omitted.

Test of Homogeneity of Variance[a]

		Levene Statistic	df1	df2	Sig.
wtp particulate matter - final household offer	Based on Mean	4,345	3	24	,014
	Based on Median	1,872	3	24	,161
	Based on Median and with adjusted df	1,872	3	10,327	,196
	Based on trimmed mean	3,162	3	24	,043

a. wtp particulate matter - final household offer is constant when What is your household's monthly disposable income level? = <1000 EUR. It has been omitted.

Ranks

	What is your household's monthly disposable income level?	N	Mean Rank
wtp particulate matter - final household offer	<1000 EUR	1	6,00
	1000 -< 2000 EUR	6	10,42
	2000 -< 3000 EUR	6	14,83
	3000 -< 4000 EUR	5	14,30
	>4000 EUR	11	18,73
	Total	29	

Test Statistics[a,b]

	wtp particulate matter - final household offer
Chi-square	5,343
df	4
Asymp. Sig.	,254

a. Kruskal Wallis Test
b. Grouping Variable: What is your household's monthly disposable income level?

Ranks

	What is your household's monthly disposable income level?	N	Mean Rank
wta particulate matter - final household offer	1000 -< 2000 EUR	3	10,50
	2000 -< 3000 EUR	11	17,59
	3000 -< 4000 EUR	7	15,57
	>4000 EUR	10	16,20
	Total	31	

Test Statistics[a,b]

	wta particulate matter - final household offer
Chi-square	1,486
df	3
Asymp. Sig.	,685

a. Kruskal Wallis Test
b. Grouping Variable: What is your household's monthly disposable income level?

Ranks

	What is your household's monthly disposable income level?	N	Mean Rank
wtp noise - final household offer	<1000 EUR	1	8,00
	1000 -< 2000 EUR	6	10,75
	2000 -< 3000 EUR	6	17,08
	3000 -< 4000 EUR	5	18,70
	>4000 EUR	11	15,14
	Total	29	

Test Statistics[a,b]

	wtp noise - final household offer
Chi-square	4,041
df	4
Asymp. Sig.	,400
Exact Sig.	,413
Point Probability	,000

a. Kruskal Wallis Test

b. Grouping Variable: What is your household's monthly disposable income level?

Ranks

	What is your household's monthly disposable income level?	N	Mean Rank
wta noise - final household offer	1000 -< 2000 EUR	3	12,17
	2000 -< 3000 EUR	11	16,77
	3000 -< 4000 EUR	7	15,93
	>4000 EUR	10	16,35
	Total	31	

Test Statistics[a,b]

	wta noise - final household offer
Chi-square	,643
df	3
Asymp. Sig.	,886

a. Kruskal Wallis Test

b. Grouping Variable: What is your household's monthly disposable income level?

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,577[a]	,333	,128	2,8727

a. Predictors: (Constant), totalchildren, wastesep, Does anyone in your household suffer from a respiratory disease?, How often has your household donated money to a nature foundation during the last year?

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	4,628	2,583		1,792	,096
	Does anyone in your household suffer from a respiratory disease?	4,058	1,941	,564	2,091	,057
	wastesep	-,411	,605	-,197	-,679	,509
	How often has your household donated money to a nature foundation during the last year?	,552	,971	,160	,568	,580
	totalchildren	,115	,712	,043	,161	,874

a. Dependent Variable: wtp particulate matter - final household offer

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,546[a]	,298	,254	2,6567	2,520

a. Predictors: (Constant), Does anyone in your household suffer from a respiratory disease?

b. Dependent Variable: wtp particulate matter - final household offer

Coefficients[a]

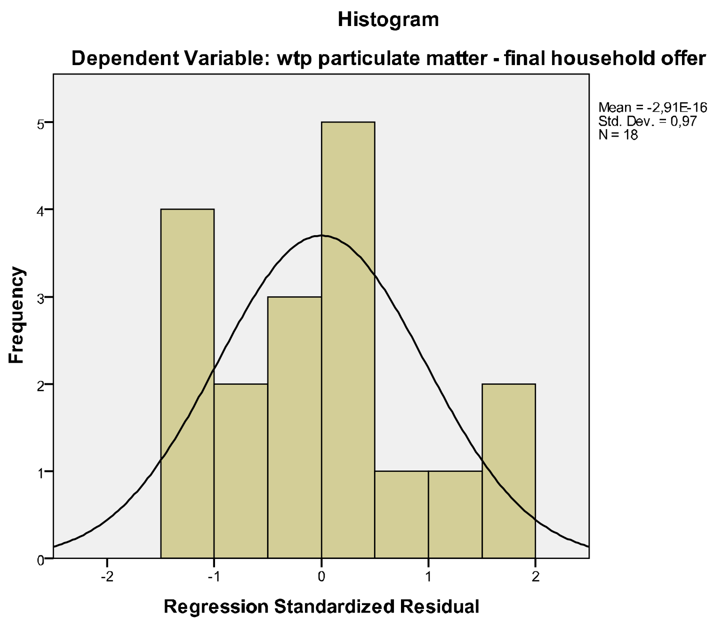
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	4,071	,710		5,734	,000
	Does anyone in your household suffer from a respiratory disease?	3,929	1,506	,546	2,608	,019

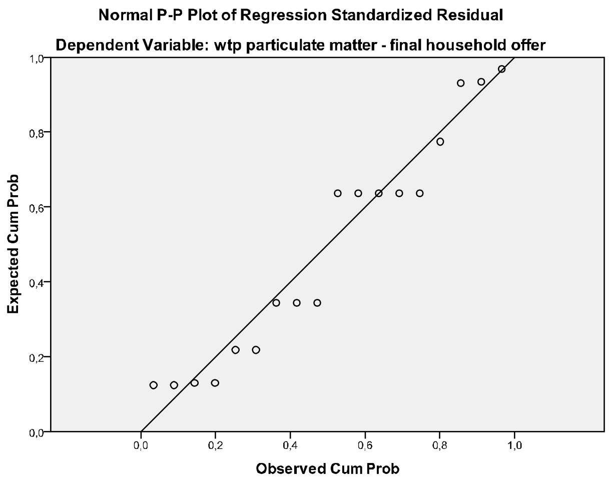
a. Dependent Variable: wtp particulate matter - final household offer

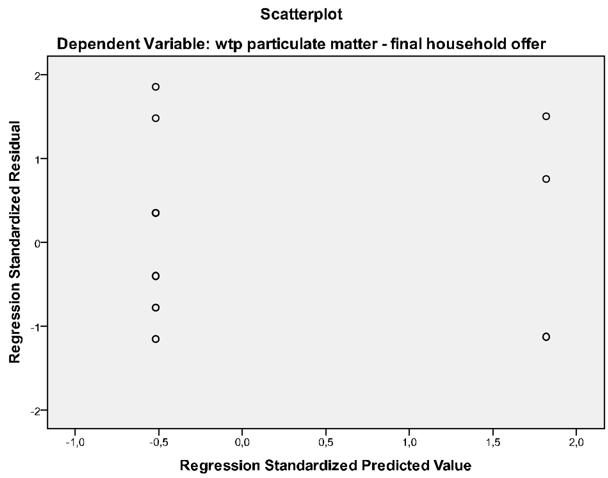
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	4,071	8,000	4,944	1,6806	18
Residual	-3,0714	4,9286	,0000	2,5774	18
Std. Predicted Value	-,519	1,818	,000	1,000	18
Std. Residual	-1,156	1,855	,000	,970	18

a. Dependent Variable: wtp particulate matter - final household offer







Ranks

	Does anyone in your household suffer from a respiratory disease?	N	Mean Rank
wta particulate matter - final household offer	No	22	14,41
	Yes	10	21,10
	Total	32	

Test Statistics[a,b]

	wta particulate matter - final household offer
Chi-square	3,566
df	1
Asymp. Sig.	,059
Exact Sig.	,060
Point Probability	,003

a. Kruskal Wallis Test

b. Grouping Variable: Does anyone in your household suffer from a respiratory disease?

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,981[a]	,963	,889	,9111

a. Predictors: (Constant), wastesep, How annoying does your household consider this traffic noise to be?, How often has your household donated money to a nature foundation during the last year?, totalchildren

b. Dependent Variable: wtp noise - final household offer

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	,189	1,647		,114	,919
	How often has your household donated money to a nature foundation during the last year?	-,464	,371	-,237	-1,253	,337
	How annoying does your household consider this traffic noise to be?	2,046	,369	,832	5,546	,031
	totalchildren	-,545	,427	-,268	-1,274	,331
	wastesep	,549	,280	,306	1,956	,190

a. Dependent Variable: wtp noise - final household offer

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,892[a]	,796	,755	1,3531	2,275

a. Predictors: (Constant), How annoying does your household consider this traffic noise to be?

b. Dependent Variable: wtp noise - final household offer

Coefficients[a]

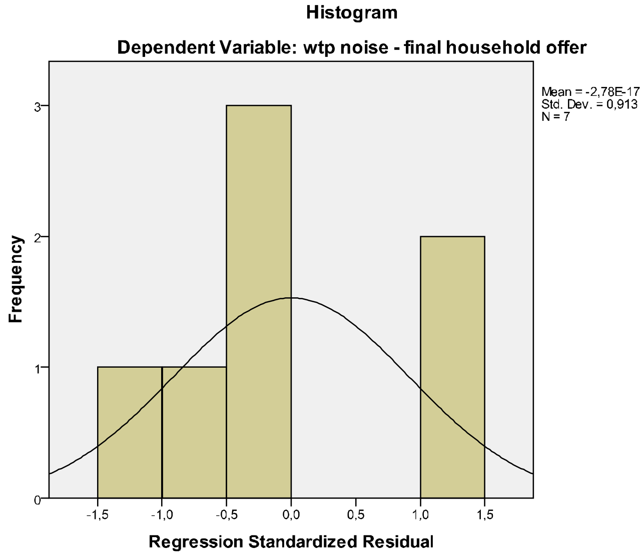
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	,846	1,245		,680	,527
	How annoying does your household consider this traffic noise to be?	2,192	,496	,892	4,416	,007

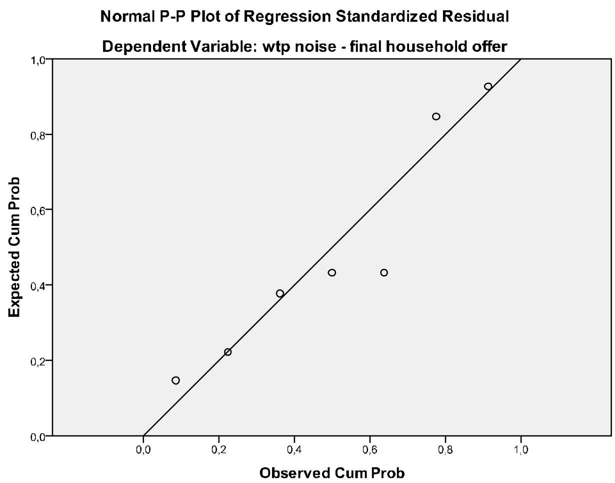
a. Dependent Variable: wtp noise - final household offer

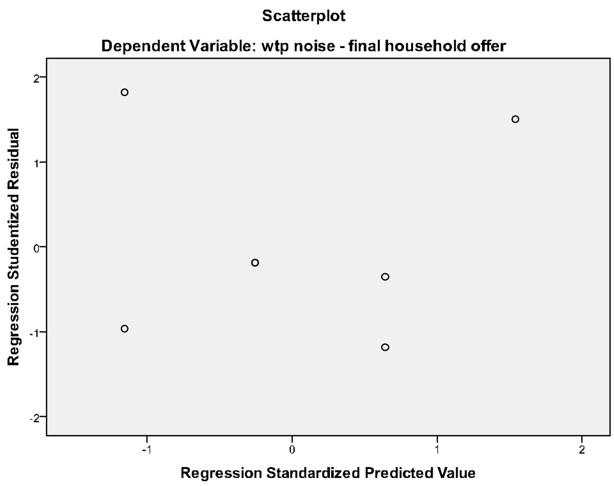
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	3,038	9,615	5,857	2,4394	7
Std. Predicted Value	-1,155	1,541	,000	1,000	7
Standard Error of Predicted Value	,531	,993	,705	,175	7
Adjusted Predicted Value	1,909	8,000	5,633	2,3115	7
Residual	-1,4231	1,9615	,0000	1,2352	7
Std. Residual	-1,052	1,450	,000	,913	7
Stud. Residual	-1,184	1,820	,065	1,160	7
Deleted Residual	-1,8049	3,0909	,2239	2,0238	7
Stud. Deleted Residual	-1,249	2,801	,253	1,492	7
Mahal. Distance	,066	2,374	,857	,857	7
Cook's Distance	,003	1,324	,394	,530	7
Centered Leverage Value	,011	,396	,143	,143	7

a. Dependent Variable: wtp noise - final household offer







Ranks

	How annoying does your household consider this traffic noise to be?	N	Mean Rank
wta noise - final household offer	not annoying	3	3,00
	somewhat annoying	12	11,42
	reasonably annoying	3	9,00
	annoying	2	18,50
	Total	20	

Test Statistics[a,b]

	wta noise - final household offer
Chi-square	9,202
df	3
Asymp. Sig.	,027
Exact Sig.	,008
Point Probability	,000

a. Kruskal Wallis Test

b. Grouping Variable: How annoying does your household consider this traffic noise to be?

Jonckheere-Terpstra Test[a]

	wta noise - final household offer
Number of Levels in How annoying does your household consider this traffic noise to be?	4
N	20
Observed J-T Statistic	89,500
Mean J-T Statistic	58,500
Std. Deviation of J-T Statistic	13,310
Std. J-T Statistic	2,329
Asymp. Sig. (2-tailed)	,020
Exact Sig. (2-tailed)	,018
Exact Sig. (1-tailed)	,009
Point Probability	,001

a. Grouping Variable: How annoying does your household consider this traffic noise to be?