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One morning in Sarajevo, 2015.

A BREATH OF BAD AIR

A contingent valuation study on mitigating air pollution in Sarajevo, Bosnia and Herzegovina

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ABSTRACT

Bosnia and Herzegovina has the highest concentration of $PM_{2.5}$ and the highest death rate related to air pollution in Europe. This study tries to address the issue by the contingent valuation method to elicit citizens' willingness to mitigate the air pollution in Sarajevo. The monetary valuation predicted that the average citizen living in Canton Sarajevo was willing to pay 4.65 KM/month (≈ 2.30 EUR) through a tax surcharge during a three-year period for a decrease of air pollutants by 20%. Suggestive implications showed that full time employed and retirees were more likely to pay for the mitigation than unemployed, however the probability of not being willing to pay increased with age. Women, landowners and those that believe in rising global temperature were predicted to have a positive causal effect on the willingness to pay, while age had a negative effect. The weaknesses of the statistical predictions occur from the small sample size of 126 individuals, thus much bigger sample is needed. This study provides estimates primarily as an indication of citizens' approval on improving the air quality in Sarajevo.

Keywords: Bosnia and Herzegovina, Sarajevo, air pollution, contingent valuation method, willingness to pay, payment card

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Gothenburg, Sweden

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Dah lošeg zraka – ”Contingent valuation” studija o ublažavanju zagađenosti zraka u Sarajevu, Bosni i Hercegovini

SAŽETAK

Bosna i Hercegovina je zemlja sa najvećom koncentracijom $PM_{2.5}$ i sa najvećom stopom smrtnosti uzrokovanom zagađenošću zraka u Evropi. Ova studija pokušava da riješi problem sa “contingent valuation” metodom kako bi potakla spremnost građana da se ublaži zagađenost zraka u Sarajevu. Sa monetarnom procjenom predviđeno je da prosječan građanin Kantona Sarajevo je bio voljan da plati 4.65 KM mjesečno (≈ 2.30 EUR) kroz poreske naknade u toku trogodišnjeg perioda za smanjenje zagađivača zraka za 20%. Sa studijom se očekiva da su zaposleni i penzioneri voljni da plate više nego nezaposleni, ali da vjerovatnoća pridonošenja smanjenju zagađenja smanjuje sa godinama ispitanika. Studija je također pokazala da žene, zemljoposjednici te ispitanici koji vjeruju u globalno zagrijavanje imaju pozitivan uzročni uticaj na spremnost za plaćanje, dok starost ima smanjen uzročni uticaj na volju za plaćanje. Slabosti studije su uglavnom u tome sto je istraživanje vršeno na svega 126 ispitanika. Za preciznije rezultate potreban je mnogo veći uzorak. Ova studija primarno služi kao indikator da su stanovnici Kantona Sarajevo voljni da se poboljša kvalitet zraka u Sarajevu.

Ključne riječi: Bosna i Hercegovina, Sarajevo, zagađenje zraka, “contingent valuation” metoda, spremnost za platiti, payment card

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ABBREVIATIONS

$\mu g/m^3$	Microgram(s) per cubic metre
BIH	Bosnia and Herzegovina
CBA	Cost-Benefit Analysis
CS	Canton Sarajevo
CV	Compensating variation
CVM	Contingent valuation method
EU	European Union
EV	Equivalent variation
FBiH	Federation of Bosnia and Herzegovina
GDP	Gross domestic product
KM	National currency, BiH convertible mark (BAM) [1 EUR ≈ 2 KM]
NO_x	Nitrogen oxides
NOAA	National Oceanic and Atmospheric Administration
$PM_{2.5}$	Atmospheric particulate matter with a diameter of 2,5 μm or less
R^2	Coefficient of determination
SDGs	United Nations Sustainable Development Goals
SO_2	Sulphur dioxide
SP	Stated preference methods and studies
TEV	Total economic value
WHO	World Health Organization
WTP	Willingness to pay

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1. INTRODUCTION

Climate change has always been a natural process on Earth but never has mankind come to bargain with clean air to this point. The exponential development of human civilization the last decades has pressured the climate and changed the mood of the atmosphere. Air pollution is considered one of Earth's main challenges as it assigns negative effects on all living organisms, assets and values, including human health. There are small chances of finding a substitute for clean air. It is then safe to say, as with clean water, clean air is a prerequisite to implement proactive actions towards a sustainable society, i.e. take on rest of the Earth's climate challenges. The priorities of developing countries seem to be oriented firstly around increasing quantity of resources and less about quality improvement and efficient use of diverse resources (e.g. employment, housing, energy, food supply, drinking water) for quality of life. For a society to be sustainable according to the Sustainable Development Goals (SDGs), it should not only undertake responsibility towards the environment but to the given economic and social conditions both today and tomorrow. (WHO, 2016 & 2017b)

Air pollution and resource use are indications of people's health status and quality of life. The latest report from World Health Organization (WHO, 2017b) updated estimates of indicators related to health issues. Bosnia and Herzegovina (BiH) got the last place for good air quality in Europe when measured by annual means by particulate matter less than 2.5 μm in diameter ($PM_{2.5}$) in urban areas (55.1 $\mu g/m^3$**)**. For comparison, Sweden grabbed the first place by having the lowest level of $PM_{2.5}$ in Europe (5.9 $\mu g/m^3$**)**.[1] Death rates by ambient air pollution correspond to the level of $PM_{2.5}$ concentrations in BiH and Sweden, respectively. WHO also reported that 40% of the BiH households use predominantly clean fuels, which is the smallest share represented in Europe (WHO, 2017b). Abundant in natural resources, BiH has an opportunistic approach to the extraction of its energy sources with high use of cheaper solid fuels, namely coal and wood. About 70% of the energy production in BiH comes from combusting coal and new such power plants are scheduled for construction in the coming years (HEAL, 2016). This consumption trend and lack of proactive energy efficient legislation or even a national strategy for energy use is bargaining with the citizens' quality of living.

[1] See air quality guidelines by WHO: http://www.euro.who.int/en/health-topics/environment-and-health/air-quality/activities/update-of-who-global-air-quality-guidelines which in general are stricter than those by the EU: http://ec.europa.eu/environment/air/quality/standards.htm

Furthermore, resources for raising public-awareness for energy efficiency are nearly non-existent.

Particulate matter (PM) is a mixture of dust and exhaust in the atmosphere generated namely from power plants, industry and road traffic, which triggers cardiovascular and respiratory diseases, leading to premature death (WHO, 2017a). Health costs in BiH that are associated with air pollution amount to over 20% of GDP (WHO, 2010). This percentage is one of the largest in the region and in Europe, which includes all the losses of resources related to weakened health and lost lives by polluted air. High concentrations of air pollutants such as nitrogen oxides (NO_x), sulphur oxide (SO_2) and PM in BiH derive mainly by the absence of filters and catalysts in industries and older automobiles and the use of unfitting solid fuels in households for heating. The capital of BiH, Sarajevo, and its surroundings are not the only communities deprived of clean air. Over the last few years many industrial cities have reported concentration levels repeatedly exceeding the recommended limits on a daily basis (Federalni hidrometeorološki zavod, 2017).

This field study aims to investigate the citizens' willingness to pay (WTP) to increase the air quality in Sarajevo. A survey was prepared with the use of the contingent valuation method (CVM) and administered during April and May 2017 in Canton Sarajevo (CS) with the help from one enumerator. The citizens were asked to value a 20% decrease of air pollution and contribute through a tax surcharge during a three-year period, 2018-2020. The possible actions assumed for reaching this mitigation level would address energy efficiency, measuring the progresses and following up on the hypothesized actions implemented by the government. Even if air is no one's property and ambient air pollution threatens without considering borders the air quality is more or less in everyone's interest to improve.

1.1 More about BiH and Sarajevo

BiH is considered a developing country in economic transition and categorized as an upper middle-income country (The World Bank, 2017). In the same year of independence in 1992, a three-year long war began in BiH. As a result of the Daytona agreement in 1995, which officially brought an ending to the war, the country was divided into two larger regions so called entities and one district; the Federation of Bosnia and Hercegovina (FBiH), the Republic of Serbia (RS), and the district of Brčko. (Institute for Statistics of FBiH, 2017a) Due to this, the state apparatus in BiH is highly complicated, making the public administration in BiH rugged

and ineffective (SIDA, 2015). There are about 3.8 million inhabitants in BiH though there has not been an official census since before the war (CIA, 2017).

Before the war, BiH had a recognized industrial base built on mainly mining, metallurgical industry and forestry. Half of Bosnia's industrial capacity was destroyed during the war and has not recovered since then. BiH has only recently been officially accepted to start the procedure for joining the European Union (EU). Until then, the country has over three thousand questions to answer and a number of EU standards to live up to, among them are their energy consumption and emissions control. Although in stagnation, BiH has taken on obligations and strategies under the Energy Community Treaty ratified in 2006 and the EU Energy Efficiency Directive (2012/27/EU) in hope for integration and development. (SIDA, 2015)

The CS goes under the administration of the FBiH and has 417,498 inhabitants settled in nine municipalities, which four of them make up the City of Sarajevo along the Miljacka river. See the picture on the population density in municipalities of CS in Appendix A on page 36. Records from December 2016 show an unemployed population by approximately 20% in CS and 37% in employment. The average monthly net income is nearly 200 KM[2] higher than the national average and amounts to 1.018 KM in CS. Sarajevo is the largest city in BiH by number of citizens and is mainly known by its historical events and multicultural spirit. (Institute for Statistics of FBiH, 2017a, b)

The topography in Sarajevo encloses the ambient pollution and builds up the inversion, which keeps the polluted air close to the ground. The health risk does not only depend on level of concentration but also time and duration of exposure to polluted air (Crouse et al., 2012). Habeš et al (2013) performed measurements on the level of NO_x in the center of Sarajevo during years 2005-2010 and concluded a declining trend without causal explanation. Still, stations of monitoring concentrations of air pollutants lack consistency and therefore there are difficulties to observe trends of air quality by the concentration of each pollutant. Nonetheless, the average unit values of air pollutants are exceeding the recommended values more frequently in Sarajevo, which increases the health risks throughout the year and not only during winter time, when the news turn attention to the frequent smog (Public Institute for Public Health of Canton Sarajevo, 2016).

[2] The currency used is the Bosnian convertible mark (KM) and has fixed exchange rate to the Euro (1 EUR = 1.95583 KM), historically pegged to the German mark.

1.2 Purpose and research questions

The purpose of this field study is to estimate citizens' WTP for implementing actions for mitigating air pollution and increasing air quality in Sarajevo to primarily avoid the negative effects on human health. The study takes also interest in attitude of the citizens towards climate change and what factors influence their stated WTP. View the survey that was used in the field in Appendix B on page 37. The CVM was used in an attempt to answer the following questions:

A. How much are citizens of CS willing to pay for mitigating air pollution and improving air quality in Sarajevo?

B. What are the attitudes among CS citizens towards climate change?

C. Can demographic factors, attitudes on environment and air pollution predict any effect on the WTP?

2. THEORY

Relevant concepts are addressed on how and why the willingness to contribute for cleaner air by the individual depends on their own resources and preferences. What would they be paying for and why?

2.1 Pure public good

Clean air is considered as a *pure public good*. Such good is characterised by being *non-excludable* in that sense that no one can be excluded from consuming it or cannot consume it without reducing the amount of air, thus air has no individual property rights. A pure public good is also *non-rival*, which means that an individual's consumption of the good does not affect another individual's ability to consume the same good, therefore there is also no competitive market price nor a specified demanded quantity. Other environmental goods than clean air are for example biodiversity and clean water. Examples of other public goods are usually lighthouses, national defence and highways. While the private goods are such as automobiles, clothes and a hot dog. (Mitchell & Carson, 1989; Bateman et al, 2002; Kolstad, 2011; Brännlund & Kriström, 2012)

Since ambient air pollution travels across national borders it is apparent that air pollution is both a local and a global problem with difficulty to define its property rights. Thus, air pollution is a non-market good. Measuring where the exhaust is coming from is an approach to determine who is responsible for the pollution. By addressing the pollution by the *polluter-pay-principal* (PPP) the problem can be constrained and the damages (externalities) mitigated. By these means, ambient air pollution is a public bad that is currently concentrated namely in urban regions. (Kolstad, 2011) In addition to the geographic perspective, clean air will also be needed for coming generations.

2.2 Total value

Air is used for breathing which is considered as the *use value* of the good. Other values of air are the *non-use values*; altruistic value and bequest value. Even if an individual is not consuming the good itself it derives value by knowing someone else has use of the good. This is called the *altruistic value*. *Bequest value* is the value an individual receives knowing that future generations will have the benefit of the resource, even if the individual has no benefit from the good itself in her or his own lifetime. Thus, the difference in these two non-use values

is essentially the time aspect, but both values include notions of altruistic motives concerning an individual's utility gained by the well-being of others. Moreover, the total value is the use and non-use values combined. (Bateman et al, 2002; Pearce et al, 2006; Powe, 2007; Hackett, 2011; Kolstad, 2011; Brännlund & Kriström, 2012)

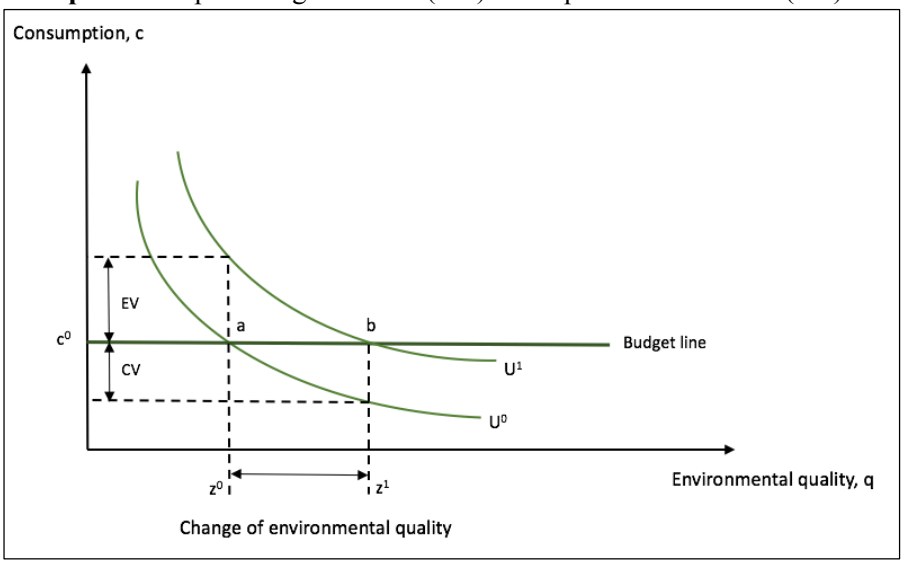
Stated preference (SP) methods, such as the CVM, are direct methods used to estimate the total value of a good. In contrast to the *revealed preference methods* which evaluates preferences in only the use values, the CVM is built on constructing a hypothetical market to derive the *total economic value* (TEV) of an environmental good without a market (Bateman et al, 2002; Powe, 2007**).** The total amount of resources that individuals would be willing to give represent the TEV of the improvement or preservation of the good (Powe, 2007). Another SP method is the *choice experiment* (CE) which tries to elucidate valuations of certain features of an environmental good on a more detailed approach (Pearce et al, 2006; Kolstad, 2011; Brännlund & Kriström, 2012). CVM and CE can thus be used for estimating non-use values before a change through the stated preferences by individuals using survey questionnaires (Powe, 2007; Hackett, 2011). By this mean, the SP studies are criticized for "unreal" estimates of peoples' actual choices and even the lack of preferences for non-use values (Diamond & Hausman, 1994; Hackett, 2011; Hausman, 2012). More on the weaknesses of the CVM on page 14.

As environmental economics in general, the mentioned SP methods are oriented mainly around the term *willingness to pay* (WTP). This term represents individual's subjective ability to value changes in welfare in monetary meanings, such changes are predominantly environmental improvements from status quo. Since the WTP by an individual is restricted by his or hers income the stated WTP can never be larger than the disposable income, i.e. what is left after taxes (Kolstad, 2011). Two such welfare measures were presented in the 1940's by the Nobel prize winner Sir John Hicks, namely *equivalent variation* (EV) and *compensating variation* (CV). The mechanisms of EV and CV are described below and illustrated in Graph 1 on the following page. (Brännlund & Kriström, 2012)

The EV is based on the amount an individual is *willing to accept* (WTA) as a compensation for a loss or decreased quality of an environmental good, i.e. to keep the same utility level (U) equivalent to the status quo before a negative change. Estimates of WTA and WTP can both be measured by CVM, however the difference is that WTP is dependent on the budget restriction since an individual is usually willing or capable to receive as much money he or she can get for

a vital good but limited by the financial resources (*c*) to pay for a good. Thus, the minimum WTA is usually difficult to decide and also likely to be larger than WTP (Brännlund & Kriström, 2012).

Graph 1. Compensating variation (CV) and equivalent variation (EV)



Source: Translated from Brännlund & Kriström (2012), p. 80.

For a gained quality or improvement of environmental good (from z^0 to z^1), the CV has its focus on the maximum WTP to increase an individual's utility from the status quo (point *a*) [$U^1(c\text{-}WTP, q^1) > U^0(c, q^0)$], a concept that could be considered for increased air quality (point *b*) (Mitchell & Carson, 1989; Powe, 2007). The distance between the indifference curves is the welfare change, which makes up the concept of CV for an environmental improvement to maximize utility through the maximum WTP within the income restriction. (Brännlund & Kriström, 2012)

Assuming one succeeds to estimate TEV then there are possibilities to estimate the social costs and benefits in order to evaluate whether the change enhances the welfare and how it would affect different socio-economic groups (Wang et al, 2006; Brännlund & Kriström, 2012). Estimating all benefits and costs of a change is important in evaluating public projects, investments and policies when looking from a welfare point of view. Such activities are part of the *Cost-Benefit Analysis* (CBA) which is widely used for decision-making in different sectors. Infrastructural projects in France from the 19th century is the first trail of evidence where CBA can be found. By estimating net present value of both the costs (not only financial but all social) and the benefits of the same project the implementations can be realised when the net present value is positive, i.e. when the benefits exceed the costs. (Pearce et al, 2006)

2.3 Previous research

There have been plentiful earlier CV studies in both developed and developing countries, but very few on environmental goods in BiH. This motivates the contribution of this field study not only to the environmental economic field but also to this geographical part of the world. Find a collection of few earlier CV studies on air pollution in Appendix C on page 41, some which are mentioned here.

One of the early and recognised CV studies was conducted after the Exxon-Valdez oil spill outside the coast of Alaska, USA in year 1989 when an oil ship got stranded and caused the death of thousands of animals. The outcome of studying the welfare loses was turned to the validity of CV studies in court investigations. The developments led to a report by the expert panel NOAA (National Oceanic and Atmospheric Administration) on recommendations for best practice of the CVM. Among their guidelines was the encouragement to perform in-person interviews with well-structured surveys in controlled environments which would subsequently result in expensive studies. (Arrow et al, 1993; Carson et al, 2003; Brännlund & Kriström, 2012; Kling et al, 2012)

The only CV study from BiH was found on biodiversity protection. Dautbašić et al (2010) performed a CV study in BiH on the whole population with a sample of almost 1200 citizens and estimated that the inhabitants were voluntarily willing to contribute for biodiversity preservation projects. The survey was administered through telephone interviews and the offered amounts in the survey that was given randomly to the respondents were ranging between 0-2 EUR. In parallel with the estimated average WTP of 0.50 EUR the study argued that the preferences of the public should be included in the financial decision-making on public goods.

A similar extensive CV study was conducted by Carlsson & Johansson-Stenman (2000) on air quality in Sweden for the whole population during the late 1990's. They used a combination of mails and telephone interviews and collected nearly 2200 complete responses on evaluations of reducing pollutants by 50%. Their estimates predicted suggestive positive effects among men, high-income earners, highly educated, owners of housing property, urban residents and environment activists. Only the older population in retirement showed a significant negative outcome on the WTP. The estimated WTP was 210 EUR/year/person which would be charged in relation to net incomes.

More than a decade later, Carlsson et al (2012) performed a combined study using both CVM and CE for comparison in a multiple country study on reducing CO_2 emissions by year 2050. Around 1000-1300 citizens in Sweden, China and United Stated respectively were asked to state their WTP, preferences and attitude about climate change in three scenarios. The majority in all three countries believed in the global temperature increase and that humans are responsible for the cause. Citizens provided their responses in a computer based survey that would minimize manipulated answers, which otherwise occur when in contact with an interviewer. The WTP was supposed to be considered as a monthly payment per household until year 2050 presumably charged through energy or fuel expenses. The estimates of WTP in each country were highest in Sweden and lowest in China, but in proportion to income levels the WTP was approximately the same in all three countries (≈ 1%).

China and similar countries with large populations that have experienced rapid economic growth are recognized for their problems by the apparent ambient air pollution. Wang et al (2006) studied the possibilities of improving the air quality by a 50% reduction of air pollutants in Beijing using the CVM. The average WTP of citizens amounted to approximately 20 EUR per household and year, which represented 0.7% of a household's annual income. Similar to the study in Sweden by Carlsson & Johansson-Stenman (2000), the significant factors that increased the WTP was higher income and educational level, while number of household members and age decreased the WTP. Moreover, urban residents were predicted to have a higher WTP than those living in the suburban areas due to poorer air quality in urban areas.

A more recent CV study in China by Wei & Wu (2017) was conducted in the bigger region around Beijing to mitigate the $PM_{2.5}$ concentrations, more specifically decrease severe polluting days by 80%. The sample size amounted to over 800 respondents between the ages of 16-69. With 89% share of citizens willing to pay, the estimates resulted in approximately 80 EUR per person and year, which represents around 1% of the GDP per capita. The noteworthy factors that affect the WTP resemble the findings in earlier studies (e.g. Carlsson & Johansson-Stenman, 2000; Wang et al, 2006). Such as higher income, education and age had a positive effect on the average WTP. However, older people and bigger families were less likely to carry additional expenses for such purposes. Moreover, the awareness of the polluted situation was palpable even though 11% were not willing to pay for air quality improvements, which could depend on difficulties to set a price on an improved air quality or for reasons preferring the PPP and assigning the financial responsibility to the government and the companies.

3. METHOD

This section introduces the CVM in general practice and follows by explaining the design and administration of the survey in this study. Lastly, critique towards the study is addressed. The survey itself can be found in Appendix B on pages 37-40.

3.1 Contingent valuation method

The first CV studies of air quality date back to the 1970's, which came to encourage use of the CVM thereafter (Brännlund & Kriström, 2012). CVM is based on interviews or surveys for inferring individuals' value of a provision or a loss of a good without an established market. Both public goods and private goods can be evaluated by directly asking people to state their WTP for an improvement or introduction of a new good on the market. In evaluating a public good an individual's preferences are attained but the stated amount of WTP is seldom or usually not at all realized. Experiences evince that stated WTP are overstated relative to the "real" amount transacted when asked to pay in a real setting (Arrow et al, 1993). Thus, the estimates are rather approximations of an environmental good's value and benefits, which can be used as a first step for assessing a CBA of a project's profitability. (Mitchell & Carson, 1989; Pearce et al, 2006; Kolstad, 2011; Brännlund & Kriström, 2012)

A CV study begins with constructing a survey with three sections; formulating a scenario, elicitation of WTP and questions on the respondent's background. The context of the scenario contains information on the status quo, the possible improvements and how the actions would affect the respondent. To get a "true" estimate as much as possible, the respondent is reminded of his or her budget constraint and informed about the provision of the good. The scenario usually follows by the main question to elicit the individual's valuation of the good on how much the respondent is prepared to pay, also known as the *elicitation format* which can be asked in different ways. Choosing the optimal elicitation format includes making trade-offs among their advantages and disadvantages in the context of the study area (Mitchell & Carsson, 1989). Thereafter, the survey usually ends with demographic, socio-economic and attitudinal questions to collect possible factors that could explain the reason on the stated WTP. To finalize the survey, one should test the acceptance and how the survey is comprehended to avoid biased answers. Initially, a focus group could be gathered to discuss the set up and wordings of the questions and follow up with a pilot study on the target group to evaluate the acceptance of the

survey. (Mitchell & Carsson, 1989; Arrow et al, 1993; Hackett, 2011; Kolstad, 2011; Brännlund & Kriström, 2012)

The finalized survey is then administered in the second stage of the CVM. The basic methods for administration and collection of answers are through mail, internet, telephone and in-person interviews. Surveys distributed by mail or internet have become more popular the last years, though they only reach people with access to internet. While telephone interviews are limited if the survey contains visual aid. In-person interviews are costly but gives the opportunity to explain and answer to questions, which is consequently sensitive to manipulation of the respondents' answer. After the sample is collected the final stage is where the answers are coded and described through statistics usually by the mean and the median. The outcome of the study culminates in the analysis of the estimates on the WTP-function. (Mitchell & Carson, 1989; Kolstad, 2011; Brännlund & Kriström, 2012)

3.2 Design of the survey

The survey in this study contained three sections on four pages all together. The first section of the survey began with some information on air pollution and current global and regional condition, which continued with the scenario that explains the possible improvements that the targeted group would pay for. The scenario that would be evaluated was a 20% decrease of air pollution in Sarajevo through mitigation actions, which would decrease probabilities of negative health effects related to air pollution. At the bottom of the first page, the payment method[3] was explained and a reminder of stating their WTP truthfully[4] was included as well to minimize biased answers. The biases of the study are elaborated from page 14.

Second section continued with four questions about attitude towards climate change, knowledge about the polluted situation and own perception if air pollution is a problem in Sarajevo. Thereafter, the main WTP-question was presented with a *payment card* as the

[3] The payment vehicle reads: *The contribution would be accounted as a monthly tax payment and would concern all citizens of the Canton Sarajevo during 2018-2020 (three years). The government would implement the mentioned actions for improving the air quality when at least 50% of the citizens in Canton Sarajevo would be willing to contribute. Positive effects would be seen already from year 2019. Every citizen would pay the same tax which would be charged in addition to your municipal taxes.*

[4] The cheap-talk script reads: *Your stated contribution is by freewill, but if you use money for this purpose, you cannot use the money for any other purpose. Please think carefully about how much you are willing to contribute, there may be many other goods and services that you would also like to buy or would have to pay for. Consider your own budget before answering question number 5 and state your amount as truthfully as you can.*

elicitation format, which was based on 12 given options in the range of 0-25 KM and a 13th which provided an option to specify a larger amount than 25 KM. Each monthly amount had a reference given in a yearly estimate to enable a better comprehension of the amount. At the end of the section, it was optional to state the reason for the chosen amount. The reasons are reviewed in the discussion and the distribution of stated WTP from the sample is presented in the results.

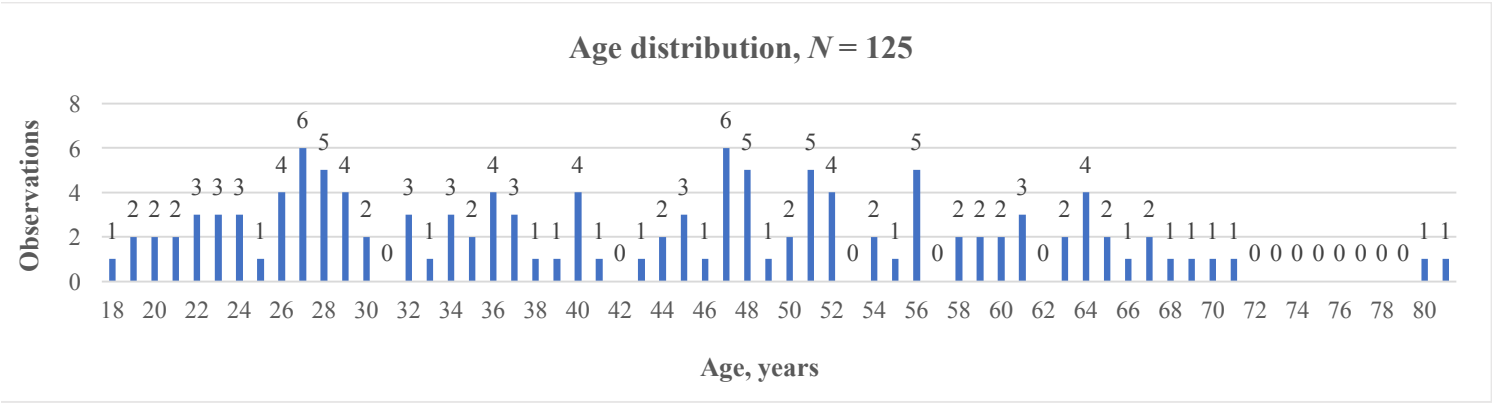
The last section followed by background questions including a final question about how much the individual understood the survey. Lastly, space was provided for optional comments at the end of the survey to make room for additional thoughts on the topic. Since there were few comments they were not analysed in the study. The demographic and socio-economic factors were chosen based on the assumption of their possibility to have an impact on the WTP and according to previous CV studies on air pollution. Included variables were such as age, gender, living location, personal income, education, family and household size, religion, diseases related to air pollution, smoking habits and land property. There are expectations that the younger population, those that live in urban areas, individuals with high income and high education and people with air pollution related diseases are more likely to give a high estimate of the WTP. Included variables concerning children and religion is motivated by the hypothesis that those who have children or consider themselves religious will state high WTP for altruistic reasons (e.g. Carlsson et al, 2012). In contrast, elderly, people living in rural areas, those with low income or low educated individuals and those with habit to smoke would have a low or zero WTP. A majority by 93% stated they understood the survey completely, while none of the respondents gave notice they did not understand the survey at all.

3.3 Collecting primary data

The target group of the study was citizens of CS older than 18 years. See the age distribution for the sample in Diagram 1 on the following page. The share of population and representation of each municipality in the sample is presented in Appendix D on page 42. In preparing the CV survey, a focus group of five individuals in Sweden and BiH gave advise one on one where each could give feedback on the design of the survey with small chances of influence from what others may propose or prefer, i.e. express their own impressions of the survey. Thereafter, a pilot study was administered in Bosnian to 10 individuals of equal share of females and males from especially the younger and older population in Sarajevo. The feedback from these 15

individuals from the focus and pilot group was mainly oriented around the length of the scenario being longer than advised, potential misunderstandings of the payment card and suggestions on questions and reformulations.

Diagram 1.



116 surveys were administered in the final study, summing up to 126 observations in total. The final version was carried out after minor corrections from experiences from the pilot study and finally administered with the help of a local Master's student in economics. Before assisting, this enumerator was informed about the scope of the study, the purpose and the method. In addition, the enumerator was part of the focus group and a helping hand when translating the survey to Bosnian. The enumerator collected 58 surveys (46% of the sample) which were administered in-person in the streets (mahalas) of Sarajevo and a handful were completed through telephone interviews with mainly familiar individuals (relatives, friends etc.) living in Sarajevo. For these reasons the enumerator bias is tested to discover if there are any significant differences between the enumerator's results apart from the author's. See page 27 and page 45.

The survey was carried out in May on avenues, in parks and streets of Sarajevo. The purpose of the survey was presented verbally with a promise of taking maximum 10 minutes of their time and their answers being anonymous in the presentation. There was also encouragement to ask questions if needed, which would be answered by the author or by the enumerator. Occasionally, the individuals interrupted and expressed lack of time or no interest in taking the survey. Numerous individuals were curious to hear more or seemed to simply have time to help out a student. The respondents were mainly by themselves, which was a conscious choice when selecting which individual to approach to avoid influence from one another. Majority of the respondents finished the survey in 5-10 minutes and there were few unanswered questions in

the sample. No question was left out unanswered by more than three respondents. The author was uncertain if the respondents read the scenario thoroughly, while the enumerator had the routine to read and encapsulate the content for the respondent and filling out the survey for them as well. Some respondents asked questions to clarify if they understood what was asked from them. Why for example the question on religion was relevant or skipped some question for reasons that one can only speculate about.

3.4 Critique

It is important to remember that every CV study is different and conditional to its setting in practice, namely by its scenario and respondents. Yet, the CVM includes inevitable, universal weaknesses. The relevant biases and critiques of this CV study will be discussed briefly before proceeding with the econometrics and the results.

3.4.1 Hypothetical valuation

Experience show that *hypothetical bias* is difficult to avoid completely (Diamond & Hausman, 1994; Kolstad, 2011; Hausman, 2012). Considering the CVM as a tool for evaluating public goods in a made-up market, it is important that the scenario is plausible and reliable as much as possible (Arrow et al, 1993). Majority of the earlier studies have at least 30% change of the environmental good, which makes the scenario of this study seem rather tentative. The 20% reduction of air pollutants is not specified within a time frame. Only a year is given for when the improvements would begin to notice. The three-year payment duration for this reduction level is simply suggested by the author as people tend to have difficulty for long-term planning. Moreover, the status-quo that explains the current concentration levels are not specified due to the aggregation of several pollutants with different concentrations and recommended levels. Together with the fact that a stated transaction is not binding the hypothetical bias becomes more critical (Powe, 2007).

There are reasons to not expect large changes in WTP estimations if for example the mitigation level would be increased to 80% instead of 20%, which would suggest that respondents are *insensitive to scope* and generate an *embedding problem*. Although the budget restriction is taken in consideration the specifics of the scenario may not be considered. Thus, the respondents think of the scenario as a change for the better good in general and consequently state a symbolic amount including achieving the *warm glow effect* and fulfilling the social

norms. Many people want to act according to social norms of trust, fairness and collective moral and therefore agree on contributing. If not capable to follow such norms they could feel guilty for failing expectations by such norms. That kind of attitude relates to insensitivity to scope of the change specified in the scenario. The magnitude of the change becomes insignificant. If responses are insensitive to the scope then they are useless in policy making, since the valuation cannot be estimated in proportion to a specific magnitude of change and used for CBA. (Diamond & Hausman, 1994; Powe, 2007)

In the scenario or the survey as whole it is a balance of providing all the information necessary and keeping it light and brief to minimize the discouragement of reading long and irrelevant texts. Several respondents asked if it was necessary to read the whole text before jumping on to the questions. Even though they held the text in front of them for a few minutes, it is still difficult to say how much they read or understood from it. To avoid this, it would be preferred to shorten the text of the scenario and suitable to ask measurable follow-up questions about the scenario to test the respondents' comprehension. The handful respondents who questioned the information in the scenario were given an open explanation.

The *cheap-talk script* is predominantly to avoid upward biased WTP-values or *strategic answering*. The cheap-talk script is a reminder of the individual's budget restriction as if they were to pay immediately. Respondent should consider their disposable income also regarding opportunity costs, i.e. other expenses for private goods and services and other funding for public goods (Powe, 2007). An encouragement to state their true ability to pay is to formulate a referendum setting, which most people are familiar with. Exaggerations of contribution can have multiple reasons aggregated by an individual's attitude and motive. There are also perceptions of the CVM as a function of indication of people's acceptance of the actions in the scenario to be realized, which resembles charities. Such contributions are related to the warm glow by making them feel as "good people". (Arrow et al, 1993; Pearce et al, 2006) Because of the weaknesses mentioned so far, the critique of CV studies suggests that the method is useless for policy making in an attempt to elicit preferences that do not exist for non-market goods and that evaluation of measures should be conveyed solely by experts (Diamond & Hausman, 1994; Hausman, 2012).

The *payment vehicle* has an impact on respondents' valuation and acceptance of the scenario, which raised questions among few respondents about how fair the payment method is. In a

setting where the public good would be provided through a tax payment the stated amount of WTP would be more likely to be based on following the social norms and expectations, and less about considering the maximum WTP (Powe, 2007). The opinions by the respondents were oriented around the PPP, the responsibility of the government, or that at least the retired people should be spared from the tax surcharge. Furthermore, charges managed by the government such as a tax meet often controversy in SP studies. Due to the distrust by the citizens towards the government because of disappointing management of existing resources it may be then a mistake to choose the government as the provider of the public good. The motivation for not including a question in the survey investigating the trust for government and administration is to avoid reminding or hinting the respondent towards a certain amount of WTP. Thus, the stated WTP would be difficult to evaluate if the response from respondents depend by the mistrust of the government or their (mis)understanding of the information.

The purpose with using the payment card is to avoid biased statements. By providing few amounts it is vulnerable to the specific values that are presented in the payment card and often unpractical for telephone interviews. However, unlike the open-ended or closed-ended payment formats, the payment card is easier to answer and reduces the outliers with high stated values. (Arrow et al, 1993; Bateman et al, 2002) Out of 126 respondents, only two provided inaccurate values which were manually removed. One individual stated a too high value (400.000 KM) and the other chose two values (5 and 50 KM). The reason could have been that the individuals misunderstood the question or the payment card. The payment card is also in risk of strategic answers, thus this elicitation format has low *incentive compatibility*. Stating no WTP could be motivated by rejecting the scenario or the incapability to carry additional expenses. (Pearce et al, 2006; Brännlund & Kriström, 2012)

3.4.2 Selection and control

A non-representing sample of the population weakens the relevancy of a study and its estimations. There were no expectations of collecting a *random sample* in this field study with a small sample. The survey was distributed in public spaces were the chances of collecting many surveys was expected to be high. Collecting a large sample as much as possible within a given time frame were one of the goals of the study to minimise biased answers. Still, the sample is likely to meet more or less sampling bias on most of the variables.

With limited resources, an enumerator was recruited to increase the chances of a larger sample. An enumerator supports the project leader or researcher with preparation and administration of the survey, and the respondents to complete it (OECD, 2006; Brännlund & Kriström, 2012). The author, who was the project leader, speaks Bosnian and therefore made the administration of the survey in field without a translator. The results from the sample show a noticeable variance on the elicited amounts of WTP in the surveys administered by the author than the answers collected by the enumerator. See Table 6 on page 27.

CV surveys are preferred to be administrated through in-person interviews (Arrow et al, 1993). The elicitation of an individual's preferences and capability to contribute could be considered sensitive information to share with others than the interviewer, which therefore is preferred to be asked one-on-one during an in-person interview (Powe, 2007). Taking in consideration that the survey was managed by two persons with both in-person interviews and only few on the telephone one could expect that there are biased results. Thus, the method in this study is in higher risk of *interviewer bias.* One can never be sure of how an enumerator acts and performs the administration without supervision. Presenting the survey and eliciting the responses in exactly the same way was surely not consistent. In-person interviews as a technique open up to critique that could go into details. The behavior of the interviewer can be a critical factor as can the interviewee's behavior in their meeting. Aside from the construction of the survey without speculating too much, the attitude of the respondent towards what is socially desirable and their knowledge in the subject are few factors that could impact the outcome of the respondent's answers. The administrators tried to keep an objective approach to minimize their influence on the responses by the respondents.

4. DATA AND ECONOMETRIC SPECIFICATION

After collecting a total of 126 observations in the survey, eight of them were dropped due to missing answers and 118 were left for final analysis in the results. The observations were coded in Microsoft Excel to create the data set for statistical analysis in the software programme Stata. This forth section explains the data and econometric tools to understand how to interpret the results and by which models and under what assumptions the research questions are answered.

Although the CVM has a descriptive function, the study is supplemented by statistical testing and regression analysis to explain the findings. The main focus of the CV study is the value of WTP and its causal effects. Therefore, the *variable of interest* is the WTP, i.e. how much each citizen is willing to pay for the government to implement mitigation actions. The following experimental design is the general probabilistic model for the effect on the outcome of citizens' willingness to contribute by the independent variables, also known as control variables, which contain background information, socio-economic factors and attitudes (*woman, age, urban, living years, employed, student, retired, high income, high education, children, household size, diseases, smoke, religious, landowner, global temp, human cause, known situation, problem*). *n* is the sample size.

$$y_i = \beta_0 + \beta_i x_i + \cdots + \beta_n x_n + \varepsilon_i \qquad i = 1, 2, 3, \ldots, n$$

y_i is the dependent variable of interest WTP, which the respondent *i* were given to choose an amount from the payment card in the survey. β_0 is constant and represents the intercept in the regression line. β_i are the slopes for each independent variable x_i with observable effects on WTP by an individual and ε_i is the error term, i.e. the unobserved variables that have not been included in explaining WTP. (Cortinhas & Black, 2012; Wooldridge, 2016)

The focus in this study are the formulated research questions about discovering the stated average WTP and what impact characteristics of demography, socio-economic factors and attitudes have on the WTP. Descriptive statistics, Ordinary Least Square regressions (OLS-regression) and Probit-regressions with marginal effects are performed to find out the answers. An overview of all variables from the survey are presented by descriptive statistics in the Appendix E on page 43.

OLS-regressions are used to predict causal effects on population level from a sample of the population. Maybe the most important condition for a strong OLS-model is the assumption on *homoscedasticity*, which holds if there is no correlation between one of the observed variables and the variability in the unobserved variables, i.e. the error term. If the assumption does not hold, the variables will be overestimated and call the error term *heteroscedastic*. Homoscedasticity is closely related to a second assumption for OLS, stating that the observed variables ought to be *exogenous* and keep no information about the unobserved part. There should also be no collinearity between the observed variables themselves. Observe the correlations between the variables in Appendix F on page 44. Every new observed variable should add "new information" to the causal effect on the dependent variable. Other assumptions involve random sampling and linear parameters in an OLS-regression. (Wooldridge, 2016) All multiple linear regressions (OLS-regressions) in this study predict effects with robust standard errors, i.e. heteroscedasticity is tested to minimize overestimates on the WTP. Nonetheless, the sample is too small to expect unbiased estimates.

The Probit-regression is performed to test the likelihood of impact on the WTP by each independent variable. The dependent variable must be a binary variable to test the likelihood of its outcome, for example the likelihood of a WTP (WTP>0) or no WTP (WTP=0). The probability is simply interpreted by the positive or negative sign of the coefficients. The marginal effect by each coefficient is an approximation by how many percentage points the independent variable has on the outcome if the independent variable decreases or increases by one unit. (Wooldridge, 2016) Mainly dummy variables (binary variables) are regressed, which are interpreted in relation to the benchmarked variable similar in the OLS. See marginal interpretation of for example *retired* on page 26-27.

Statistical testing is used to test hypotheses about the true causal effect, i.e. if the results from the sample can say something about the population mean (Wooldridge, 2016). To derive significant results with true estimates it is important that the distribution of the WTP is normally distributed. A normal distribution is made by the mean value and the standard deviation (std. dev.) and should be symmetrical (bell-shaped). The area under the curve bears the probability 1 (100%), which is related to the *p-value* as an important indicator of significant results from the predicted statistical estimates. (Cortinhas & Black, 2012)

By using the observations from the sample one can test if they are statistically representative about the population. The one-sample t-test is performed to investigate if there is any WTP on population level, i.e. if the mean WTP is larger than 0 KM. To perform a t-test a *null hypothesis* must be formulated. The level of significance is called the alpha, which is the probability of rejecting a true null hypothesis, also called a *type-I error*. *Type-II error* is committed when a false null hypothesis is not rejected. The type-I error is unavoidable if one wants to find the true causal effect, i.e. receive estimations for the whole target group (the population) from few observations of it (the sample). The decision rule here is to reject the null hypothesis if the *p*-value is smaller than alpha equal to 0.05, i.e. on a 5% significance level. (Cortinhas & Black, 2012; Wooldridge, 2016)

Although the focus is turned towards the results of the stated WTP, assessing the differences between the results of the administrators is motivated mainly by curiosity but also for reviewing the reliability of the study. Independent two-sample t-tests are used to study the null hypothesises about equal means of WTP between the characteristics of two groups or samples (Wooldridge, 2016). A summary of 23 t-tests on the variables in the divided sample can be found in the Appendix G on page 45. All in all, there are several variables that differ between the administrators which will be briefly mentioned in the results.

5. RESULTS

This study aims to answer how much the citizens of CS are willing to pay for mitigating air pollution; what are their attitude towards climate change; and what factors explain their WTP for improving the air quality in Sarajevo. A total of 126 observations were collected in Sarajevo by two administrators in May 2017. 118 respondents provided complete answers in the survey and are included in the causal and probability predictions by OLS- and Probit-regressions. Table 1 below provides descriptive statistics on the variables in the regressions.

TABLE 1. Descriptive statistics of the variables used in the regressions

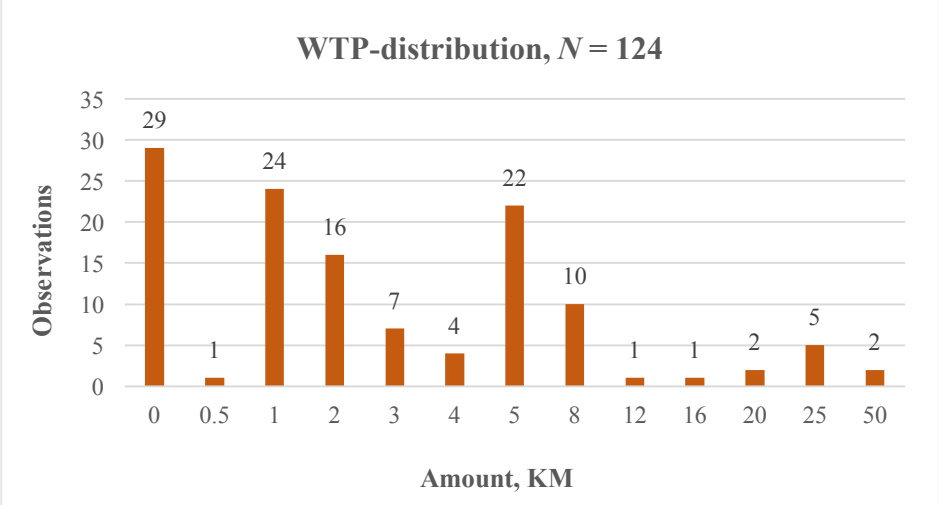
Variable	*Description*	*Obs.*	*Mean*	*Std. dev.*	*Min.*	*Max.*
WTP	= stated amount per month for a three-year period, KM[1]	124	4.65	8.0899	0	50
Woman	= 1, if respondent is a woman	126	0.4603	0.5004	0	1
Age	Years	125	43	15.4228	18	81
Urban	= 1, if living in municipalities Centar, Ilidza, Novi Grad, Novo Sarajevo, Stari Grad	125	0.856	0.3525	0	1
Living years	Years living in Canton Sarajevo	125	32	17.0463	0.67	81
Full time	= 1, if full time employed (40h/week)	126	0.5317	0.501	0	1
Part time	= 1, if part time employed	126	0.0794	0.2714	0	1
Student	= 1, if student	126	0.1667	0.3742	0	1
Retired	= 1, if retired	126	0.1349	0.343	0	1
Unemployed	= 1, if unemployed	126	0.0873	0.2834	0	1
High education	= 1, if completed university/post-graduate education	126	0.5873	0.4943	0	1
High income	= 1, if monthly net income is 901 KM[1] or higher	126	0.3968	0.4912	0	1
Children	= 1, if having children and/or grandchildren under the age of 18	126	0.381	0.4876	0	1
Household size	Number of household members	126	3	1.32598	1	6
Diseases	= 1, if at least one household member suffers from heart or lung disease	126	0.2143	0.412	0	1
Smoke	= 1, if respondent smokes cigarettes	125	0.336	0.4742	0	1
Religious	= 1, if considers themselves religious	124	0.7097	0.4558	0	1
Landowner	= 1, if owner of land	126	0.4762	0.5014	0	1
Global temp	= 1, if believes in increasing global temperature	126	0.8571	0.3513	0	1
Human cause	= 1, if believes that humans are the main cause of climate change	126	0.8413	0.3669	0	1
Known situation	= 1, if knows about the magnitude of the pollution in BiH	126	0.9127	0.2834	0	1
Problem	= 1, if thinks pollution is a problem in Sarajevo	126	0.9762	0.1531	0	1
Enumerator	= 1, if survey administered by the enumerator	126	0.4603	0.5004	0	1

[1] (1 EUR ≈ 2 KM)

5.1 How much are the citizens willing to pay?

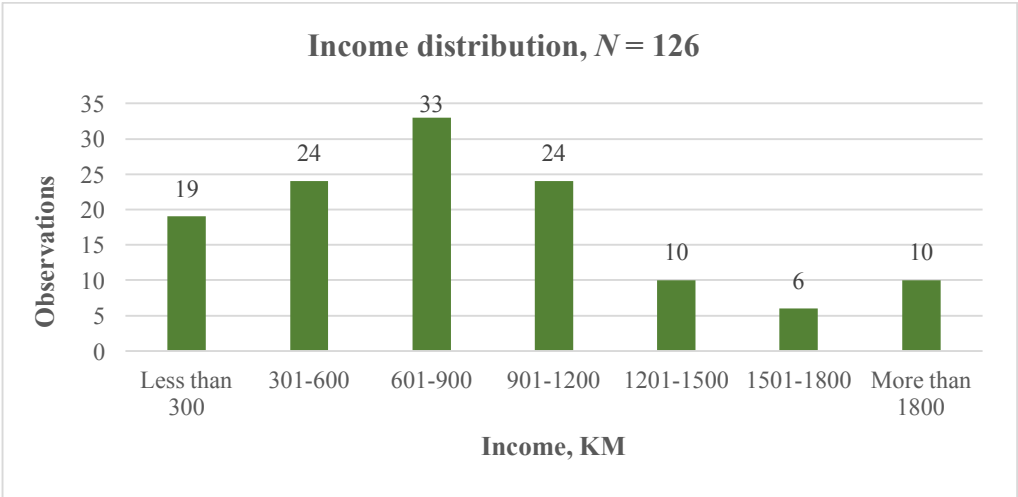
Given the responses on the payment card, the total mean value of WTP is predicted to be 4.65 KM (≈ 2.30 EUR) which is found in the 95% confidence interval [3.21–6.09]. The median is 2 KM and is the 50th-percentile relevant from a democratic perspective, but the mode is 0 KM with the majority of 23%. Thus, the distribution of WTP is positively skewed with high outliers to the right, which makes the normal distribution (symmetry) questionable in the t-tests. Observe the distribution in Diagram 2 below.

Diagram 2.



The estimated average monthly net income in the sample is around 800 KM, which makes the mean WTP (4.65 KM) about 0.6% of the disposable income. See the income distribution from the sample in Diagram 3 below. Mind that more than 60% stated they were employed.

Diagram 3.



A one-sample t-test is performed to see if there is a WTP for increased air quality on population level. See Table 2. The null hypothesis (H_0) one would like to reject is that there is no WTP on population level. The alternative hypothesis (H_a) one would like to prove is that there is a WTP.

$$H_0: WTP = 0$$
$$H_a: WTP \neq 0$$

TABLE 2. One-sample t-test – WTP

Group	**Obs.**	**Mean**	**SE**	**Std. dev.**	**95% CI**
WTP	124	4.65	0.73	8.09	3.21 – 6.09
t-statistics	6.3995				
p-value	0.0000				

The null hypothesis is rejected since the *p*-value is smaller than alpha ($p<0.05$). This means that there is a WTP on population level. Considering the observations on WTP are not normally distributed, the *p*-value is critical. Making an observation from the table in Appendix D, the average WTP is 3.50 KM higher among urban residents than among residents in rural areas, which can be explained by being exposed to higher concentrations of air pollution in urban developments.

5.2 What impacts the WTP?

Since one in four respondents stated no WTP the OLS-prediction of the WTP by the whole sample could be biased. Nevertheless, a majority of the respondents are familiar with the polluted situation and believe in climate change by the increasing global temperature and humans impact of the change. The biggest consensus among the respondents is on air pollution being a problem in Sarajevo. See the percentage points in Table 3. Moreover, all of the respondents that had no WTP for mitigating the pollution believe that air pollution in Sarajevo is a problem.

TABLE 3. Respondents' attitude, $N = 126$

Attitude (binary variables)	**Share of sample (%)**
Global temperature is increasing	86
Humans are the main cause for climate change	84
I am familiar with the situation as described	91
Air pollution is a problem in Sarajevo	98

To estimate the causal effects on the WTP by certain factors with a hypothesized impact, an OLS-regression was performed on the demographic (1) and attitudinal (2) variables from the study. In addition, the effect by including an enumerator to assist in the field study was considered in the last regression (3). The specification for the OLS-regressions is stated below and the estimated coefficients are presented in Table 4.

$$WTP_{air} = \beta_0 + \beta_1 Woman + \beta_2 Age + \beta_3 Urban + \beta_4 Living\ years + \beta_5 Full\ time + \beta_6 Part\ time + \beta_7 Student + \beta_8 Retired + \beta_9 High\ income + \beta_{10} High\ education + \beta_{11} Children + \beta_{12} Household\ size + \beta_{13} Diseases + \beta_{14} Smoke + \beta_{15} Religious + \beta_{16} Landowner \quad (1)$$

$$+ \beta_{17} Global\ temp + \beta_{18} Human\ cause + \beta_{19} Known\ situation + \beta_{20} Problem \quad (2)$$

$$+ \beta_{21} Enumerator \quad (3)$$

TABLE 4. OLS-regression on WTP by (1) demographic variables, (2) demographic variables and attitude variables, and (3) demographic, attitude variables along with the influence of the enumerator. (Robust standard errors are specified in parentheses.)

Variables	**(1)**	**(2)**	**(3)**
_constant	4.68 (5.19)	7.99 (6.60)	8.81 (6.50)
Woman	3.77 (1.57)**	3.56 (1.58)**	2.28 (1.44)
Age	- 0.18 (0.09)**	- 0.18 (0.09)**	- 0.13 (0.09)
Urban	2.33 (1.65)	1.81 (1.80)	0.46 (1.73)
Living years	0.07 (0.07)	0.06 (0.07)	0.04 (0.07)
Full time	1.11 (1.68)	1.13 (1.59)	1.15 (1.70)
Part time	- 0.39 (1.48)	- 0.83 (1.59)	1.24 (1.75)
Student	0.56 (2.08)	- 0.27 (1.89)	0.18 (1.94)
Retired	- 0.30 (2.55)	- 0.87 (2.95)	- 0.68 (3.03)
High income	2.55 (1.73)	2.08 (1.84)	2.73 (1.86)
High education	- 1.75 (1.41)	- 1.87 (1.39)	- 1.93 (1.37)
Children	1.41 (1.55)	1.62 (1.69)	2.33 (1.73)
Household size	- 0.70 (0.55)	- .74 (0.60)	- 0.67 (0.59)
Diseases	0.41 (2.11)	0.82 (2.27)	1.26 (2.19)
Smoke	0.67 (1.56)	0.56 (1.60)	0.21 (1.54)
Religious	1.03 (1.39)	1.36 (1.46)	2.14 (1.57)
Landowner	4.49 (1.66)***	4.28 (1.63)***	3.25 (1.44)**
Global temperature		2.99 (1.61)*	2.31 (1.54)
Human cause		0.50 (1.68)	0.11 (1.65)
Known situation		- 0.91 (1.79)	- 0.51 (1.81)
It's a problem		- 4.75 (4.04)	- 3.40 (4.25)
Enumerator			- 4.91 (1.55)***
R^2	0.2057	0.2324	0.2850
N	118	118	118

Note: *, ** and *** indicate significance at 10%, 5% and 1%, respectively.

The results from the first two regressions predicted that women and landowners have each a significant positive effect on WTP in the first two OLS-regressions on a 5% and 1% level, respectively. Women were predicted to be willing to pay an average of almost 4 KM more than

men each month. Landowners were expected to pay around 4.50 KM per month on average. Whilst, age had a significant negative effect on WTP; for every year older an individual became the WTP decreased by barely 0.20 KM on a 5% significance level.

Adding the control variables of attitude in the second regression, only those that believe in increased global temperature had an effect on WTP by a 10% significant level. The WTP was predicted to increase by 3 KM by those that believe in global temperature increase. The effects of the other significant variables from earlier (1) stay approximately the same.

The variable *enumerator* changed the significance of the others in the third regression. The survey administration by the enumerator is predicted to have a strong influence on the stated amount of contribution. On a 1% significance level, the citizens approached by the enumerator were predicted to have a WTP of almost 5 KM less on average than those approached by the author.

The coefficient of multiple determination (R^2) provides a value from 0 to 1 of how well each of the independent variables together in the regression model explain the dependent variable WTP (Wooldridge, 2016). The variation by the chosen control variables in the first model explained the effect on WTP by a little over 20%. Adding the attitude variables and the enumerator's administration, the R^2 adds almost 8 percentage points more for explaining the effect on WTP.

✷✷✷

The Probit-regression is performed to elucidate what factors increase or decrease the probability of stating no WTP. The specification for Probit-regressions by marginal effects on the probability of having no WTP is stated below.

$$\begin{aligned} Pr\,(1 \mid no\ WTP) = \Phi\,(&\beta_0 + \beta_1 Woman + \beta_2 Age + \beta_3 Urban + \beta_4 Living\ years \\ &+ \beta_5 Full\ time + \beta_6 Part\ time + \beta_7 Student + \beta_8 Retired \\ &+ \beta_9 High\ income + \beta_{10} High\ education + \beta_{11} Children + \beta_{12} Household\ size \\ &+ \beta_{13} Diseases + \beta_{14} Smoke + \beta_{15} Religious + \beta_{16} Landowner \\ &+ \beta_{17} Global\ temp + \beta_{18} Human\ cause + \beta_{19} Known\ situation + \beta_{20} Problem \quad (4) \\ &+ \beta_{21} Enumerator) \quad (5) \end{aligned}$$

The results from the first Probit-regression (4) in Table 5 predicted four significant factors that explain the probability of not being willing to contribute. By a significance level of 5%, age had a positive effect on no WTP; for every year older the probability of having no WTP increases by 10 percentage points. This positive marginal effect is supported by the results from the OLS-regressions where age predicted a negative effect on WTP. Full time or part time employed and retired individuals have, in comparison to unemployed, a negative significant effect on the probability of no WTP, i.e. 32, 16 and 24 percentage points lower probability than unemployed for stating no WTP, respectively. The variable *retired* was the most significant variable on an 1% level and this first Probit-regression explained the probability effect on WTP by almost 25%.

TABLE 5. Marginal effects on the probability of not having a WTP

Variables	**(4)**	**(5)**
Female	- 0.07 (0.09)	- 0.13 (0.08)
Age	0.10 (0.01)**	0.01 (0.01)***
Urban	- 0.14 (0.16)	- 0.21 (0.17)
Living years	- 0.001 (0.003)	- 0.002 (0.003)
Full time	- 0.32 (0.17)*	- 0.30 (0.17)*
Part time	- 0.16 (0.09)*	- 0.10 (0.12)
Student	- 0.08 (0.15)	- 0.04 (0.16)
Retired	- 0.24 (0.07)***	- 0.23 (0.06)***
High income	- 0.12 (0.11)	- 0.12 (0.11)
High education	0.001 (0.11)	0.02 (0.10)
Children	- 0.03 (0.10)	0.01 (0.10)
Household size	0.01 (0.04)	0.01 (0.04)
Diseases	0.11 (0.12)	0.14 (0.13)
Smoke	0.04 (0.09)	0.02 (0.09)
Religious	0.09 (0.09)	0.12 (0.08)
Landowner	- 0.09 (0.09)	- 0.12 (0.08)
Global temperature	- 0.18 (0.15)	- 0.24 (0.16)
Human cause	- 0.01 (0.14)	- 0.04 (0.14)
Known situation	0.04 (0.13)	0.04 (0.12)
It's a problem	Collinear	Collinear
Enumerator		- 0.22 (0.10)**
Pseudo R^2	0.2466	0.2792
N	117	117

Note: *, ** and *** indicate significance at 10%, 5% and 1%, respectively.

In the second Probit-regression (5), when the variable *enumerator* was included with the regressors from the previous regression (4), the variable *part time* lost its significance. *Full time* employed and *retired* kept their respective significance level, but decreased their respective marginal effect on the probability of no WTP. Meanwhile, age had a stronger significant effect; for every year older an individual became the probability of having no WTP increased now by only one percentage point. Those respondents who took the survey administered by the

enumerator were 22 percentage points less likely to have a zero WTP than those administered by the author. Adding the variable *enumerator* in the second Probit-regression explained the probability effect on WTP by almost 28%, which is 3 percentage points higher than in the previous regression.

The variable *It's a problem* gave no new information in the Probit-regressions, thus failed the condition of no perfect collinearity. See the section earlier on data and econometric specification. This is due to *It's a problem* being a constant in the Probit-regression on not having a WTP, since all those that stated no WTP thought there is a problem with air pollution in the city. Note that only three observations in the sample did not think that air pollution is an issue in Sarajevo.

The probability of having a WTP greater than 0 KM, i.e. to have a willingness to contribute at all, is revealed by simply switching the sign of a coefficient. For example, retired individuals were 23 percentage points more likely to pay than unemployed in the second Probit-regression (5).

5.3 The influence of the enumerator

The enumerator collected 58 observations predominantly in-person and few by telephone. Making up almost half of the sample size there are reasons for studying the administration of the survey by the enumerator. However, the influence of the enumerator and the methodology is not focused in the research questions of this study. Table 6 below shows some of the distributions of stated WTP in the samples.

TABLE 6. Statistical description of the stated WTP in three samples, KM

Mean	Median	Mode	Min	Max	CI 95%
		Whole sample (N=124)			
4.65	2	0	0	50	**3.21 – 6.09**
		Author (n=66)			
7.38	5	5	0	50	**4.86 – 9.90**
		Enumerator (n=58)			
1.54	1	1	0	5	**1.12 – 1.97**

To test if there is a statistical significant dissimilarity between the average WTP estimated by the two administrators, the null hypothesis is that there is no difference between the administrator's mean WTP and the alternative hypothesis suggests that there is.

$$H_0: \textit{diff (enumerator, author)} = 0$$
$$H_a: \textit{diff (enumerator, author)} \neq 0$$

TABLE 7. Independent two-sample t-test with unequal variances – average WTP by administrators

Group	**Obs.**	**Mean**	**SE**	**Std. dev.**	**95% CI**
Author	66	7.38	1.26	10.27	4.86 – 9.90
Enumerator	58	1.54	0.21	1.62	1.12 – 1.97
t-statistics	4.5545				
p-value	0.0000				

By the results from the two-sample t-test presented in Table 7, the null hypothesis is rejected and there is a significance on a 1% level that the mean WTP between the author's survey administration and the enumerator's differ from one another. One could only speculate what the difference between the administrators results depends on. By observing the results from the t-tests for significant differences between the administrators in Appendix G, the lower average WTP from the enumerator's elicitation could depend on a smaller share of people that believe in global temperature increase, fewer women and landowners, and a larger share of elderly in the sample. Even if all considered the air pollution in Sarajevo as a problem more respondents in the enumerator's administration had no WTP than those administered by the author. Notwithstanding several statistically significant differences, both administrators tried to keep an objective approach to minimize biased results.

6. DISCUSSION

The reason for few environmental studies in BiH could be the absence of consistent records and scarcity of local resources. Although there are various views of the true magnitude of impact air pollution has on environment and health, the scenario of the study circumvents providing too much information about the specific effects. Similar to the strategy taken by Carlsson and Johansson-Stenman (2000) the author had no intention to focus on evaluating how much the pollution impacts the life of the citizens and their thoughts on the matter. Instead, focus was turned towards the citizens' willingness to contribute monetarily for an improvement of the air quality in Sarajevo. The average WTP (4.65 KM) represents less than 1% of the predicted average monthly net income level in the sample (800 KM). Since the average monthly net income is around 1,000 KM in the population of CS a tax surcharge by almost 5 KM would barely be noticed in the budget of an average citizen in CS. The descriptive statistics show that 60% of the respondents are mainly employed and only 9% out of work in the sample, which does not represent the socio-economic conditions in the population.

It is important to remember that CV studies are applied in different settings, which makes it problematic to make comparisons and draw finite conclusions from their predicted estimates. Disregarding unrepresentative population in this sample, the average WTP had similar outcomes as most of those in the earlier mentioned CV studies when considering the WTP in relation to local average income levels, though different predicted significant causal effects. Wang et al (2006) and Carlsson et al (2012) both provided results of mean WTP being less than or around 1% share of income levels. In addition, the sample share of those willing to pay was 77% in this study, which represents nearly the median (between 66-92%) from the share of WTP in similar previous CV studies (Carlsson & Johannson-Stenman; 2000; Wang et al, 2006; Carlsson et al, 2012; Wei & Wu, 2017). Significant higher estimates of WTP among urban residents were not only found in Sweden (Carlsson & Johannson-Stenman, 2000) and China (Wang et al, 2006) but also in CS. The significant decreasing effect by age on WTP was also predicted by Wang et al (2006), however opposite results were found by Wei & Wu (2017).

Notwithstanding, the sample is too small to say anything specific about the outcome, even if few factors were statistically significant. Women, landowners and individuals who believe that the global temperature is increasing were predicted to have a willingness to contribute for

improving the air quality, while the willingness decreased by age. Thus, one would interpret that the younger population have more motivation to improve their living conditions since they have more years to live than older individuals. Elderly express a hopeless feeling without a place in the society, even though some mentioned bequest values in consideration of their grandchildren. But due to their experience of insecure incomes the probability of their WTP decreased as expected in the regression model. Thus, even if retirees would contribute more than they are capable, their responses seem to be somewhat rational, which is perceived as the hypothetical bias is minimized.

Even if more variables are included in a model or the R^2 increases, it does not mean true causal effects are predicted in the model. What is statistically significant may not be economically significant and vice versa. Educational level showed a negative (and insignificant) effect on WTP, which could indicate that environmental actions are not prioritized by those with high education. However, considering that a rather large share of highly educated are missing qualified jobs (Institute for Statistics of FBiH, 2017a-b) it could then explain the probability of no WTP.

One in four respondents were not willing to pay although every one of these saw the polluted situation in Sarajevo as a problem. Thus, there could be other aspects in the unobserved part that explain the absent WTP than those observed variables in the models. Observing those reasons provided by the respondents in Table 8, the public's attitude and view of the government is relevant when sceptic about the real interests and outcomes of the scenario. These results are similar to the reasons found by Wang et al (2006) and Wei & Wu (2017) in China.

TABLE 8. Shared reasons for stated WTP

Most popular responses	**Share of sample (%)**
According to private budget	16 (12.8)
Fair amount for us as citizens	7 (5.6)
Sceptical towards the government	6 (4.8)
The government should pay/PPP	5 (4)
Other (health, future generations, etc.)	11 (8.8)
No stated reasons	81 (64.8)
Total	126 (100.8)*

* Due to rounding.

Expressing disbelief for the actions in the scenario could indicate taking the matter seriously and imagining the possible improvements as non-hypothetical and an urgent issue worth the while. On the other hand, the given scenario could be of no meaning and promote no WTP due to strategic answering and low incentive compatibility. The scepticism towards the government can persist regardless of which actions would be implemented, as long as the government is the stakeholder. Nonetheless, it is easy to think that "everything is the government's fault", but then again, the apathetic, impecunious state is apparent in many citizens' every-day life for a reason. Thus, note in Table 8 that the majority did not share their reason for their WTP, which makes it difficult to continue this discussion without too many speculations. However, alike the study conducted by Carlsson et al (2012) which compared attitudes on climate change in China, Sweden and USA, the majority of the respondents in CS believe that the global temperature is rising and that human activities are the cause of the increase. In comparison to these three countries the estimated attitudes in BiH on these matters lie between those in Sweden and USA.

Other assumed factors that could impact the answers by the respondents is which lost and gained features of improved air quality are considered (e.g. visibility in the city, health effects and prices of other energy sources), the administration of the survey during clear summer days when few visible polluted days, the interview setting to fill out the survey, previous knowledge related to the scenario and subject, and priorities of the individuals in BiH. Notwithstanding the small sample, there is however a large share (98%) of the citizens that experience the air pollution as a problem in Sarajevo which seem to be willing to mitigate the related issues.

7. CONCLUSION

Even though the estimates from this CV study bring implications that the citizens are willing to contribute monetarily for mitigating the air pollution, the absolute valuation should be taken with great caution. The estimates predict that the average citizen living in Canton Sarajevo is willing to pay 4.65 KM/month during a three-year period, which represents less than 1% of average income per month. This aggregates to around 170 KM/person or 57 million KM for the total contribution from the society[5] after three years. For a 20% reduction of air pollutants this is a substantial amount that should not be disregarded for potential improvements of air quality and other related environmental issues in Sarajevo and surrounding areas.

Few demographic or socio-economic factors had a significant impact for the population by this study. From the OLS-regression, women were willing to pay an average of almost 4 KM more than men each month. WTP was predicted to increase by landowners and those who believe that the global temperature is rising, but decrease by age and the enumerator's survey administration. However, those taking the survey by the enumerator were more likely to be willing to pay than those that were approached by the author in the study, even if the observations by the author had fewer that had no WTP. Suggestive implications showed that full time employed and retirees were more likely to pay for mitigating the air pollution than unemployed but the probability of having no willingness to pay increased with age.

Classical comments for a small sample study is to work for a bigger sample to reach a greater share of the population and estimate the true causal effects on the variable of interest. By modifying the CV survey and perhaps combining it with a CE could be a trail to understand the indications of the citizens' preferences better (Hanley et al, 1998; Powe, 2007). Similar research in the future could be applied in other polluted cities in BiH by the support of this study.

Along with investigating citizens' preferences, it is equally important to harmonize regulation and increase function of the air quality monitoring in several cities in BiH to promote sustainable development in every aspect. Despite a small sample, this study predicts estimates as indication of support from the citizens on improving the air quality in Sarajevo.

[5] Population in working age (>15 years) in CS = 346,595 inhabitants (Institute for Statistics of FBiH, 2017b).

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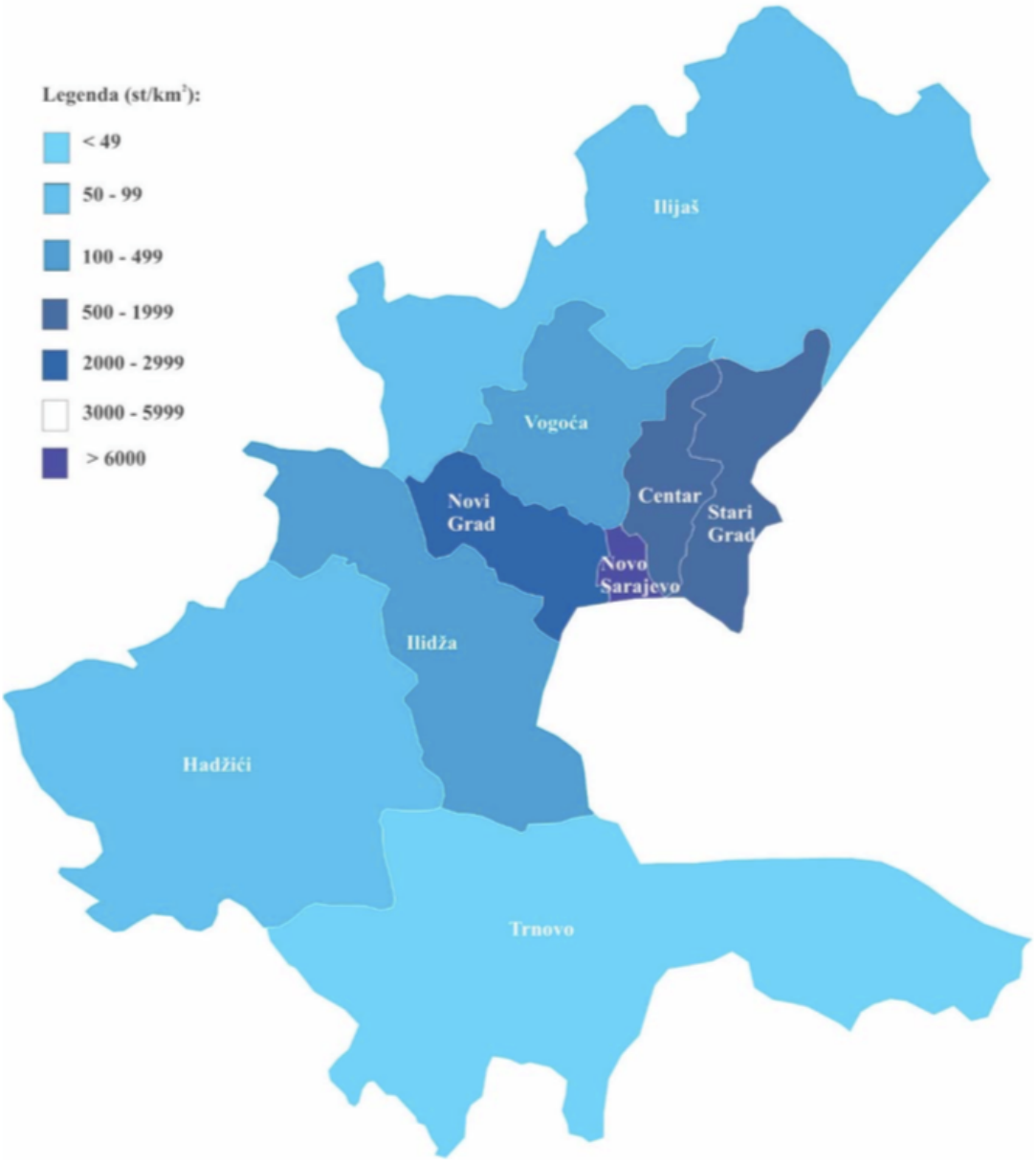
APPENDIX

A. Density in municipalities of Canton Sarajevo



Source:
http://zpr.ks.gov.ba/sites/zpr.ks.gov.ba/files/demografska_analiza_ks_po_opcinama_03-16-finalno.pdf (2017)

The municipalities Centar, Novi Grad, Novo Sarajevo and Stari Grad make up the City of Sarajevo. In this study, Ilidža is included as urban due to its urban development.

See distribution of the average WTP for respective municipality on page 42.

UNIVERSITY OF GOTHENBURG
SCHOOL OF BUSINESS, ECONOMICS AND LAW

Sida
SWEDISH INTERNATIONAL DEVELOPMENT COOPERATION AGENCY

SURVEY

Estimating monetary value of air quality by mitigating air pollution

The situation today

Several studies show that air pollution is associated with increased rates of deaths and diseases, particularly in urban regions. Air pollutants such as acid gases (SO_2 and NO_x) and fine particles (PM_{10} and $PM_{2,5}$) have unfavorable health effects on heart and lung systems. These pollutants come mainly from coal energy plants and vehicles driven on fossil fuels, which also have negative effects on animals, plants, agricultural and cultural assets. About 70% of Bosnia-Herzegovina's energy production comes from coal and new coal energy plants are planned for construction in the coming years, which generates most of the pollution in BiH. Health costs in BiH, associated with air pollution, amount to over 20% of GDP. This percentage is one of the largest in the region and in Europe. The average unit values of air pollutants are exceeding the recommended values more frequently in Sarajevo, which threatens the health of the citizens throughout the year and not only during the colder months when the smog is visible.

Possible improvements

Assume that the government were about to take actions which include improving energy supply and efficiency use, infrastructure, emissions control from industrial and individual furnaces, and evaluation of quality work to reduce air pollution in BiH. With these actions, concentration of the mentioned air pollutants could be reduced by 20% within three years in Sarajevo, and the probability of individuals and household members suffering from lung and heart diseases related to air pollution can be substantially reduced. Assuming higher budget for implementation yields better results, i.e. positive effects, this research investigates how much citizens would be ready to contribute for implementing the actions mentioned in this paragraph.

N.B.! The contribution would be accounted as a monthly tax payment and would concern all citizens of the Canton Sarajevo during 2018-2020 (three years). The government would implement the mentioned actions for improving the air quality when at least 50% of the citizens in Canton Sarajevo would be willing to contribute. Positive effects would be seen already from year 2019. Every citizen would pay the same tax which would be charged in addition to your municipal taxes. Your stated contribution is by freewill, but if you use money for this purpose, you cannot use the money for any other purpose. Please think carefully about how much you are willing to contribute, there may be many other goods and services that you would also like to buy or would have to pay for. Consider your own budget before answering question number 5 and state your amount as truthfully as you can.

Your attitude

1. Do you believe in increasing global temperature? □ Yes □ No

2. Do you believe that humans are the main cause of the climate change? □ Yes □ No

3. Did you know about the polluted situation in BiH as described here? □ Yes □ No

4. Do you think pollution is a problem in Sarajevo? □ Yes □ No

How much would you be willing to contribute?

5. Which amount best describes your maximum willingness to pay (KM) monthly during a three-year period, through a tax surcharge, to improve the air quality in Sarajevo with the actions described in the first page? *(encircle one of the 13 following amounts)*

Monthly in KM:	**0.00**	**0.50**	**1.00**	**2.00**	**3.00**	**4.00**	**5.00**
(Yearly in KM:)	(0.00)	(6.00)	(12.00)	(24.00)	(36.00)	(48.00)	(60.00)
Monthly in KM:	**8.00**	**12.00**	**16.00**	**20.00**	**25.00**	**More than 25.00: _____**	
(Yearly in KM:)	(96.00)	(144.00)	(192.00)	(240.00)	(300.00)	*please specify your amount*	

State your reason why you chose the amount above *(optional)*:

_____

Background questions

Gender: □ Male □ Female **Age** *(year of birth):* _____

Municipality: _____
(Centar, Hadžići, Ilijaš, Ilidža, Novo Sarajevo, Novi Grad, Stari Grad, Trnovo or Vogošća)

How long have you been living in the Canton of Sarajevo? _____

What is your main status?
□ Working full time *(40h/week)* □ Student
□ Working less than full time □ Retired □ Unemployed

What is your level of finished education?
□ Elementary school or less □ Secondary school □ University and post-graduate degree

In what interval is your monthly income *(net, KM)***?**
□ Less than 300 □ 601-900 □ 1201-1500
□ 301-600 □ 901-1200 □ 1501-1800 □ More than 1800

How many children do you have? _____

Do you have children/grandchildren under 18 years old? □ Yes □ No

Number of household members *(including yourself):* _____

What is the main source of energy (electricity, heat and cooling) in your household?
□ Coal *(lignite, brown coal, coal briquettes and charcoal)*
□ Oil *(extra light fuel oil and liquefied petroleum gas)*
□ Natural gas
□ Renewable energy *(hydro, wind, geothermal, biomass and agricultural waste)*
□ Wood pellets
□ Other wood *(fuelwood, wood briquettes, wooden planks and similar)*
□ I do not know

Other: _____

Does anyone in your household (including yourself) suffer from heart or lung diseases?

□ Yes □ No

Do you smoke cigarettes? □ Yes □ No

If Yes: How many cigarettes/day on average?

□ 1-10 cigarettes □ 11-20 cigarettes □ More than 20 cigarettes

How much money/week do you spend on cigarettes? _____KM

Do you consider yourself religious? □ Yes □ No

Do you own any land in BiH? □ Yes □ No

How well did you understand this survey? □ Completely □ Partially □ Not at all

Comments *(optional)*

THANK YOU FOR YOUR ANSWERS!

C. Compilation of earlier studies on air pollution

TABLE 9. Overview of earlier studies on air pollution in relation to this study

Study	Place	Public good	Scenario	Mean WTP[1]/year	Payment vehicle	Elicitation format
Osmanovic (2017)	Sarajevo, BiH	Air pollution	20% reduction of pollution concentration	€30/person	Income tax surcharge	Payment card
Akhtar et al (2017)	Lahore, Pakistan	Air quality improvement	Decrease level of atmospheric contamination by 50%	€100/person	Different but unspecified	Open-ended
Wei & Wu (2017)	China	$PM_{2.5}$ pollution	80% reduction of severe $PM_{2.5}$ pollution days	€80/person	Multiple alternatives	Payment card
Ndambiri, Mungatana & Brouwer (2015)	Nairobi, Kenya	Improve air quality management	Policy proposal through motorised emission reduction	€40/person	Onetime payment	Payment card
Vlachokostas et al (2011)	Thessaloniki, Greece	Air quality improvement	Increasing life expectancy with one year	€920/person	Green tax	Open-ended
Wang & Zhang (2009)	Jinan, China	Air quality improvement	Raise the air quality standards from Class III to Class II	€10/person	Fee	Open-ended
Wang et al (2006)	Beijing, China	Air environment	50% reduction of the air pollutant concentration in five years	€20/household	Fee	Open-ended
Afroz et al (2005)	Klang Valley, Malaysia	Air quality improvement	20% reduction of $PM_{2.5}$	€0.02/litre	Increased fuel price	Open-ended, payment card and dichotomous choice
Carlsson & Johansson-Stenman (2000)	Sweden	Air pollution	50% reduction of harmful substances	€210/person	Fee by income proportion	Open-ended
Halvorsen (1996)	Norway	Air pollution	50% reduction due to reduced emissions from traffic	€130/person	Income tax surcharge	Open-ended

Note: Partially compiled from Carlsson & Johansson-Stenman (2000) and Wei & Wu (2017).
[1] Converted to euros by www.xe.com and rounded (1 EUR ≈ 1.95 BAM ≈ 1.20 USD ≈ 9.50 SEK ≈ 7.85 CNY ≈ 121.95 KES ≈ 5 MYR). Inflation is not considered.

D. Average WTP for municipalities in Canton Sarajevo

TABLE 10. Average WTP for nine municipalities in Canton Sarajevo, respectively.

Settlement	**Municipality**	**Share of population (%)[1] (2016)**	**Share of sample (%)**	**Mean WTP** (KM) $N = 124$	**Mean net income[1] (2016)** (sample mean $N = 126$)
Urban	Centar Sarajevo	54,369 (13)	31 (25.6)	4.69	1,197 (530)
	Ilidža	69,164 (16.6)	16 (12.8)	4.38	820 (807)
	Novi Grad Sarajevo	119,694 (28.7)	25 (20.8)	8.44	868 (813)
	Novo Sarajevo	64,639 (15.5)	22 (17.6)	3.68	1,115 (1104)
	Stari Grad Sarajevo	36,395 (8.7)	11 (8.8)	2.45	1,027 (846)
Urban total:		344,261 (82.5)	105 (85.6)	4.73	1,005 (820)
Rural	Hadžići	24,264 (5.8)	2 (1.6)	0.50	832 (450)
	Ilijaš	20,283 (4.9)	4 (3.2)	0.25	638 (1050)
	Trnovo	1,238 (0.3)	1 (0.8)	1.00	814 (750)
	Vogošća	27,452 (6.6)	11 (8.8)	3.09	763 (546)
Rural total:		73,237 (17.6)	18 (14.4)	1.21	762 (699)
Canton Sarajevo Total:		417,498 (100.1)[2]	124 (100)	3.16	1,018 (798)

[1] Source: http://fzs.ba/wp-content/uploads/2017/07/Kanton-Sarajevo-u-brojkama.pdf (2017)

[2] Due to rounding.

E. Summary of all variables from the survey

Variable	*Description*	*No. obs.*	*Mean*	*Std. dev.*	*Min.*	*Max.*
WTP	= stated amount per month for a three-year period, KM	124	4.65	8.0899	0	50
Woman	= 1, if female	126	0.4603	0.5004	0	1
Age	Years	125	43	15.4228	18	81
Urban	= 1, if living in municipalities Centar, Ilidza, Novi Grad, Novo Sarajevo, Stari Grad	125	0.856	0.3525	0	1
Living years	Years living in Canton Sarajevo	125	32	17.0463	0.67	81
Full time	= 1, if full time employed	126	0.5317	0.501	0	1
Part time	= 1, if part time employed	126	0.0794	0.2714	0	1
Student	= 1, if student	126	0.1667	0.3742	0	1
Retired	= 1, if retired	126	0.1349	0.343	0	1
Unemployed	= 1, if unemployed	126	0.0873	0.2834	0	1
Primary	= 1, if completed or uncompleted elementary/compulsory education	126	0.0238	0.1531	0	1
Secondary	= 1, if completed secondary education (high school/gymnasium)	126	0.3889	0.4894	0	1
High education	= 1, if completed university/post-graduate education	126	0.5873	0.4943	0	1
High income	= 1, if monthly income is 901 KM or higher	126	0.3968	0.4912	0	1
Children#	Number of children	126	1	1.0797	0	4
Children	= 1, if having children and/or grandchildren under the age of 18	126	0.381	0.4876	0	1
Household size	Number of household members	126	3	1.32598	1	6
Diseases	= 1, if at least one household member suffers from heart or lung disease	126	0.2143	0.412	0	1
Smoke	= 1, if respondent smokes cigarettes	125	0.336	0.4742	0	1
Cigarettes day	= 1, if more than one package (20 cigarettes) per day by those who smoke	42	0.1905	0.3974	0	1
Cigmoney week	Weekly spending on purchasing cigarettes by those who smoke, KM	40	29.14	20.66	5	100
Religious	= 1, if considered religious	124	0.7097	0.4558	0	1
Landowner	= 1, if owner of land	126	0.4762	0.5014	0	1
Understand completely	= 1, if completely understands survey	126	0.9286	0.2586	0	1
Understand partially	= 1, if partially understands survey	126	0.0635	0.2448	0	1
Don't understand	= 1, if does not understand survey	126	0	0	0	0
Global temp	= 1, if believes in increasing global temperature	126	0.8571	0.3513	0	1
Human cause	= 1, if believes that humans are the main cause of climate change	126	0.8413	0.3669	0	1
Known situation	= 1, if knows about the magnitude of the pollution in BiH	126	0.9127	0.2834	0	1
Problem	= 1, if thinks pollution is a problem in Sarajevo	126	0.9762	0.1531	0	1
Coal	= 1, if coal	126	0.1349	0.343	0	1
Oil	= 1, if oil	126	0.1349	0.343	0	1
Gas	= 1, if gas	126	0.5794	0.4956	0	1
Renewables	= 1, if hydro, wind, geothermal, biomass and agricultural waste	126	0.0238	0.1531	0	1
Pellet	= 1, if wood pellet	126	0.0476	0.2138	0	1
Other wood	= 1, if other wood than pellet	126	0.1825	0.3878	0	1
Electricity	= 1, if a power plant with mix energy sources (hydro/wind/coal)	126	0.0794	0.2714	0	1
Mix energy	= 1, if actively mixes energy source	126	0.1825	0.3878	0	1
Enumerator	= 1, if survey administered by the enumerator	126	0.4603	0.5004	0	1

F. Correlation between variables in the regressions

	wtp	female	age	urban	living~s	fulltime	parttime	student
wtp	1.0000							
female	0.1890	1.0000						
age	-0.1417	0.0326	1.0000					
urban	0.1232	-0.0451	-0.0728	1.0000				
livingyears	-0.0255	-0.0374	0.6391	0.0860	1.0000			
fulltime	0.2316	-0.0322	-0.0862	0.1347	0.0318	1.0000		
parttime	-0.1127	0.0155	0.1478	-0.2218	-0.0241	-0.3148	1.0000	
student	-0.0051	-0.0008	-0.5363	0.0484	-0.3801	-0.4532	-0.1333	1.0000
retired	-0.1378	-0.0033	0.5968	0.0309	0.4562	-0.4244	-0.1248	-0.1797
highincome	0.1353	-0.0474	0.1231	0.1731	0.1638	0.5495	-0.1136	-0.3440
higheduc	0.0413	0.0776	-0.1516	0.2909	-0.0550	0.1835	-0.1141	-0.0052
under18	-0.0343	-0.0823	0.4103	-0.0257	0.1760	0.0257	0.0743	-0.3440
household	-0.0739	-0.1569	-0.1799	-0.0227	-0.2008	-0.0437	-0.0730	0.1695
diseases	0.0772	0.1287	-0.0438	0.1086	0.0553	0.0421	-0.0209	-0.1288
smoke	-0.0013	-0.0520	0.1403	0.1473	0.0616	-0.0069	-0.0303	-0.0291
religious	0.0592	0.1175	0.0254	-0.1012	-0.1421	0.0590	-0.0080	-0.0267
ownland	0.2194	-0.0715	0.1760	-0.0521	0.0168	0.1893	-0.0403	-0.1320
glotemp	0.1851	-0.0216	-0.0448	0.2287	0.0694	0.0616	-0.0402	0.0576
humancause	0.1554	0.0999	-0.1041	0.0379	-0.1365	0.0864	0.0382	0.1141
situation	0.0784	0.0129	-0.1601	0.2005	-0.1124	0.2150	-0.1118	-0.0181
problem	-0.0788	-0.0621	0.0614	-0.0663	0.0222	0.1671	0.0491	-0.2222
enumerator	-0.3708	-0.2215	0.2771	-0.2725	0.0645	-0.1012	0.3095	-0.2001

	retired	highin~e	higheduc	under18	househ~d	diseases	smoke	religi~s
retired	1.0000							
highincome	-0.1234	1.0000						
higheduc	-0.1440	0.4846	1.0000					
under18	0.2244	0.1738	-0.0819	1.0000				
household	-0.1400	0.0403	-0.0155	0.2233	1.0000			
diseases	0.0063	-0.0123	-0.0732	-0.0123	-0.0899	1.0000		
smoke	0.1061	0.0134	0.0009	-0.0233	0.0795	-0.1009	1.0000	
religious	-0.0587	-0.0398	-0.1184	0.0757	0.1050	-0.0098	0.0320	1.0000
ownland	0.0521	0.0359	-0.0745	0.0708	0.0239	-0.0641	0.0317	0.0318
glotemp	-0.0273	0.1390	0.2165	-0.1036	-0.0889	-0.0495	0.0126	-0.1658
humancause	-0.0379	0.1234	0.0950	-0.0257	0.0496	-0.1212	0.0966	-0.0479
situation	-0.2005	0.0717	0.1439	-0.2283	-0.1654	0.1746	0.0503	0.0535
problem	-0.0871	0.0160	-0.0269	0.1268	-0.0943	0.0880	-0.1083	0.0161
enumerator	0.0794	0.0657	-0.1347	0.3100	0.0663	0.0294	-0.0766	0.1764

	ownland	glotemp	humanc~e	situat~n	problem	enumer~r
ownland	1.0000					
glotemp	0.0657	1.0000				
humancause	0.0931	0.4972	1.0000			
situation	0.0659	0.0261	-0.0485	1.0000		
problem	0.0430	-0.0685	-0.0663	-0.0518	1.0000	
enumerator	-0.1371	-0.2429	-0.1759	-0.0929	0.1588	1.0000

(118 obs.)

The strongest positive correlation (63.91%) is between *age* of an individual and the total *livingyears* an individual has spent on living in CS. For every year older an individual becomes, the more likely it is that the lived years increase in the location they live (CS).

The most negative correlation (-53.63%) is between *age* and being a *student.* The older an individual is the less likely it is that he or she is enrolled as a student.

G. Summary of t-tests between the administrators

TABLE 11. Summary of 23 t-tests on average results between enumerator and author

VARIABLE	AUTHOR *N* = 68	ENUMERATOR *N* = 58	*P*-VALUE
WTP	7.38	1.54	0.0000***
NO WTP	0.1912	0.2759	0.2639
WOMAN	0.5441	0.3621	0.0413**
AGE	39	47.5	0.0015***
URBAN	0.9403	0.7586	0.0037***
LIVING YEARS	31	33.5	0.4171
FULL TIME	0.5882	0.4655	0.1715
PART TIME	0	0.1724	0.0003***
STUDENT	0.2353	0.0862	0.0252**
RETIRED	0.1029	0.1724	0.2588
UNEMPLOYED	0.0735	0.1034	0.5569
HIGH EDUCATION	0.5946	0.4054	0.1424
HIGH INCOME	0.3824	0.4138	0.7218
HOUSEHOLD SIZE	3.15	3.31	0.4930
CHILDREN	0.25	0.5345	0.0009***
DISEASES	0.1912	0.2414	0.4976
SMOKE	0.3582	0.3103	0.5757
RELIGIOUS	0.6363	0.7931	0.0557*
LANDOWNER	0.5441	0.3966	0.0998*
GLOBAL TEMPERATURE	0.9412	0.7586	0.0033***
HUMAN CAUSE	0.8824	0.7931	0.1745
KNOWN SITUATION	0.9412	0.8793	0.2234
IT'S A PROBLEM	0.9559	1	0.1071

Note: *, ** and *** indicate significance at 10%, 5% and 1%, respectively.

Significant differences between the administrators are found in stated WTP, share of women, age, share of individuals living in urban areas, share of part time employed, share of students, share of minors/children, share of individuals that consider themselves as religious, share of landowners, and those that believe in increasing global temperature.