

Thesis

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Bureaucrats' Willingness-to-Pay for CO₂ Emission Reduction Programs

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Abstract

Aiming at exploring the issue of duality of the Swedish government system and the possible influence of a detached public administration, a study of bureaucrats' characteristics, potential preferences and consequent willingness to pay (WTP) for certain policies was needed. This research attempts therefore at investigating how acceptance of CO₂ emissions reduction programs among public agents is influenced by factors such as the cost of the program, concerns with air quality, impacts on biodiversity, improvements in the fuelling stations infrastructure, the use of electricity as fuel and individual characteristics such as gender. Subsequently what impact these predictors have on bureaucrats from different public agencies' WTP for the same programs. For the estimates, binary probit regressions were performed. The results revealed significance of the attributes for the decision over accepting one of the scenarios, particularly the additional information of a budget constraint. However, it was possible to conclude that WTP did not vary significantly among agencies.

Keywords: stated preferences, willingness-to-pay, bureaucrat, CO₂ emissions

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1. Introduction

Considerable transformations are today a reality in contemporary world society, with different moving pieces contributing to the change. Among many others, the rapid technological developments, the echoes of past financial crisis, the reignited political animosities centred on issues such as migration, nationalism and inequality, and the very evident ecological challenges represent realities that urge governments to produce regulation and policy at a consistent rate in order to solve problems faster, more adequately and sustainably. Therefore, building an understanding of governance as an incessant process of struggling over decision-making under circumstances of growing involvement of non-state actors on numerous levels, opens up new research possibilities that fall under the umbrella of regulatory governance (Howard, 2020). Furthermore, getting acquainted with the effect of all actors who influence the process of policy making at all phases is fundamental to develop a thorough knowledge of the policy making process itself. This knowledge development process requires, inevitable attention to the mechanism of delegation of authority from legislatures (politicians) to government authorities (bureaucrats). The dynamic in question takes place due to the information advantage that bureaucrats have over politicians and represents a crucial process in decision-making (Hammes et al., 2020). As Araya (2018) concluded, a research agenda to address the political influence of bureaucrats is needed and it should not be circumscribed to the organizational capabilities of public administration, being relevant when addressing government systems with a larger and “bottom-heavy” public administration sector.

A particular case is the Swedish public administration sector, where dualism between the political ministries and the non-political agencies is established in the Constitution since 1809 (Larsson, 2002). A unitary¹ political context where Wetterberg (2004) concluded that more extensive authority is delegated to the regional-level county councils and municipalities than is ordinary in other unitary states worldwide. Levin (2009) states that local self-government is a critical principle in Sweden, where local government plays a central role in the broader system of national welfare governance. A system of governance that, as pointed out by Montin (2016), is also permeated by markets² and market logics.

¹ “In a unitary state, the central government commonly delegates authority to subnational units and channels policy decisions down to them for implementation. Unitary systems contrast markedly with federal systems, in which authority is constitutionally divided between the central government and the governments of relatively autonomous subnational entities.” (*Encyclopædia Britannica*, 2021).

² The marketization of the public administration is pointed out by Grandberg and Öjehag-Pettersson (2019) as the specific processes and practises within the public sector that constitute the creation and implementation of markets as systems of

The autonomy of the municipalities and public agencies from the government shows clear boundaries but it has been influenced and impacted by the 26 years of membership in the European Union. Jacobsson and Sundström (2020) concluded, for example, that the fragmentation seems to have increased enhancing the influence of bureaucrats, in comparison with the past, in particular areas such as the environment. This level of fragmentation is also confirmed in the report Statskontoret (2000)³ which concludes that the government does not have an overview of what the government agencies do regarding the EU and how that influences the municipalities. From Montin (2016) it is possible to conclude that environment is the area where the EU has had the largest impact on legislation and the work developed by municipalities in the country. In a more recent report by Riksdag (2020) an investigation is conducted on the work coordination between the Swedish parliament and the EU, concluding that the parliament as well as the government has to adopt a more proactive position.

To explore the issue of duality of the Swedish government system and the possible influence of a detached public administration, a study of bureaucrats' characteristics, potential preferences and consequent willingness to pay for certain policies is needed. This research attempts therefore at investigating how acceptance of CO₂ emissions reduction programs among public agents is influenced by factors such as the cost of the program, concerns with air quality, impacts on biodiversity, improvements in the fuelling stations infrastructure, the use of electricity as fuel and individual characteristics such as gender. Subsequently what impact these factors have on bureaucrats' willingness to pay (WTP) for the same programs. Furthermore, the influence of information about the government having budget constraints was also tested. Choice experiment data from a survey presented in Hammes et al. (2020) is used.

The survey presented in Hammes et al. (2020) is a questionnaire answered by bureaucrats in five Swedish government agencies. The questionnaire was divided into three parts; respondents' education and previous work experience; a section about individual characteristics (age, income, gender, etc.) and attitudes towards risk; and five choice

resource allocation and also more general tendencies in society where market rationality is growing towards all areas of human activity.

³ Government agency under the Ministry of Finance that makes investigation into the functioning of the government system in Sweden

experiment questions. In Hammes et al. (2020) the results for the separate fifth choice experiment question, which addressed the question of the use of CBA, are presented. The results⁴ were significant, explaining circumstances in which a bureaucrat would not be interested in using information from a CBA. Namely, risk aversion concerning environmental outcome, cost of doing a CBA and high preferences for the environment.

In this study, an analysis is done of the initial four choice experiment questions in the questionnaire. Here the respondents were asked to consider two hypothetical scenarios and the trade-offs between different attributes. In each choice scenario an opt-out alternative is included to account for the status quo or no program possibility. Each question attempts at mimicking a real life choice context for the bureaucrat, suggesting a couple of scenarios as options, stating the benefits and costs of accepting each one respectively. The main objective is to cross the data extracted about the attributes in the choice experiment with the decisions made by the respondents, investigating therefore the significance of these characteristics on the probability of acceptance of the proposed scenarios. To achieve this, binary probit model estimations were performed with the aim of investigating the significance of the attributes and the probability of acceptance by the bureaucrats,

In addition to investigating the determinants of acceptance, we are interested in examining the WTP of the respondents for accepting the programs/scenarios. The extent to which bureaucrats are willing to pay to support these programs, or how preferences vary with program design, is relatively unknown. A better understanding of bureaucrats' individual preferences for CO₂ emissions reduction policies would allow for a clearer picture of how these public servants behave when responding to the process of policy making and convey a closer look into what is in the origin of that response behaviour.

The outline of the paper is as follows: the next section will provide a review of the relevant literature produced on the study of civil servants and how environmental policy can be influenced by those, aiming this way at creating a theoretical framework on which the study is based. The third section provides the empirical body of the thesis, where the survey is described, and descriptive statistics of the data is presented. After that, the model and estimation results are presented. Section three of this study ends with an estimation of the WTP

⁴“risk aversion concerning the environmental outcome, the bureaucrats environmental attitudes, and the cost of taking CBA information into account have a considerable impact on the probability of using information from CBA.”(Hammes et al, 2020)

of the respondents. A discussion of the results is conducted in the fourth part of this work. Section five presents a summary of the findings, conclusions, and recommendations.

2. Theoretical Framework and Literature Review

In the 19th century, Carl Jonas Almqvist crystalized the uniqueness of Sweden's management and administration contexts with the famous quote "Only Sweden has Swedish gooseberries". This uniqueness is illustrated by the high degree of autonomy of the Swedish public administrators, which is embedded in the law and has its origins in the birth of the State in the 17th century. To take an example given by Hall (2013), "ministerial interference" is banned, hence Swedish Government ministers are not allowed to exercise any influence over decisions by the administrators. Another important element is the far-reaching autonomy of Swedish municipalities with tax-raising powers and division of competences. This autonomy, too, has a long pedigree. Civil servants also have great freedom of speech, and all public documents are in principle just that: public; this is a tradition that has its roots in the Swedish version of the Enlightenment known as the Age of Freedom (Bergström, 2018) and that it was materialised in the Freedom of the Press Act⁵. Another important principle in Swedish policy tradition is the reliance of national government on consensus-based coordination among agencies. Nerhagen and Hansson (2019) approached this governance dimension by trying to examine how CBA is negotiated and accounted for by central actors in the Swedish policy setting context. The study captured the necessity to take into account aspects such as policy integration between agencies and national government as a way to explain the non-use of such assessment tool. Furthermore, in their investigation, Nerhagen and Hansson (2019) mention the influence of governing by environmental objectives⁶ on the Swedish governmental culture. Although it is the government who sets the objectives. This philosophy predicts decentralization of interpretation and execution to semi-autonomous agencies. These agencies consequently fulfill their own public goals by using the configurational design of public organizations as an instrument (Christensen and Lægreid, 2006). This demarcation between political ministries and the non-political agencies is clearly stated by Öjehag-Pettersson and Grandberg (2019) when describing how

⁵ First version in 1766 and the current version was written in 1949 (Weibull, 2020). It states that any person, including public servants, has the right to anonymity when providing statements to the press. However, as pointed out by Halvarson et al. (2003), this principle can be overridden when the matter may affect national security.

⁶ In 1999 the *Riksdag* created several environmental quality objectives to provide a clear aim to environmental action. Generational goal, Environmental quality objectives and milestone targets illuminating the way to the necessary changes in society (Regeringskansliet, 2013).

serious of an offense is an intromission of a member of the government in the affairs of the administrative agencies: “every year, the Standing Committee of the Constitution in parliament investigates cases of suspected illegitimate meddling in the affairs of the administrative agencies by members of the government”. Interestingly enough, the prohibition against any sort of interference includes the Members of Parliament and all other public authorities (Larsson, 2002). The lack of authority by national politicians over municipalities and the important influence of agencies over the work done in these, are considered in this study relevant arguments for the investigation of the preferences and decisionmaking of bureaucrats in government agencies at the national level. These reasons are aligned with Rothstein (2000) argument that Swedish society is characterized by a considerable level of trust, not only between citizens but toward government institutions.

As discussed in Lindvall and Rothstein (2006), in the Swedish decentralised government system, there is the question of if the decisions made are representative for the preferences of the population. To answer this question, empirical research is needed. However, as stated by Eggert et al. (2018), the environmental economics research available has not addressed the issue of bureaucrats’ willingness to pay with considerable depth. Carlsson et al. (2011) studied the preferences for environmental goods and services between bureaucrats and the general public, through the choice experiment method. The previously mentioned study by Hammes et al. (2020) instead investigated if there were differences between bureaucrats working indifferent government agencies. This study investigates this issue further by analysing the determinants of willingness to pay. In the next section the theory behind the use of willingness to pay to analyse preferences is described.

2.1 Preferences and willingness to pay estimation.

Empirical demand studies, experimental laboratory settings and stated preference surveys, are often the stage for the estimation of the core economic concept of willingness to pay of a consumer for a good. Precise estimation of social values for non-market goods is fundamental to guarantee enhanced welfare results for public policy. These estimates play an essential role in the evaluation of costs and benefits of public goods provision. Thus, information from this procedure allows for assumptions and optimization models that can lead to an increase in efficiency. Furthermore, such instrument is valuable for policy makers when deciding on the public investments and policy strategies to address among other matters, environmental impacts. According to McNair et al. (2011) discrete choice methods using stated choice experiment data have become a more used approach to evaluate social values for non-market goods with multiple attributes such as environmental goods. This approach consists normally in presenting respondents with a succession of choice questions, where the participant chooses its preferences among two or more attribute-based alternatives in every choice question. With stated preference methods, survey participants are asked to imagine how much they would be willing to pay to improve the status quo or to prevent it from deteriorating (e.g., to prevent a reduction of air quality), for instance, through taxes or donations that help to improve or preserve the current status (Cameron, 1987). The theoretical basis from which the properties of willingness to pay (WTP) are comprehended derive from the equivalence of this measure with compensating (or equivalent) variation. Hicksian welfare theory further gives us a formal foundation for how these metrics change with prices and the base utility level (Kling and Zhao, 2007).

As described by Boardman et al. (2018), these are the dichotomous choice methods and the participants are questioned whether they would be willing to pay a certain price for an improvement in quantity or quality of a good or implementation of policy that would impact the good. A binary context offer is then created where respondents can choose between accepting or rejecting the proposition. The monetary amounts proposed vary over a range and are referred to as *bid prices*. For each bid the probability of acceptance can be calculated. According to Boardman et al. (2018), the expectation is that the increase of bid prices is associated with the decline of acceptances providing the foundation for estimating a demand function, as well as signalling the treatment of the elicitation by the respondents as an economic decision.

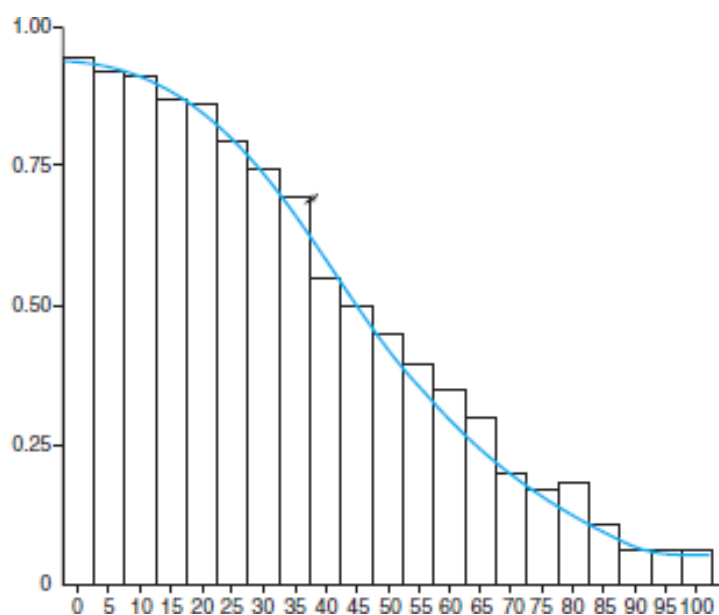


Fig. 1 – Expected distribution of responses. (Source: Boardman et al., 2018).

In the histogram above, a representation of the expected distribution of responses to bid prices is illustrated. The vertical axis shows the percentage of respondents who answered “yes” to the bid price in the horizontal axis. Boardman et al. (2018) explanation comes in hand when interpreting the response frequencies, as being estimates of the probability that a randomly drawn member of the sample of respondents is willing to pay a specific amount. The fitted curve can also be interpreted as the demand curve of an average member of the sample based on the histogram. The demand curve in figure 1 differs from a standard demand curve by representing the probability that a respondent would be willing to pay for a particular outcome at every price, instead of the quantity of a good the respondent would be willing to acquire at every price. According to Boardman et al. (2018), analysts evolved their methods and nowadays instead of working directly from the histogram of accepted bids, implement instead random utility models crossing acceptance with the relationship among the bid price and an expression of WTP as a function of demographic characteristics.

Although, when implementing choice experiments, as stated by Green and Laffont (1979), utility-maximising consumers might misstate their preferences in this type of context. For example, Carlsson et al. (2011) when investigating the difference in WTP for environmental policies between administrators from the Swedish Environmental Protection Agency (EPA) and citizens, raised the possibility of these civil servants’ preferences being more influenced by the demands of the environmental objectives mandated by the Swedish Parliament than for the perspective of the general public. Boardman et al. (2018) names this possible issue in

contingent valuation of *strategic behaviour*, and describes it as the misrepresentation of a true preference with the objective to achieve a more desired outcome.

However, decision makers at the policy level continue to require real numbers to legitimize allocation of spending, which makes the different valuation approaches rather important to give economic value to nonmarket goods. Choice experiments to examine WTP for environmental resources is widely used. Rolfe and Williams (2017) concluded when studying the citizens' WTP for emissions reduction, in Australia, how the choice responses vary when the level of uncertainty associated with emissions reduction options is added in the choice alternatives. In China, Han et al. (2010), concluded that the public was willing to contribute to improve environmental quality, by studying its WTP for environmental conservation. Hulshof and Mulder (2020) in a study developed in the Netherlands, examined the WTP for CO₂ emissions reduction in passenger transport and concluded positively about the potential of the market of emission reduction in passenger transport and that clear and certified information can represent a fundamental policy for achieving emission reductions objectives. In Sweden, Carlsson and Johansson-Stenman (2000) studied the WTP for improved air quality and concluded that it was higher for men, members of environmental organizations and people living in big cities. Gamble et al. (2008) found that Swedish household consumers showed increased WTP for green electricity.

The body of work on WTP for nonmarket goods is significant and diverse, although it mainly looks at the problem from the lenses of the general public and frequently overlooking the importance of studying the players involved in process of decision making. In Sweden, that work is already on going, as developed by Eggert et al. (2016) when comparing WTP of bureaucrats, recreational anglers and the public. Also, Hammes et al. (2020) when concluding that risk averse bureaucrats with strong environmental preferences are more likely to use information from CBA methods. Carlsson et al. (2011), mentioned previously in this text, attempted at investigating how align are the public servants policy recommendations with the public opinion of those same policies. The results showed a higher WTP of the administrators studied in comparison with the citizens.

The range to which individuals are willing to pay for emission reduction programs, or how preferences are impacted by the program attributes is considerably unknown. Therefore, this study aims at taking another step further in trying to understand how public servants value these nonmarket goods, while understanding their preferences. The range to which individuals are

willing to pay for emission reduction programs, or how preferences are impacted by the program attributes is considerably unknown.

3. Empirical Analysis

3.1 The Policy Context

In Sweden the emissions and removals of greenhouse gases are impacted by factors such as population density, industrial infrastructure, climate and among others, transport. Sweden is a considerably large country but with only nearly 10 million inhabitants and a population density of 25 inhabitants per km². A significant part of the territory is covered mainly by forest land. In 2018, emissions of greenhouse gases in the Swedish territory accrue to 52 million tonnes of carbon dioxide. As stated by the Ministry of the Environment (2020) there is a clear reduction since 1990 but the rate is still not sufficient and additional measures are necessary to meet national climate targets. Therefore, as of 2017, a climate policy framework was set in motion by the Swedish parliament under the Paris Agreement⁷. The ambition of the Swedish government is that the country becomes a frontrunner⁸ in the implementation of sustainable environmental policies, both within the country and also contributing for the global targets.

To encourage the decrease in greenhouse gas emissions Sweden introduced among other policy instruments, the Klimatklivet, or Climate Leap. It is a program that provides investment support to companies, municipalities, regions and organizations for a total of 3.5 to SEK 4 billion between 2015 and 2020. The program also predicts the state's support for the purchase of so-called green cars with the help of the super green car premium. In 2015, a total of SEK 215 million was paid out in super green car premiums. An extension of the program until 2026 was proposed by the government and additional financial support was granted to the Swedish Environmental Protection Agency to support more challenging and greater environmental projects. These initiatives towards the future could also represent a challenging next decade for the Swedish public agencies.

⁷ The countries involved in the agreement are responsible to participate in stopping and holding the increase of the average global temperature under 2 degrees Celsius.

⁸ According to Jänicke (2005) “ ‘environmental pioneer’ – or leader – is usually defined as a state that, compared to other countries, at a given point or period of time effectuates and pursues the most stringent approach in environmental policy and thereby intentionally or unintentionally sets an example that can be emulated or where others even feel pressured to emulate it”

3.2 The survey

The questionnaire designed by Hammes et al. (2020) dealt with government policy to encourage the production of biofuels from forestry. The general goal in their research was to assess the impact of CBA information on the involved bureaucrats' response behaviour. We are instead, interested in understanding the WTP of the respondents. The questionnaire is divided in 8 versions, where four contain the basic choice experiment questions and in two versions additional information about the policy context is provided. The information added contained, firstly, an explicit reminder of the CO₂ reduction goal to be achieved by 2030 and secondly, a reminder of the alternative cost of public funds. The assessment of how different pieces of information may influence the responses is a method used in stated preferences contexts, and it is plausible in this particular study because, according to Nerhagen and Forsstedt, (2019) a recurrent instrument that has been more used due to the management by objectives in environmental policy is a constraint in form of a framework budget.

As an introduction for the participant, information about the Swedish policy ambitions of creating a fossil-free vehicle fleet by 2030 was provided. In Sweden, traffic represents 64000 million km per year. The average energy consumption per 10 km is 5.6 kWh and carbon dioxide emissions about 1.7 kg per 10 km. The total emissions of carbon dioxide from passenger cars in Sweden was approximately 11 million tonnes in 2015. The ambition is for Sweden to reduce emissions from passenger car traffic by approximately 70%, by 2030, compared to the current situation. According to the Ministry of the Environment (2020), the Swedish government have established milestone targets for territorial CO₂ emissions reduction in areas under the EU's Effort Sharing Regulation. These were adopted for the years of 2020, 2030 and 2040. It is also stated in the questionnaire that research has shown that a partial solution for the policy ambitions is to utilize biomass from forest raw material. Since the biomass can be used to produce electricity or biodiesel, among other things. The Directive 2014/94/EU is also cited to inform the participants of the fact that different technical solutions have effects on the vehicle fleet and on the need for infrastructure for the distribution of alternative fuels, including electricity. At last, a mention is made to the support and incentives given by the state to private initiatives related with the private acquisition of CO₂ emissions reducing means of transportation. It refers to Klimatklivet, a program already before.

The survey is divided into three parts. The first regards the participants' previous work experience and education. Next, five choice experiment questions are formulated. The main focus of this research is to investigate the data collected from the four remaining choice experiment questions that Hammes et al. (2020), did not include in their paper. Finally, questions were asked about the individual.

Each one of the four choice experiment questions under discussion in this paper consist of the standard type evaluating the trade-offs among distinct attributes. Different reduction kg quantities of CO₂ emissions until 2030 are proposed. Distinct options are proposed for the amount of SEK in contributions of the government to reduce climate impact until 2030. The scenarios also include attributes related with the air quality, impact on biodiversity, the use of alternative fuel of biomass and the availability of the fuelling infrastructure until 2030. Table 1 summarizes the options and trade-offs included in the experiment. The possibility to opt out is also available to the respondent.

Table 1. Summary of choice experiment options

	Scenario A(1,2,3,4)	Scenario B(1,2,3,4)
Annual emissions 2030 (Reduction since 2020) milion tons	1.9Mton (9.1Mton) 3,8Mton (7,2Mton) 6,4Mton (4,6Mton) 8,9Mton (2,1Mton)	8,9Mton (2,1Mton) 1,9Mton (9,1Mton) 3,8Mton (7,2Mton) 6,4Mton (4,6Mton)
State support 2020- 2030 (total) SEK	200billion 0,5billion 5billion 5billion	20billion 0,5billion 20billion 200billion
Air Quality impact	Better everywhere Better in big cities Better in big cities Better everywhereN	Better everywhere Better everywhere Better everywhere Better everywhere
Biodiversity impact	Unchanged(same methods) Unchanged(same methods) Positive(alternative methods) Unchanged(same methods)	Unchanged(same methods) Unchanged(same methods) Unchanged(same methods) Positive(alternative methods)
Alternative fuels of biomass	25% electricity 75% biofuel 25% electricity 75% biofuel 25% electricity 75% biofuel 75% electricity 25% biofuel	25% electricity 75% biofuel 75% electricity 25% biofuel 25% electricity 75% biofuel 75% electricity 25% biofuel
Availability of fuelling infrastructure	Worse in smaller cities and countryside Same as today Same as today Same as today	Worse in smaller cities and countryside Same as today Same as today Same as today

3.3 “Bureaucrats” description and Sample statistics

The data was collected in 2017 and five Swedish public agencies were exposed to the survey where each of the 1,488 civil servants answered different questions forming a sample of 3608 observations.

The bureaucrats at TRAFÄ have the highest average wages of workers. One explanation could be the fact that this agency employs a clearly high percentage of workers with a degree in economics. On the other side, TRV together with TS have the lowest share of employees with a degree in economics. Concerning gender there is considerable variation among agencies. With TRAFÄ and TS showing the lowest shares of women. Regarding the possibility of having an environmental affiliation, the variation is not significant. Although TRAFÄ displays a substantially lower share of workers engaging with environmental organizations outside of work.

By analysing the data it is clear that TRAFÄ presents the highest rate of acceptance for the scenarios proposed. This aspect could be related with the greater number of employees with a degree in economics that this agency has. Interesting enough is the rather low percentage of acceptance of bureaucrats from NV. When investigating the impact of added information (*Infotext*) about the emissions reduction and budget constraint, once again TRAFÄ displays the highest level of acceptance for the propositions. Moreover, the percentage of rejections when confronted with additional information is, as expected, rather high and it does not vary significantly among the agencies.

Table 3 shows the descriptive statistics of the respondents by questionnaire version. A zero after the name of the agency indicates that the questionnaire version they received did not contain information about the emission reduction goal and budget constraint (variable *Infotext*), and 1 that the information was included. The distribution of questionnaire versions within the agencies is rather balanced, with the exception of TRV which participated with considerably more versions without the information about the budget and emissions goals, and also TRAFÄ that even though participated with the least number of respondents, showed a significant difference in number of questionnaire versions answered.

Table 2: Summary statistics on responses and respective agency

	NV	TRV	TS	STEM	TRAF
<i>N</i>	728	1768	224	808	80
Income	40000-50000 (41.5%)	30000-40000 (40.26%)	30000-40000 (41.96%)	40000-50000 (41.66%)	40000-50000 (45.45%)
Environmental Affiliation	23.94%	25.63%	22.38%	24.08%	16.67%
Economics Degree	12%	5%	5%	11%	40%

Abbreviations: NV, *Naturvårdsverket*; TRV, *Trafikverket*; TS, *Transportstyrelsen*; STEM, *Statens energimyndighet*. TRAF, *Trafikanalys*.

Table 3: Summary statistics for respondents per agency and questionnaire version

	<i>N</i>	Accept	Female	Environmental Affiliation(share)	Economics Degree(share)
NV(0)	344	133	.37	.23	.12
NV(1)	384	144	.54	.11	.7
TRV(0)	928	382	.38	.25	.08
TRV(1)	840	333	.12	.15	.05
TS(0)	112	49	.58	.22	0
TS(1)	112	47	.14	.14	.9
TRAF(0)	24	12	.64	.7	.36
TRAF(1)	56	25	.16	.16	.38
STEM(0)	400	161	.55	.23	.12
STEM(1)	408	141	.52	.13	.15

Abbreviations: NV, *Naturvårdsverket*; TRV, *Trafikverket*; TS, *Transportstyrelsen*; STEM, *Statens energimyndighet*. TRAF, *Trafikanalys*.

3.4 The Model

When examining empirical survey data such as the field experiments from Bishop and Heberlein (1979), it is common to find binary choice models for individual response, and discrete choice models in econometrics. These techniques implemented, aim at predicting if the respondent is willing to pay an assign amount (bid) using explanatory variables. Although, these estimation methods only facilitate the extraction of estimated choice probabilities as a function of the bid. Since only probabilities are obtained it is not possible to conclude about how much an individual is actually willing to pay. Instead, the average WTP for the whole sample can be estimated by the process $\sum p_i t_i$ where p_i is the probability that each respondent will pay the bid amount t_i (Cameron and James, 1987a). For a considerably more precise estimation of the probabilities, supplementary explanatory variables can be used in the computation of the comprehensive mean valuation.

In this application we attempt at explaining a bureaucrat's choice behaviour for distinct CO₂ reduction programs, when faced with a different bids for each program. We have used the approach suggested by Cameron and James (1987) about how to estimate willingness to pay from survey data. The bids were created by dividing, for each scenario, the amount of monetary (in SEK) state support required from 2020 until 2030, for the quantity (in kilograms) reduction of CO₂ emissions during the same period. Furthermore, dummy variables were coded for the remaining four attributes represented in the choice questions. We expect that the individual's choices will be influenced both by the attributes of the alternatives and by his or her own characteristics. Hence, we examine an individual's choice between two alternatives, accept (=1) or not accept (=0).

Furthermore, we introduced the variable *lnbid*, which according to Giraud (2001) the log transformation of the bid had the benefit of limiting the WTP to fall between zero and infinity, assuming therefore a positive number which is in accordance with our study. In order to study the WTP of the respondents from each agency for the different scenarios proposed, a bid was created as an instrument to incorporate the total investment granted until 2030 and the actual amount of CO₂ emissions reduction until the same year. We are also interested in comparing the different agencies' bureaucrats' WTP for the emission reduction programs. For this, the bids were created by dividing, for each scenario, the amount of monetary (in SEK) state support

required from 2020 until 2030, for the quantity (in kilograms) reduction of CO₂ emissions during the same period. Furthermore, dummy variables were coded for the remaining four attributes represented in the choice questions. We expect that the individual's choices will be influenced both by the attributes of the alternatives and by his or her own characteristics

We model then, the bureaucrats' latent valuation of the scenarios; $z_n^* = K'x_n + \eta_n$ where x_n is a vector of variables, K' is an unknown vector of parameters and η_n represents the error term. What we consider is an indicator variable z_n taking the value 1 if $z_n^* > t_n$ (if one of the CO₂ emissions reduction program is accepted) and zero if not. Since there is a variation in the bid among respondents, Cameron and James (1987)'s approach comes in hand to derive the valuation function. Assuming that η_n is normally distributed with $(0, \sigma^2)$, one can write

$Prob(z_n^* > t_n) = 1 - \Phi(\gamma t_n - x_n \tau)$ where Φ is the standard normal cumulative distribution function, $\gamma = -1/\sigma$ and $\tau = K/\sigma$. The recognition of the scale parameter $\sigma = -1/\gamma$ is possible with the inclusion of the bid t . The valuation function parameters may therefore be derived by $K = \tau\sigma = -\tau/\gamma$. The expression for the probability of individual n to accept the proposed bid is the following:

$$Prob(Zn = 1) = Prob(Zn^* > tn) = \Phi(-\gamma(tn) + \tau_l Ln + \tau p + \sum_k K_k X_{kn}) \quad (1)$$

The standard cumulative distribution function is Φ , and τ_l , γ , τp , K_k are the parameters to be estimated while k is the number of socio-economic variables, X_{kn} . L is equal to one if the respondent was given information about the budget constraint and zero otherwise. In our case these variables are *lnbid*, and *NV_bid*, *TS_bid*, *STEM_bid* and *TRAFa_bid* for each agency examined. Also, we include the dummy variables for the other attributes in the choice experiment⁹. In addition, we add socio-economic variables such as *Income* and *Economics* to test how income and having a degree in economics respectively, influence the WTP for a CO₂ emissions reduction program. The inclusion of additional explanatory variables allows a more accurate estimation of the probabilities used in the computation of the comprehensive mean valuation.

⁹ the dummy representing air quality improvement everywhere (*Aireverywhere*), a dummy for zero impacts on biodiversity (*BioUnchanged*), a dummy for the increase of electricity use as fuel in 75% until 2030 (*ElecChange75*), a dummy for the worsening of the fuelling infrastructure until 2030 (*FuelWorse*) and a dummy for genre (*Female*).

When choosing the more adequate econometric approach to this investigation, two estimators were tested. First, were estimated random effects probit models, and secondly, ordinary binary probit models were used. Initially it was perceived as important the fact that the data in question has multiple observations for each individual, which led to the use of random effects probit models. The intention was to use the process developed by Gibbons (1994), for the case in which the outcome of interest is a series of correlated binary responses. Furthermore, probit models advantageous factors when using panel data techniques are the capacity to control for unobserved heterogeneity, reducing omitted variables' biases (Greene, 2012). Interesting enough is, when reviewing the literature on the matter, the fact that authors do not account for this effect. Example of that is McNair et al. (2011) when studying the effect of expanding binary choice tasks in a stated preferences context. Also Liu et al. (2018) when using multivariable logistic regression on a study of WTP for air quality in China. Another example is Naanwaab et al. (2014) when applying logistic regression to study the WTP of consumers with survey data.

Although, and following the scientific body of work developed we decided to test a more traditional approach in choice experiments, a simple binary probit model. The effect on the results was insignificant which lead to choosing this approach instead of the previous. As stated by Verbeek (2017) binary choice models were designed to model the “choice” among two discrete alternatives. These models basically express the probability that $y_i = 1$ directly. In general we have:

$$\{y_i = 1|x_i\} = (x_i, \beta) \quad (2)$$

For a function $J(.)$. The equation (2) says that the probability of having $y_i = 1$ depends on the vector x_i containing individual characteristics. In this case, the probability of a respondent accepting one scenario might depend upon its income, gender, education or gender. Function $J(.)$ should only take values in the interval $[0, 1]$. According to Verbeek (2017) the attention is normally restricted to the functions of the form $(x_i, \beta) = (x'\beta)$. Since $F(.)$ has also to stay among 0 and 1, it is natural to pick F to be some distribution function. Ordinary choices are the standard normal distribution function

$$(w) = \Phi(w) = \int_{-\infty}^w \frac{1}{\sqrt{2\pi}} \exp\left(-\frac{1}{2}t^2\right) dt. \quad (3)$$

We present four estimations, the first with only the two treatment groups *Infotext*¹⁰, and *Inbid* as a parameter estimate for all agencies. The second with *NV_bid*, *TS_bid*, *TRAFa_bid* and *STEM_bid*, bid variables for each agency. The third with the significant attributes included in the choice experiment question and studied previously. At last, in the fourth, we included gender (*Female*), and the socio-economic variables such *Income* and *Economics*.

3.4.1 Variables

Which variables should therefore be included in the model? As described in Table 4 *Infotext* is introduced. This variable captures a significant aspect for this study which is the reminder for the respondent of his own income and budget constraint. As mentioned when the description of the model in section 3.3, the variable *Inbid* is the variable used to assess the WTP of the bureaucrats for the scenarios. Furthermore, to separately investigate the WTP for the different agencies, a bid variable was created for each one of them (*NV_bid*, *TS_bid*, *TRV_bid*, *TRAFa_bid*, and *STEM_bid*).

How biomass is used in the transport sector affects emissions of air pollutants, with the aim of increasing the use of electricity as fuel, the reduction of damaging emissions is likely to decrease and improve therefore the air quality. *Aireverywhere* is a dummy variable that informs the respondent on the improvements in the air quality that the chosen scenario would include. When it has the value of 1 it means the air quality improvements will be everywhere and the value of zero informs otherwise. An increased use of biomass in the transport sector may have consequences for the possibility of achieving the environmental goal of living forests. The assessment today is that more action is needed to achieve this goal. Increased use of alternative forestry methods, which for example does not involve clear-cutting, is seen as a measure to reduce the impact on biodiversity. Increased use of such methods may, however, have consequences for the availability of biomass for the production of biofuels and electricity. *BioUnchanged* is a dummy variable that represents no changes in the level of impact on biodiversity until 2030 (=1) or otherwise (=0). *ElecChange75* was included as a dummy variable in the model because it introduces, in the possible scenarios, a target that consists in the increase of biomass use (from the forest) for electricity production in 75% until 2030. *FuelWorse* is included in the model as a dummy variable. It weights the choice behaviour of the respondent when confronted with a scenario that foresees the increase of electricity use, and

¹⁰ Questionnaires with and without the reminder of the budget constraint.

the necessary changes in the distribution and charging infrastructure of fuel. When having the value of 1 it informs the bureaucrat that the fuelling infrastructure will be in 2030, worse than today, and is equal to 0 if otherwise. The model also includes the individual attribute *Female* (Female if equal to 1 and male if equal to 0) which, as the above-mentioned explanatory variables, revealed significance with convincing p-values and a relevant coefficient.

Table 4: Descriptive statistics of the variables

Variable	Obs	Mean	Std. Dev.
<i>Accept</i>	3608	0.392	0.485
<i>Infotext</i>	3608	0.498	0.5
<i>lnbid</i>	3608	-6.164	2.253
<i>Female</i>	3608	1.548	0.498
<i>Income</i>	3608	2.845	0.960
<i>Economics</i>	3608	0.104	0.306
<i>Aireverywhere</i>	3608	0.538	0.495
<i>BioUnchanged</i>	3608	0.503	0.489
<i>ElecChange75</i>	3608	0.497	0.489
<i>FuelWorse</i>	3608	0.476	0.493
<i>NV_bid</i>	3608	-1.210	2.672
<i>TS_bid</i>	3608	-0.382	1.610
<i>TRV_bid</i>	3608	-3.098	3.468
<i>STEM_bid</i>	3608	-1.384	2.783
<i>TRAFa_bid</i>	3608	-0.139	0.982

3.4 Results

As described earlier, in the stated choice questions about 40% accepted ($Accept=1$) at least one of the CO₂ emissions reduction programs proposed. From the nearly 60% of bureaucrats that did not accept one of the programs ($Accept=0$) 51% were given the questionnaire version with extra information on the budget ($Infotext=1$). In Table 5 we present the estimation results of the significance of the different attributes included in the choice experiment questions.

In this study, the main interest parameters seem to show an impact on the probability of bureaucrats accepting a CO₂ emissions reduction programs while the coefficient signs seem to also confirm economic theory. As expected, the probability of the bureaucrats to accept one of the proposed scenarios decreases the more expensive it is. This parameter revealed itself significant ($p\text{-value}=0.01$), providing interesting data and strong evidence that allowed the investigation of the bureaucrats' willingness to pay in the next section of the paper. Regarding the predictor *Infotext*, additional information provided seems to decrease the probability of accepting one program being consistent with Hammes et al. (2020) results, since the share of respondents accepting each bid decreases slightly in the presence of additional information. The coefficient of *BioUnchanged* was the most statistically significant, showing that scenarios that consider biodiversity unaltered until 2030 instead of originating positive effects, impact negatively the probability of respondents accepting those options. This conclusion can be associated with the type of agencies involved in the study. Since the work developed in the five examined agencies is directly or indirectly related with the environment, and, as previously stated, they pursue positive future environmental changes that result in biodiversity improvements. The respondents choice behaviour was also positively (0.3) influenced by the possibility of an increase of 75%, in biomass originated fuels such as electricity until 2030. As predicted, the impact of an improvement in air quality everywhere is positive and relatively significant with 95% confidence. In terms of individual characteristics, female bureaucrats have roughly 11% more probability to accept the CO₂ emission reduction programs proposed. Predicators such as, having a degree in economics (*Economics*) or the level of income (*Income*), have performed poorly suggesting weak evidence against the null hypothesis. When controlling for the influence of the bids for each agency all coefficients reveal insignificance, hence suggesting that there is no difference in WTP among these agencies.

Table 5: Estimation results for the binary probit models. Dependent variable ($Z_n=1$)

	Only Info	+agencies	+ individual characteristics and attributes
Accept			
Infotext	-0.070* (0.03)	-0.071* (0.09)	-0.082 (0.06)
Inbid	-0.090*** (0.00)	-0.092*** (0.00)	-0.106*** (0.00)
NV_bid		0.011 (0.21)	0.011 (0.25)
TS_bid		-0.009 (0.47)	-0.005 (0.69)
TRAFA_bid		-0.030 (0.17)	-0.023 (0.31)
STEM_bid		0.007 (0.34)	0.009 (0.27)
Aireverywhere			0.151*** (0.01)
BioUnchanged			-0.404*** (0.00)
ElecChange75			0.300*** (0.00)
FuelWorse			-0.145*** (0.01)
Economics			-0.003 (0.97)
Income			-0.021 (0.37)
Female			0.114* (0.00)
_cons	-0.798*** (0.00)	-0.798*** (0.00)	-0.955*** (0.00)
<i>N</i>	3608	3608	3608
AIC	4402.67	5261.68	5312.65
BIC	4469.68	5137.87	5242.68
LogL	-2389.53	-2369.38	-2287.89

*** $p < .01$, ** $p < .05$, * $p < .1$

3.4.1 Willingness to Pay

The estimated coefficients obtained before suggested that, concerning the WTP, there was not a significant difference among NV, TS, STEM and TRAFSA. We kept our base model with the dummy variable *Infotext* since the remaining variables included in the models in Table 6 did not increase the explanatory power of the base model. This is confirmed by the obtained X^2 -value of 5.32 for the likelihood ratio test and 5.28 for the Wald test, which is under the 95% critical value at 4 df., when comparing the full model with the base model. From the post estimation results of the Akaike information criterion we can also assess the good fit of our base model. Therefore, and using the transformation suggested by Cameron and James (1987a; 1987b) we can obtain the valuation function:

$$\text{Log}(z) = \frac{\text{Constant}}{\text{lnbid}} - \frac{\text{Infotext}}{\text{lnbid}} * \text{Infotext}$$

$$\text{Log}(z) = 8.86 - 0.78 * \text{Infotext}$$

Using the above, we obtain the WTP estimates represented in Table 5¹¹.

Table 6. Mean WTP for the emissions reduction programs for the different agencies' bureaucrats (SEK/Kg)

	N	Mean	95% CI
Bureaucrats' WTP	3608	5145.28	2981.10 – 8645.87

According to the results estimated, the maximum price at or below which a bureaucrat will accept one of the proposed scenarios for CO₂ emissions reduction is 5145.28SEK per kilogram.

¹¹ The mean is calculated using this procedure: $E(z) = \exp(\mu) \exp(\sigma^2/2)$

4. Discussion and Concluding remarks

This research has examined the bureaucrats' WTP for CO₂ emission reduction programs and the attributes, characteristics or preferences that can influence the acceptance of these programs. We have focused on certain public agencies that work closely with environmental policy and are directly involved in the attainment of the environmental goals that Sweden has set for 2030. In four stated choice questions the respondents were asked to reveal their preferences when considering two scenarios and the trade-offs that each included. These options included, among other attributes, a bid amount that would help us examine the WTP of the respondents for these programs. In the analysis we model and compare the response behaviour from the different public agencies represented in the study. To investigate the influence of preferences in the response behaviour, we included attributes of the different scenarios, socio-economic attributes and individual characteristics of the respondents. To perform this investigation, binary probit models were used.

Our results indicate that the attributes of the scenarios proposed does influence the choice behaviour of the bureaucrats and confirm the theory by exhibiting the positive and negative significances on the probability of acceptance of the programs. The bureaucrats' acceptance of the programs is considerably bounded to the possible increase of biomass use (from the forest) for electricity production in 75% until 2030. The chance of an emission reduction program to not implement any positive or negative changes in biodiversity reveals to be negatively significant when accepting the programs. The reason for this might be that the focus of Sweden's environmental goals for 2030 dedicates considerable importance to the positive change in land use and forestry and consequently a positive effect in biodiversity. Furthermore, another main target for Sweden is the replacement of fossil fuels for non-fossil electricity and biomass, which can be a strong indicator for the type of response examined. However, the most expressive variables were *lnbid* and *Infotext*, showing that the probability of the bureaucrats to accept one of the proposed scenarios decreases the more expensive it is, and the inclusion of a remainder of the respondent's budget constraint also affects negatively the acceptance of the programs. The latter confirms the theory on the importance of a budget constraint reminder when implementing contingent valuation methods.

As regards the willingness to pay for the emission reduction programs proposed, the intention was to study the response differences among agencies and with the aim of theory attempt at

discussing those distinctions. The results indicated that the WTP for NV, TS, TRAFKA, TRV and STEM did not present considerable differences. Supporting the idea explained by Kling and Zhao (2007) that hicksian theory fails at explaining how learning opportunities such as new information or the possibility of delaying a purchase might impact WTP. In a dynamic environment characterized by irreversibility, uncertainty and the potential for learning, WTP for a good differ from the formal variation measures. In other words, in the face of uncertainty about the value of a good, an agent could benefit from waiting if more information about the good's value can be acquired in the future. Waiving future learning opportunities, potentially involves a compensation for the consumer in form of a lower price.

This result is in line, for example with Hammes et al. (2020) findings that response behaviour from TRV was not significantly affected by the remainder of the budget constraint (*Infotext*). The fact that in Sweden, “domestic transport accounts for a third of greenhouse gas emissions” (Ministry of the Environment, 2021), makes the case for a strong necessity to improve transport-efficiency, increase environmentally friendly vehicles and improve the access and infrastructure (electrification) for sustainable renewable and alternative fuels. These demands might be in line with the homogeneity of response displayed by all the agencies in the study, since they represent major players in the achievement of the environmental goals for Sweden.

With the country looking for positioning the country as a worldwide frontrunner in sustainable environmental policy, and the ambitious environmental targets drawn by the Swedish Parliament under the Paris Agreement, it signals immediacy of action to the public agencies and municipalities. Public servants working directly or indirectly with environmental policy are expected promptly to take action and participate actively in the design of an improved environmental future. Therefore, it seems relevant to extend the research on bureaucrats' preferences and behavioural choices, since their role in decision making is so crucial and for that reason, perhaps decisive for the future.

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Appendix 1

Table A1:	Descriptive statistics on independent variables
Variable	Description
Dependent Variable	
Accept	Respondent accepts one of the scenarios=1 Respondent rejects or not respond =0
Independent Variables	
Eversion	Questionnaire version. There are 4x2.10, 20, 30, 40 without Infotext 11, 21, 31, 41 with Infotext
Infotext	0 if reminder of budget constraint not included 1 if reminder of budget constraint included
Agency	0 NV Naturvårdsverket ; 1 TS Transportstyrelsen; 2 STEM Statens energimyndighet;3 TRAFATA Trafikanalys; 4 TRV Trafikverket
NV	1 if Swedish EPA, 0 otherwise
TTRV	1 if Trafikverket, 0 otherwise
TS	1 if Transportstyrelsen, 0 otherwise
TRAFATA	1 if TRAFATA, 0 otherwise
STEM	1 if Energimyndigheten, 0 otherwise
ID	Respondent ID
Inbid	2.25; 2.35; 3....
NV_bid	Bid for NV
TS_bid	Bid for TS
TRV_bid	Bid for TRV
TRAFATA_bid	Bid for TRAFATA
STEM_bid	Bid for STEM
Air Everywhere	1 if Improvement of Air quality everywhere; 0 if otherwise
BiodiversityPositive	1 if positive consequences; 0 otherwise
BiodiversityUnchanged	1 if unchanged; 0 otherwise
AltEnergy75	1 if use 75% of biofuel 2030; 0 otherwise
Fuelingwrsthandty	1 if fueling infrastructure in 2030 worse than today; 0 otherwise
ElecChange75	1 if use of electricity as fuel increases 75% until 2030; 0 otherwise
ElecChange25	1 if use of electricity as fuel increases 25% until 2030; 0 otherwise
Economics	1 If degree in Economics, 0 otherwise
Female	1 = Woman 0 = Man
Income	1 = 20000 – 30000 2 = 30001 – 40000 3 = 40001 – 50000 4 = 50001 – 60000 5 = 60001 – 70000 6 = More than 70001 SEK

