

The influence of individual characteristics and institutional norms on bureaucrats' use of CBA in environmental policy: a model and a choice experiment

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Abstract

Social scientists regularly criticize the use of cost-benefit analysis (CBA), which has led to much focus being placed on investigating the possible biases related to its results. Recent research shows that CBA is not routinely done prior to environmental, energy, and climate policymaking in Sweden, and in countries where a CBA is made, the results have little influence on political decisions. This paper investigates obstacles to using CBA information with a focus on bureaucrats. We use empirical data from Sweden, where the ministries are small by international standards and hence government agencies have a sizeable influence on policymaking.

We construct a theoretical model and then test the theoretical predictions with empirical data collected from five Swedish government agencies. The empirical results lend support both for the assertion that 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 a CBA. Hence risk averse and bureaucrats with strong environmental preferences are less likely and bureaucrats with low cost of doing a CBA more likely than other bureaucrats to use CBA information. Finally, a binding governmental budget constraint may positively influence a bureaucrat's choice of undertaking a CBA. A tentative conclusion is therefore that it may be possible to increase the use of CBA by making the budgetary consequences of policies much clearer and demanding due consideration of costs.

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Bureaucrats; Cost-Benefit Analysis; Delegation; Environmental Policy; Environmental Preferences; Risk Aversion/Neutral/Loving

JEL Codes

D61; D73; H41



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1. Introduction

While doing a cost-benefit analysis (CBA) prior to regulation has been standard procedure in the United States at least since the 1980s,¹ in many other countries, politicians and (certain) bureaucrats express distrust in CBAs (see Mouter et al., 2013, for a case study of the Netherlands; anecdotal evidence indicates similar attitudes at least in Sweden, Finland, and Australia). However, the use of CBA creates “a reasonably clear standard tied to individual preferences that can make special interest deals harder to accomplish without tying the hands of the state” (Rose-Ackerman, 2007, p. 23). Rose-Ackerman describes CBA, risk assessment, and cost-effectiveness analyses as “universalizing techniques that cut across substantive fields and provide a way to compare programs and allocate funds using uniform criteria” (2007, p. 12).² She also notes that these methods are superior to, e.g., the precautionary principle, as this principle is not defined clearly enough to provide realistic policy guidance. Sunstein (2017) makes an argument for doing CBA prior to decision-making in terms of “thinking slow” (see also Kahneman, 2011), i.e., that a CBA reduces at least two common fallacies of thinking, namely the framing effect and loss aversion. The OECD has been recommending the use of CBA at least since 2012 (OECD, 2012). The question that arises is why some bureaucrats feel so negative about CBAs and are so unlikely to perform them and use the information they yield.

In Sweden, where the empirical data used in the present study was gathered, the bureaucrats working at government agencies or serving on committees of inquiry are the ones tasked with finding information about the impact of policies. Numerous Swedish studies indicate that CBA is rarely done prior to the launching of environmental, energy, and climate policies (Samakovlis & Vredin Johansson, 2005; 2007; Pyddoke & Nerhagen, 2010; Broberg, Samakovlis, & Forslund, 2010;

¹ For a history of the use of CBA in the US, see Enthoven (2019).

² We will in the following talk about a CBA. We use this term comprehensively, and it should be thought to encompass all the universalizing techniques that Rose-Ackerman (2007) and Enthoven (2019) mention and even a regulatory impact assessment.

Forsstedt & Nerhagen, 2016; Nerhagen & Forsstedt, 2016). Typical reasons given for this include policymaking traditions and the fact that legal requirements pertaining to regulatory impact assessments focus on budgetary consequences for the state and on reducing the administrative burden for enterprises. Besides, the main principle that has guided environmental policy in Sweden for over 20 years has been the precautionary principle (Nerhagen, Forsstedt, & Edvardsson, 2017; Hansson & Nerhagen, 2019). In Swedish policymaking, CBA is only standard procedure when determining the prices and subsidies paid for medicines, and when transport infrastructure projects are chosen (Hultkrantz (2009).³ The question that arises is, what motivates a bureaucrat to do or use information from a CBA in the absence of explicit political requirements?⁴

The present paper focuses on the question of what influences a bureaucrat's decision to do or use information from an existing CBA. Bureaucratic decision-making has often been studied using delegation models (for an overview, see Bendor et al., 2001). The delegation model -literature deals with the circumstances under which decision-making power is delegated from a principal (e.g., a parliament or congress, a chief, etc.) to an agent (an agency, a bureaucrat, an employee, etc.) (Bendor & Meirowitz, 2004). For example, Alesina and Tabellini (2007; 2008) study the normative criteria used for allocating policy tasks to elected policymakers (politicians) or non-elected bureaucrats. They show that it is preferable to allocate a policy task to a bureaucrat if time inconsistency and short-termism is an issue, or if vested interests have large stakes in the policy

³ For a recent assessment of the use of CBA in European policymaking, see Andersson (2018).

⁴ The present paper does not consider politicians, nor does it explain how or why the bureaucrat has the power to influence the policy choice. We assume that somebody has delegated this power to the bureaucrat, who in turn will have to choose between making the decision under uncertainty or finding out more information about possible consequences of the proposed decision. The reason for this assumption is that the governance system is decentralized in Sweden and ministerial rule of bureaucrats explicitly forbidden.

outcome. Nevertheless, a bureaucrat can very well choose to ignore the socially optimal policy according to Alesina and Tabellini.⁵

In the present paper, we build on the tradition of delegation models in order to explain why bureaucrats may or may not be interested in “delegating” power over policy proposals to a CBA. Our model assumes that if a bureaucrat searches for more information (i.e., carries out/uses information from a CBA), they will have to make a decision that results in a socially optimal policy being implemented rather than their own ideal policy.⁶ If, however, they do not search for information, they can choose whichever policy they desire but cannot be certain about the outcome of that policy. The model results in four hypotheses about the influences of risk aversion, policy preferences, the cost of carrying out a CBA, and the influence of a binding budget constraint on the likelihood of using information from a CBA. We test the hypotheses using data collected from bureaucrats working for one of five Swedish government agencies: the Swedish Environmental Protection Agency

⁵ According to empirical evidence, the same can be said about the politicians, too. Thus, e.g., Nilsson (1991), Nyborg (1998), Sager and Ravlum (2005), Eliasson and Lundberg (2012), Mouter, Annema and van Wee (2013; 2015), and Mouter (2016) show that politicians, while demanding that the bureaucrats conduct CBAs, do not end up using the results when making decisions. Iaryczower et al. (2013) conduct an empirical study of elected versus appointed bureaucrats (in their case, state supreme court judges in the US) and find that non-elected bureaucrats on average have better information, are more likely to change their preconceived opinions about a case and are more effective (make fewer mistakes) than their elected counterparts (politicians). Their results therefore counter the theory-based claim by Alesina and Tabellini (2008), but support the findings of the large literature showing politicians’ disregard for CBA results.

⁶ The bureaucrat’s preferred point could be their private preference. However, e.g., Eggert et al. (2016) show that a person, who thinks they are acting in the capacity of a representative for the entire society, can choose differently from their private preferences. The bureaucrat’s preferences can also represent their social preferences. Finally, the bureaucrat may act out of a professional norm that they have internalized during education or over the course of their professional life.

(SEPA), the Swedish Energy Agency (SEA), the Swedish Transport Administration (STAdmin), the Swedish Transport Agency (STAgency), and Transport Analysis (Trafal), respectively. The empirical analysis is based on responses from 439 bureaucrats.

The paper is organized as follows: In the next section, we construct a model of delegation by a bureaucrat to a CBA. In Section 3, we describe the questionnaire and the data collected. Section 4 presents results both from non-parametric and parametric analyses based on the hypotheses formulated in the theoretical part of the paper. Section 5 summarizes the results and concludes the article.

2. The model

2.1. The economy, the bureaucrat, and incentives to do a CBA

The model in this section is an application of the model of delegation developed by Bendor and Meirowitz (2004). Consider an economy consisting of H individuals denoted by superscript $h = \{1, 2, \dots, H\}$. Assume also a finite set, $\{1, \dots, J\}$, $1 \leq J \ll H$ of bureaucrats. Besides utility from private goods, individuals derive utility from a non-rival and non-excludable public policy outcome, $g \in G$. Utility derived from the public policy outcome is given by a function $q^h(g)$, q^h being increasing and concave in g , i.e., $q_{gg}^h > 0$, $q_{ggg}^h \leq 0$, the subscripts denoting differentials. The preferences for the public policy outcome are continuously distributed with mean μ_g and variance σ_g^2 . We denote the socially optimal level of the policy outcome by g^* .

An individual bureaucrat $j \in \{1, \dots, J\}$ has a unique preference point for the public policy outcome, denoted by $g^j \in G$. We assume that the bureaucrat always prefers a higher level of the public policy outcome than the socially optimal one, i.e., $g^j > g^*$.⁷

⁷ This assumption may seem restrictive. However, a single individual's choice of a public policy outcome will only equal the socially optimal level if their preferences equal the average preferences of the entire population.

A particular policy is given by $p \in P$, the policy being for example a carbon tax, an emissions trading system, a low carbon fuel standard, or a bonus-malus system for low emission vehicles. The policy is perturbed by a random shock (ϵ). The shock reflects society's response to a given policy, which is not known in advance. For example, the price elasticity of fuel demand could be much lower (or higher) than believed. We assume that the shock is symmetrically distributed with a mean of zero, $\bar{\epsilon} = 0$, and a variance of σ_{ϵ}^2 , and that the influence of the shock is linear, so that $g = p + \epsilon$. The outcome g is then a random variable that depends on policy, so that the cumulative distribution function of g given policy p is $F(g|p)$. g reflects the *attainment* of policy goals, e.g., the Paris Agreement target of no more than 2°C average global warming or the Swedish goal of reducing greenhouse gas (GHG) emissions from the transport sector by 70% compared with 2010 values by 2030.

Given uncertainty about the mapping from policies to outcomes, each bureaucrat has an optimal policy. The bureaucrat can, if they so choose, inform themselves about the mapping from policy to outcome, i.e., they can learn the value of the shock. This requires effort, however. The cost of effort is denoted by c^j , with the cost increasing in effort. The greater the effort, the more likely the bureaucrat is to find the value of the shock, ϵ . In practice, the cost of effort can be seen as the cost of performing a CBA or taking in and using information from one. Moreover, knowing the perturbation

The probability of this occurring is zero. The level of the policy outcome then either falls short of or exceeds the social optimum. If the bureaucrat does not conduct a CBA, the costs of the policy may be underestimated, two recent examples being the Government Official Reports that set out a strategy for Swedish climate policy (Miljömålsberedningen, 2016:21) and for climate and clean air (Miljömålsberedningen, 2016.:47). If the costs are underestimated, then even a bureaucrat with lower-than-the-population-average preferences for the policy outcome may choose a level of policy that exceeds the social optimum. As is shown by Uba (2010), Swedish bureaucrats tend to prefer quite environmentally friendly policies. Carlsson et al. (2011) and Eggert et al. (2016) conduct empirical studies that show that the bureaucrats at the Swedish Environmental Protection Agency on average prefer policies that are more ambitious than those preferred by the general public.

(ϵ) permits complete “shock absorption”; if a decision-maker chooses a policy (p) after they observe the disturbance (ϵ), they can always find a policy that, when combined with the shock, yields any desired (feasible) outcome (g) (Bendor & Meirowitz, 2004, p. 298). We can define the shock as a function of the cost of effort, $\epsilon(c^j)$, with $\epsilon_c(c^j) < 0$ if $\epsilon > 0$ ($\epsilon_c(c^j) > 0$ if $\epsilon < 0$), i.e., the impact of the shock on the outcome approaches zero as the cost of effort increases. Furthermore, there exists some maximum level of effort, c^{max} , such that $\epsilon(c^{max}) = 0$, i.e., that given enough effort, the true value of the shock can be found.

The extensive form of the game is then as follows: A bureaucrat has the authority to propose policy p .⁸ Before making their proposal, they decide whether to do/use information from a CBA or not. The bureaucrat consequently faces the following problem: They prefer outcome $g^j > g^*$ but cannot reach that outcome with certainty due to the shock. In the absence of a CBA, they choose policy to maximize their expected utility, given their expectations of the cumulative distribution of outcomes, $F(g|p)$. Because the bureaucrat’s preferences are strictly single-peaked and because $F(g|p)$ is nondegenerate for all p , the expected utility of the bureaucrat is strictly less than the utility obtained by getting the ideal outcome with certainty.

Because utility varies continuously in outcomes, the bureaucrat has certainty equivalents (CE) in outcome space. The CE form a set of outcomes such that the bureaucrat would be indifferent between getting any such outcome for sure and taking a policy that maximized their expected utility.⁹ This set of certainty equivalents defines the bureaucrat’s *CBA set* (the CBA set corresponds to the delegation set in Bendor and Meirowitz, 2004, p. 299). It defines the bureaucrat’s propensity to

⁸ The bureaucrat *proposes* policy. This does not necessarily mean that the politicians will adopt the proposed policy. Modelling political decision-making is beyond the scope of this paper.

⁹ Jehle and Reny (1998, pp. 208-209) define the certainty equivalent as the amount of wealth we could offer an individual with certainty that would make them indifferent between accepting that wealth with certainty and facing a gamble k offering w_i with probability p_i , the expected value of the gamble being $E(k) = \sum_{i=1}^n p_i w_i$.

do/use information from a CBA; the larger the CBA set, the more likely a bureaucrat is to carry out a CBA. We examine the determinants of the CE in the next proposition:

Proposition 1. Of two bureaucrats, the one with a higher Arrow-Pratt measure of risk aversion has a higher risk premium than the one with a lower measure.

Proof: The proof of the risk premium being higher for a more risk-averse bureaucrat, i.e., the one with a higher Arrow-Pratt measure, than that for a less risk-averse one follows Jehle and Reny (1998, pp. 208-211) and will not be repeated. ■

The result in Proposition 1 is ambiguous, however. What is the bureaucrat risk averse toward – the CBA outcome or the environmental outcome? This cannot be determined on theoretical grounds.

Therefore, we formulate two alternative hypotheses that we can test empirically:

Hypothesis 1. A more risk-averse bureaucrat is afraid of getting a policy outcome far from the social optimum. Therefore, a more risk-averse bureaucrat has a larger CBA set than a risk-neutral/loving one.

Hypothesis 2. A more risk-averse bureaucrat is afraid of not reaching the environmental goal. Therefore, a more risk-averse bureaucrat has a smaller CBA set than a risk-neutral/loving one.

Turning to the question of the impact of attitudes on the choice of policy, consider a bureaucrat who must make a proposition for a public policy, p , which together with the shock, $\epsilon(c^j)$, determines the outcome of the public policy, g . Considering a discrete problem, the probability of ϵ taking any given value is $\pi_i, i \in \{1, \dots, n\}$. The bureaucrat's problem is to choose the effort cost to maximize the expected utility from g :

$$(1) \quad \max_{g^j} \sum_{i=1}^n \pi_i q^j (p + \epsilon(c^j)), \text{ s. t. } 0 \leq c^j \leq C,$$

where C is some upper limit of the possible effort cost.

What happens to the effort put into finding the value of the shock as the bureaucrat's policy preference, p , increases? We formulate the following proposition:

Proposition 2. If bureaucrats i has a higher preference for the policy outcome than bureaucrat j , i.e., $g^i > g^j$, bureaucrat i will be less likely to do a CBA than bureaucrat j .

Proof: We prove Proposition 2 by totally differentiating (1) with respect to (w.r.t.) p and c^i and rearranging. We find

$$\frac{dc^i}{dp} = - \frac{\sum_{k=1}^n \pi_k q_g^i (p + \epsilon(c^i))}{\sum_{k=1}^n \pi_k q_g^i (p + \epsilon_c(c^i))} < 0. \blacksquare$$

Thus, as p increases, the cost of effort, and consequently the effort put into finding ϵ , falls.

Therefore, a bureaucrat with higher preferences regarding the public policy outcome is less likely to put more effort into finding out the true value of ϵ , i.e., they are less likely to do a CBA than bureaucrats with less extreme preferences.

However, how the situation is perceived is also related to education and experience. With little experience with CBAs, a bureaucrat may perceive that the CBA does not reveal all necessary information about the shock. This case is analogous to that of informationally imperfect agents in the model of Bendor and Meirowitz (2004, p. 300). Thus, even if the bureaucrat does a CBA, it is possible that they will have to make an uninformed decision. This puts them in the worst of all possible worlds: There is policy bias but no compensating adaptation of the policy to the state of the world.

Thus, assume that with probability ρ^j the CBA reveals the true state of nature, the probability of the state of nature remaining unknown being $(1 - \rho^j)$. Hence, the expected value of doing a CBA increases in the bureaucrat's own competence, measured by ρ^j . As ρ^j falls, the CBA set contracts.

We formulate the following proposition:

Proposition 3. Uncertainty about the CBA results diminishes the CBA set.

To illustrate Proposition 3, assume that with full certainty ($\rho^j = 0$), the expected CBA result equals the bureaucrat's certainty equivalent, i.e., the bureaucrat is indifferent between doing a CBA or not. Now introduce uncertainty about whether the CBA will reveal the true value of the shock or not. The value of the CBA is reduced by uncertainty. This means that the expected value of the CBA falls outside the bureaucrat's CBA set and the bureaucrat under uncertainty is not willing to do a CBA.

We summarize the findings from Hypotheses 1, and 2, and Propositions 2, and 3 regarding the size of the CBA set in Table 1. A minus sign in Table 1 indicates that a bureaucrat with that particular property has a smaller CBA set and a plus sign that the CBA set is larger, the first sign referring to the individual's risk aversion, the second to their policy preferences, and the third to the level of uncertainty about CBA results.

Table 1 The impact of risk preferences (Hypotheses 1 and 2, first sign), policy preferences (Proposition 2, second sign) and the uncertainty about CBA results (Proposition 3, third sign) on the CBA set. A minus sign indicates a smaller CBA set; a plus sign a larger one.

	HIGH POLICY PREFERENCE		LOW POLICY PREFERENCE	
	Low uncertainty	High uncertainty	Low uncertainty	High uncertainty
RISK AVERSE W.R.T. CBA	+, -, +	+, -, -	+, +, +	+, +, -
RISK NEUTRAL/LOVING W.R.T. CBA	-, -, +	-, -, -	-, +, +	-, +, -
RISK AVERSE W.R.T. POLICY OUTCOME	-, -, +	-, -, -	-, +, +	-, +, -
RISK NEUTRAL/LOVING W.R.T. POLICY OUTCOME	+, -, +	+, -, -	+, +, +	+, +, -

Two unambiguous cases arise in Table 1 for Hypothesis 1 and Hypothesis 2, respectively. The bureaucrat who is risk averse with respect to the CBA outcome (Hypothesis 1), who has low policy

preferences (Proposition 2), and low uncertainty about the CBA results (low cost of carrying out a CBA, Proposition 3) is the most likely to use information from a CBA, i.e., they have the largest CBA set. The bureaucrat who is risk-neutral/loving with regard to the CBA outcome, with high policy preferences, and high uncertainty about the CBA results (high cost of carrying out a CBA) has the smallest CBA set.

On the other hand, a bureaucrat who is risk averse with respect to the environmental outcome (Hypothesis 2), who has high policy preferences (Proposition 2), and who experiences high uncertainty about the CBA results (Proposition 3) has the smallest CBA set, while the corresponding risk-neutral/loving bureaucrat with low policy preferences and with low uncertainty about the CBA results has the largest set. All the other cases are of indeterminate size.

2.2. The influence of institutional norms on the use of CBA

In addition to the influence of individual characteristics, institutional norms may influence bureaucrats' behavior and their search for information. An important norm of this type is the requirement that government agencies have to consider the implications of a regulation on the government's budget. Jussila Hammes (2017) argues that one difference between government agencies that regularly conduct CBAs and those that do not, is that the former seem to be acting under a governmental budget constraint while the latter do not. A governmental budget constraint can, when binding, impose an upper limit on the supply of public goods. It may then be impossible for a bureaucrat to reach their ideal point. If, however, the bureaucrat, by doing a CBA, can get the government to relax the budget constraint, they may have an incentive to do so.

Consequently, if the governmental budget constraint limits the supply of the public good to a level below the bureaucrat's CBA set, the incentives to do a CBA depend on the bureaucrat's expectations about the social optimum. An expected social optimum that corresponds to the budget constraint will not induce them to do a CBA. If, however, the CBA results likely lie closer to the bureaucrat's ideal point, they *will* do a CBA. The bureaucrat's CBA set may consequently increase in this case. This

is because the social optimum, though non-desirable for the bureaucrat, lies closer to their ideal point than the budget-constrained level of provision.

Proposition 4 A binding governmental budget restriction increases the probability of a bureaucrat doing a CBA.

The null of Proposition 4 is that there are no systematic differences between bureaucrats working for government agencies acting under a binding budget constraint and those not so constrained.

To test the four propositions, we designed a choice experiment that was sent to civil servants at five government agencies. In the next section, we describe the questionnaire and data collection.

3. Questionnaire, data collection, and the data

3.1. Description of the questionnaire and the data

The choice experiment tested the influence of CBA information on the participating civil servants' response behavior. The questionnaire dealt with a government policy to encourage the production of biofuels from forestry. The questions were based on a number of recent studies (Bosted, Mustonen, & Gong, 2015; Henning, 2015; Swedish Energy Agency, 2015; 2016; Apaydin, 2016; Konjunkturinstitutet, 2016; Kungliga ingenjörsvetenskapsakademien (IVA), 2016; Nationellt skogsprogram, 2016; Ministry of Enterprise and Innovation, 2016; Swedish Transport Administration, 2016). A pre-study was conducted on a reference group consisting of representatives from the Swedish Energy Agency, the Swedish Environmental Protection Agency, the Swedish Transport Administration, the Swedish Transport Agency, and Transport Analysis, i.e., the same agencies that answered the questionnaire.

As an introduction, the respondents were given information about the current policy landscape in Sweden with a political ambition of creating a fossil-free vehicle fleet by 2030. They were also informed that biofuels from forests could be part of the solution and about current energy use and CO₂ emissions from the car fleet in Sweden. Finally, they were told that the government in different

ways encourages the transformation of the car fleet, for example through government grants (see Appendix A1).

The questions were divided into three sections. The first concerned the respondents' education and previous work experience. The second part consisted of five choice experiment questions, four of a standard type evaluating the trade-offs between different attributes, and a fifth, which is the one analyzed in this study. Hence, when answering the fifth question, the respondents had already been forced to consider the possible trade-offs involved. The questionnaire ended with questions about individual characteristics (age, sex, income, etc.) and attitudes both to risk and more generally.

The aim of the fifth choice question was to create a scenario that resembles a real-life choice context. The assumption is that the choice situations that the bureaucrats encounter in their everyday work include a description of both the benefits and the costs of undertaking a certain action. To mimic this, the questionnaire contained information about the estimated societal benefit of reducing CO₂ emissions (0.8–1.2 SEK per kg CO₂ reduced) and the cost of four different action programs to reduce these emissions from the transport sector over the 10-year period 2020–2030; see Table 2.^{10, 11} The respondents also had the option to reject all alternatives, hence choosing the status quo. This we assumed to imply a zero willingness to pay.

Table 2. Action programs presented to respondents in the questionnaire.

KWH PER 100 VEHICLE KILOMETERS ON AVERAGE IN 2030	CO₂ EMISSIONS IN 2030 (REDUCTION COMPARED	INVESTMENT GRANT IN
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¹⁰ We tested a similar question in a previous study where the respondents were university students in economics, biology or social sciences (Jussila Hammes, Pyddoke, & Nerhagen, 2013; Nerhagen, Pyddoke, & Jussila Hammes, 2014). We found differences in response behavior between the economics majors and those in the other fields.

¹¹ The average exchange rate in 2017 when the experiment was conducted was 9.6326 SEK per EUR and 8.538 SEK per USD.

		WITH 2020 VALUES WITH THE SAME TRAFFIC VOLUME)	TOTAL UNTIL 2030
PROGRAM 1	50	9.1 billion kg/year (1.9 billion kg/year)	5 billion SEK
PROGRAM 2	30	4.5 billion kg/ year (6.5 billion kg/ year)	20 billion SEK
PROGRAM 3	48	8.4 billion kg/ year (2.6 billion kg/ year)	0,5 billion SEK
PROGRAM 4	20	1.9 billion kg/ year (9.1 billion kg/ year)	200 billion SEK

For Programs 1–3 (P1–P3), total benefits exceed the total costs. P1 is inefficient compared with P3, which results in approximately the same climate impact at a much lower cost. Which of the two alternatives, P2 or P3, is to be preferred depends on the choice of benefit estimate and decision rule (net present value or benefit-cost ratio).¹² The upper benefit estimate, 1.2 SEK per kg CO₂, yields a higher net present value for P2, while the lower estimate of 0.8 SEK per kg CO₂, yields a higher estimate for P3. The average benefit estimate, 1 SEK per kg, yields the same net present value for P2 and P3. P2 makes a larger contribution to the reduction of CO₂ emissions, however. Using the benefit-cost ratio as the decision criterion, P3 is superior to P2. P4 is the only alternative that reaches the goal of reducing GHG emissions from the transport sector by 70% by 2030, but at a very high cost.

In the third part of the questionnaire, we started by gauging the respondents' risk preferences. The respondents were asked to choose between a series of small sums of money with certainty (starting from 10 SEK; about 1 EUR or 1.2 USD and running up to 200 SEK) or a lottery with a 50% chance of

¹² According to Boardman et al. (2006), the appropriate decision rule in a CBA is to choose the project with the largest net present value (NPV) since this always provides the correct answer, unlike the benefit-cost ratio. However, NPV may not result in the most efficient allocation of resources since there may be other alternatives not included in the choice set that might be better. This may be so due to budgetary and/or political constraints, or cognitive capacity limitations.

winning 300 SEK (31 EUR or 35 USD), the game stopping when the respondent chose the sum of money with certainty over the lottery. The answers were used to construct the variable *Risk neutral/loving* (RN/RL), which takes the value of one if the respondent is risk neutral or loving and zero if risk averse.

The third part of the questionnaire ended with a large number of questions examining the respondents' attitudes. We used this information to construct two indexes of attitudes and aptitudes. Each index was constructed using the first components of a principal component analysis. The first index (*economic preferences*) is composed of responses to questions about the importance of CBA, rationality, and cost-effectiveness. The variable is used as a proxy for the cost of doing a CBA (Proposition 3). The second index (*environmental preferences*) is composed of responses to questions about the importance of the natural environment, ecological sustainability, and reduced oil dependency. This variable is used as a proxy to test the intensity of preferences for the environment (Proposition 2). The responses to both these questions range from 1 (not at all important) to 6 (great importance). The correlation between economic and environmental preferences is 0.1032 (at the 5% level of statistical significance).

Altogether there were $4 \times 2 = 8$ different versions of the questionnaire; four versions of the basic choice experiment questions, and two versions where half of the respondents received additional information about the policy context. The extra information contained, first, an explicit reminder of the CO₂ reduction goal for the transport sector to be achieved by 2030, i.e., a reduction by 70% compared with 2010 levels, and second, a reminder of the alternative cost of public funds. This is similar to an ordinary willingness to pay study where respondents are reminded about their own income and budget constraint. The binary variable *Infotext* captures this aspect of the questionnaire; it takes the value of one for those who got the additional information and zero otherwise. The variables used are summarized in Table 3.

Table 3 Descriptive statistics of the variables included in the regressions.

VARIABLE	N	MEAN	STD.	MIN	MAX
INFOTEXT	425	0.496	0.501	0	1
SEPA	425	0.195	0.397	0	1
STAGENCY	425	0.061	0.240	0	1
STADMIN	425	0.492	0.501	0	1
SEX (1=WOMAN)	425	0.447	0.498	0	1
WORK EXPERIENCE	425	9.913	9.939	0.5	46
ECONOMIC PREFS	425	-0.003	1.388	-5.337	2.242
ENVIRONMENT PREFS	425	-0.005	1.372	-5.051	1.852
RISK NEUTRAL/LOVING (RN/RL)	425	0.395	0.489	0	1

3.2. Data collection

The questionnaire was sent to 1,488 civil servants at five Swedish government agencies: the Swedish Energy Agency (SEA), the Swedish Environmental Protection Agency (SEPA), the Swedish Transport Administration (STAdmin), the Swedish Transport Agency (STAgency), and Transport Analysis (TrafA). These are the main agencies working with the transition to a fossil-free vehicle fleet by 2030. The data was collected in May 2017.¹³ As noted above, eight versions of the questionnaire were used, and 185–188 copies of each version were sent out.

At SEA, SEPA, and STAdmin, we could send the questionnaire to all staff involved in policy-related work, including heads of office. Only office clerks were excluded from the sample at these agencies. At the STAgency, we received permission to send the questionnaire to a random sample of 67 out of about 243 relevant workers, and at TrafA to the 11 employees working with economic analysis. The results of the data collection are summarized in Table 4. As can be seen, some respondents were on

¹³ The original questionnaire was sent out on May 3rd to SEA, SEPA, STAgency, and TrafA, and on May 11th to STAdmin. Reminders were sent on May 17th and 30th, respectively.

leave of absence or were not relevant for other reasons. Hence, the valid sample consists of 1,383 respondents.¹⁴

Table 4. Summary statistics for respondents from the government agencies.

	EMPLOYEES CONTACTED	ON LEAVE	ADMINIS- TRATOR	NO REPLY DUE TO TIME CONSTRAINT	NET SAMPLE	RESPONSE RATE
SEPA	442	37	3	2	400	91 (23%)
SEA	287	25	1	0	261	103 (39%)
STADMIN	681	34	2	0	645	226 (35%)
STAGENCY	67	1	0	0	66	29 (44%)
TRAFA	11	0	0	0	11	10 (91%)
TOTAL	1,488	97	6	2	1,383	459 (33%)

The response rate varied considerably between the agencies. SEPA had the lowest response rate at 23%, and Trafa the highest at 91%. From comments sent by personal e-mail to the lead author as well as comments in the questionnaire, we found that there are several reasons for the variation in the response rate. An important one appears to be that bureaucrats are hesitant to answer questions outside their area of expertise. This may explain why the response rates from STAgency and Trafa are comparatively high, while not all staff at SEA and SEPA work with transport-related questions. Moreover, the time available to answer the questionnaire appears to have been a limiting factor, and it seems the questions were considered complicated. Other comments along this line were that the choice questions do not reflect current management practices and/or that the questions do not fully reflect a more complex reality. Some respondents therefore deliberately chose not to answer the questionnaire. One person claimed that the reason for not replying was that bureaucrats only provide information to the decision-making process, while the decisions and trade-offs are made by

¹⁴ The analysis is based on “out of office” and some written replies to the lead author. Assuming not all office clerks sent e-mails stating this, or that not all persons on leave had an “out of office” reply, the valid workforce may still be overestimated.

politicians. It is possible that only persons with a more favorable attitude to questionnaires of this type responded, which may above all bias the answers obtained from SEPA.

3.3. Description of respondents

Descriptive statistics of the respondents are provided in Table 5. A zero after the name of an agency indicates that the questionnaire version they received did not contain information about the emissions reduction goal and budget constraint, and a 1 that the information was included.

Table 5. Summary statistics for respondents per agency and questionnaire version (minima and maxima in parentheses).

	RESPONSE TIME (MINUTES)*	YEARS AT PRESENT WORK	YEARS AFTER EDUCATION	YEAR OF BIRTH	SHARE OF ECONOMICS DEGREES	SHARE OF WOMEN
SEPA (0)	27.4 (6–99)	7.94 (0.5–30)	19.15 (2–39)	1969 (1952– 1990)	0.14	0.39
SEPA (1)	34.37 (5–99)	9.23 (0.5–46)	20.12 (1.5–48)	1969 (1946– 1993)	0.14	0.58
SEA (0)	35.76 (6–99)	6.01 (0.5–18)	13.46 (2–34)	1975 (1953– 1991)	0.12	0.52
SEA (1)	38.13 (11–99)	6.36 (0.5–20)	18.15 (3.5–45)	1971 (1952– 1991)	0.15	0.53
STADMIN (0)	32.97 (5–99)	12.78 (0.5–42)	22.57 (2–43)	1967 (1950– 1991)	0.07	0.47
STADMIN (1)	34.75 (2–99)	12.97 (0.5–42)	23.03 (2–47)	1968 (1946– 1991)	0.06	0.41
STAGENCY (0)	16.67 (8–32)	7.27 (0.5–22)	19.87 (5–45)	1971 (1952– 1988)	0	0.36
STAGENCY (1)	45.64 (12–99)	3.93 (0.5–16)	19.69 (4–37)	1972 (1953– 1989)	0.07	0.07
TRAFA (0)	26.67 (17–44)	4.17 (2–7)	14.67 (10–22)	1975	0.33	0.67

	(1970–1978)					
TRAFA (1)	21.14 (15–30)	5,5 (1.5–7)	15.71 (2–25)	1972 (1962–1981)	0.43	0.14

*99 is used for those with a recorded time of over one hour. In these cases, it is likely that they started to fill in the questionnaire, took a break and then came back later to complete.

The bureaucrats at STAdmin have worked the longest at the agency and also have the longest work experience. SEPA and STAdmin have the highest average ages of workers. Respondents at SEA, STAgency and Trafa have relatively few years of work experience at their respective agency but especially employees at the STAgency have a lot of work experience from other jobs. One explanation for this is that STAgency is the result of a merger between previous regulatory agencies; hence, some of the employees have been working with these issues for a long time. A similar explanation applies for Trafa, which was created at the same time as STAdmin and STAgency. STAdmin together with STAgency have the lowest share of employees with a degree in economics, while Trafa has the highest. Regarding gender, there is some variation across agencies, with Trafa and STAgency having the lowest shares of women.

Summary statistics for risk preferences are shown in Table 6. The majority of individuals are risk averse, which is in line with standard economic theory. Breaking the numbers down by agency, we see that while risk aversion remains the biggest category in each case, there are marked differences in the degree of risk aversion, risk neutrality, and risk loving across agencies. These differences, however, are not statistically significant.

Table 6. Results from analysis of risk aversion

	MEAN	OBS
FULL SAMPLE		
Risk averse	61.20%	433
Risk neutral	17.09%	433
Risk loving	21.71%	433

SEPA			
	Risk averse	54.76%	84
	Risk neutral	17.86%	84
	Risk loving	27.38%	84
SEA			
	Risk averse	60.61%	99
	Risk neutral	22.22%	99
	Risk loving	17.17%	99
STADMIN			
	Risk averse	66.20%	213
	Risk neutral	13.15%	213
	Risk loving	20.66%	213
STAGENCY			
	Risk averse	51.85%	27
	Risk neutral	25.93%	27
	Risk loving	22.22%	27
TRAFA			
	Risk averse	40.00%	10
	Risk neutral	20.00%	10
	Risk loving	40.00%	10
ECONOMICS MAJOR			
	Risk averse	38.30%	47
	Risk neutral	29.79%	47
	Risk loving	31.91%	47
OTHER MAJOR			
	Risk averse	62.81%	398
	Risk neutral	15.08%	398
	Risk loving	22.11%	398

The differences between individuals who have a degree in economics and those with other degrees are statistically significant (see bottom boxes of Table 6). Thus, workers with economics degrees are significantly less risk averse than individuals with other degrees, and significantly more risk neutral and risk loving.

We analyze the responses to the choice question in two ways. First, we provide nonparametric information on the response behavior of the different agencies. Secondly, we add the influence of individual specific characteristics with a multinomial logistic regression.

4. Results

4.1. Non-parametric analysis of the influence of institutional norms

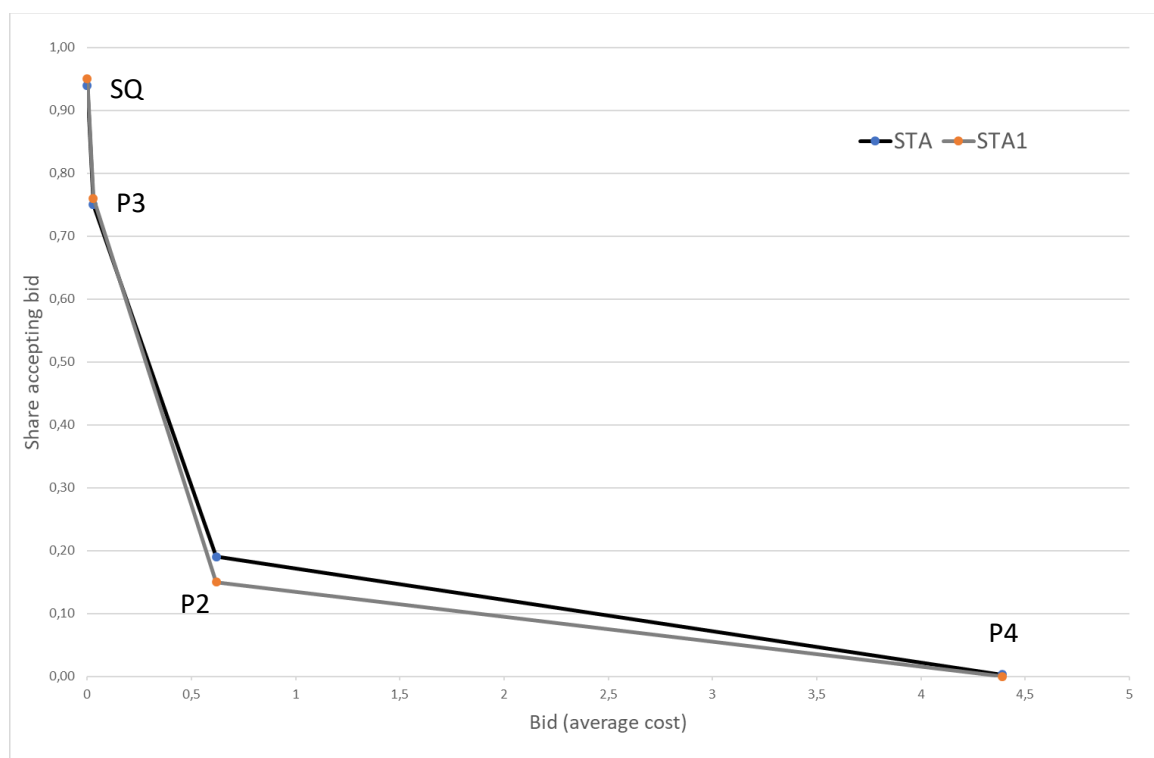
We start by examining the difference between the group that received extra information about a budget constraint and the emissions reduction goal and the group that did not receive this information (variable *Infotext*). In these analyses, 27 observations were excluded since those individuals chose P1.¹⁵ We have applied the non-parametric approach in Kriström (1990), testing the difference between the groups receiving different “treatments” as in Frykblom (1997). Figure 1 shows the empirical survival functions for the two groups in four of the five government agencies included. The data underlying the graphs are presented in Appendix A3.¹⁶ Trafa is not included because of too few observations. The x-axis shows the average costs of, i.e., the bids for, the status quo (the alternative of not choosing any of the programs) and P2–P4. On the y-axis are the shares accepting a certain bid. The black curve shows responses without *Infotext* and the grey curve displays the responses with it.

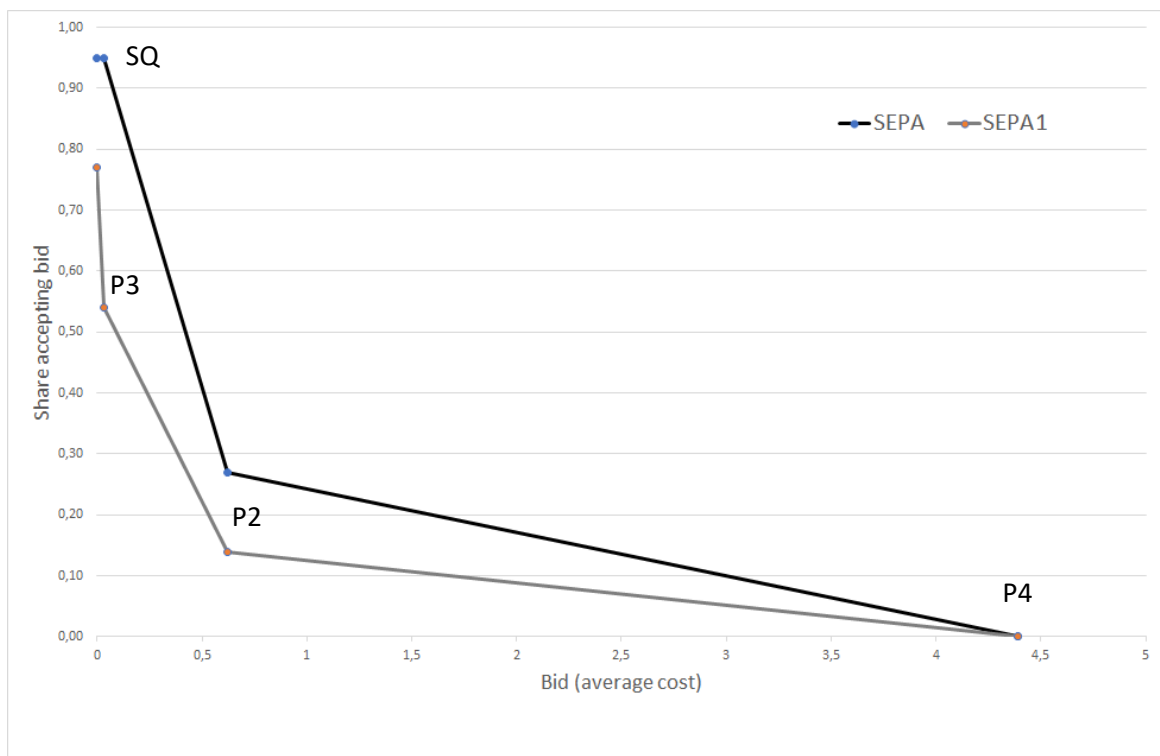
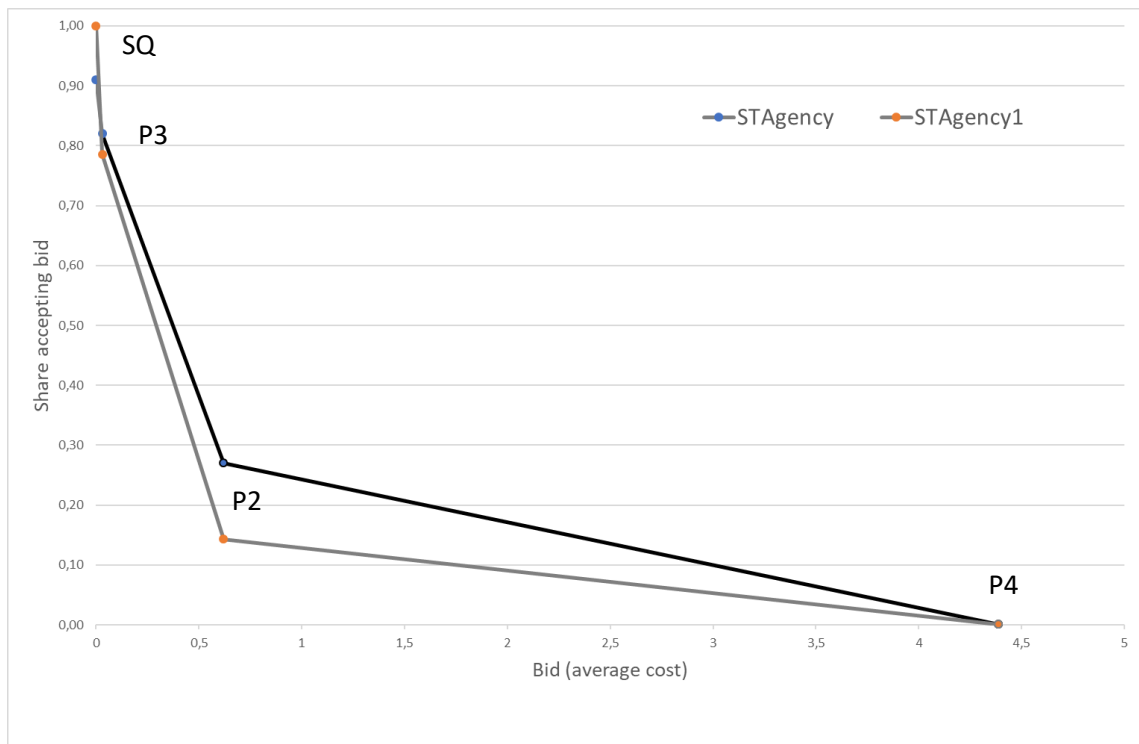
From the graphical presentation, we can see that there is heterogeneity in the response behavior. Based on the results from Eggert et al. (2016), this was to be expected. There are some clear patterns in the behavior. First, a majority of the respondents at all agencies prefer P2, for which total cost is approximately equal to total benefit. This is illustrated in Figure 1 by the distance between points P3 and P2. As described in the appendix, the share accepting this bid is in most cases above 50%.

¹⁵ The P1 option was included in the questionnaire because in real life, there may be several options that achieve approximately the same reduction but some of them are costlier than others. Furthermore, it is commonly found in choice experiments (willingness to pay studies) that some individuals deviate from the theoretical assumptions of rationality underlying the questions and we wanted to test whether this was the case also in our experiment. The option is included in the regression analyses presented below.

¹⁶ Since we are interested in finding whether there is a difference in the share accepting each bid in the two treatment groups, and not in estimating mean willingness to pay, we use linear interpolation in these graphs.

Furthermore, the share of respondents choosing P4, which would achieve the 70% reduction goal in CO₂ emissions by 2030, is fairly stable for those not receiving additional information, at around 20% (distance between point P2 and the end point, P4). It is somewhat higher for SEPA and STAgency and lower for STAdmin and SEA. However, providing additional information changes the response behavior by lowering the share of respondents accepting each bid, the difference being statistically significant for all agencies except STAdmin. In other words, with the additional information a larger share of the respondents chose lower bids or status quo.





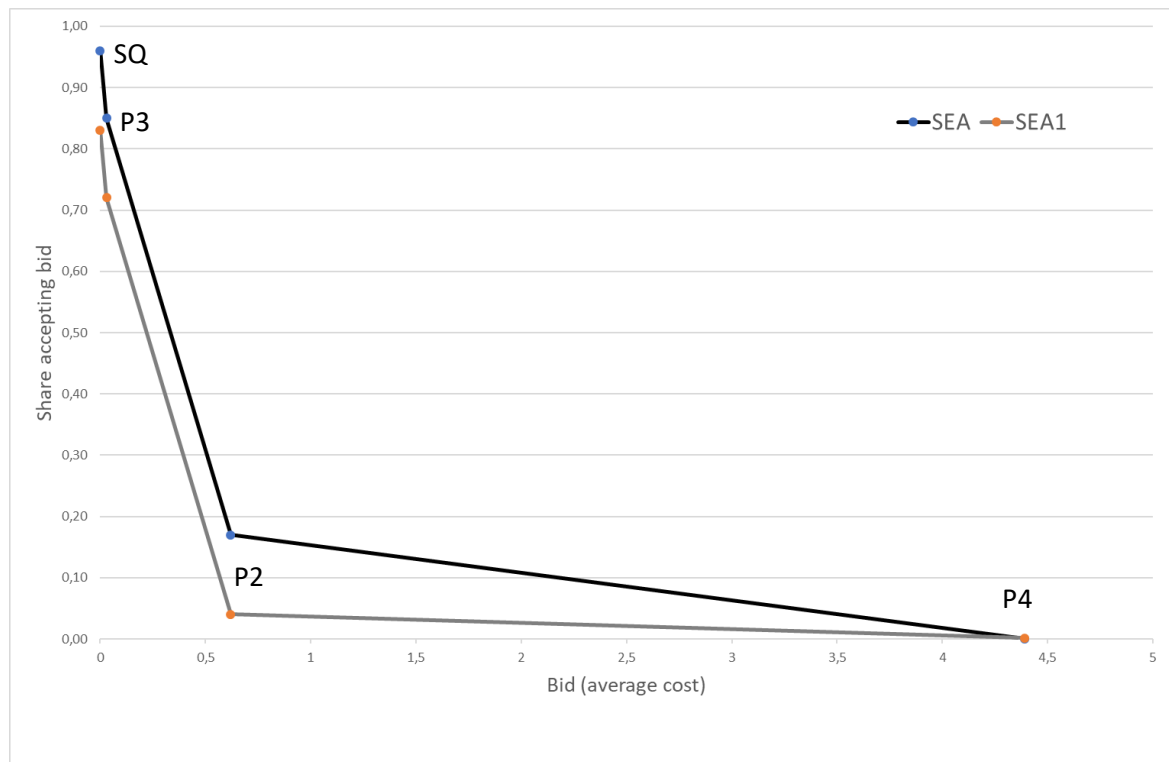


Figure 1. Empirical survival curves for STAdmin, STAgency, SEPA, and SEA. The grey curve shows responses with (indicated by 1) and the black curve shows responses without Infotext.

We use Pearson's χ^2 -test to examine whether the share accepting different bids at each agency varies systematically. Moreover, we test whether the responses differ systematically between SEA and SEPA. The results are presented in Table 7. Due to the small number of observations, these tests were not done for STAgency or Trafa.

Table 7 Results from an χ^2 test for the treated (1) and non-treated (0) groups.

ALTERNATIVES	N	PEARSON CHI2(3)	PROBABILITY
STADMIN (0) – STADMIN (1)	189	0.7541	0.860
SEPA (0) – SEPA (1)	80	17.5056	0.001
SEA (0) – SEA (1)	94	7.2002	0.066
SEPA (0) – SEA (0)	84	4.9617	0.175
SEPA (1) – SEA (1)	90	8.3194	0.040

Based on Table 7, we can reject the null hypothesis of no influence of the information text for SEPA but not for SEA and STAdmin. Moreover, there are statistically significant differences in response behavior between the respondents from SEPA and SEA.

The difference in response behavior between the different government agencies suggests support for Proposition 4 about the influence of a binding governmental budget constraint. The reasoning is as follows: Out of the three agencies studied, STAdmin is the one where the bureaucrats regularly work under a budget restriction since the investment funds available for the building of, maintenance of, and reinvestment in infrastructure are limited. It may then be that the bureaucrats at this agency automatically take a governmental budget constraint into consideration, without any extra reminders. The SEA is an “intermediate” case where, e.g., those working with research funding regularly meet a budget constraint, while analysts probably more rarely have to consider one. As noted by Hultrantz (2009), environmental and energy policies more seldom meet a governmental budget constraint; instead, such policies are either revenue neutral for the state or generate an income. The exposure of the bureaucrats at SEPA and, to some extent, SEA to a budget constraint is limited.

Finally, we find that economic information appears to influence the response behavior. This is illustrated by the majority of respondents choosing the alternative where the total cost is approximately equal to the total benefit (P2). Including information about a budget constraint for SEPA and SEA reduced the share accepting the alternative with the highest bid (P4), which would achieve the politically stated reduction goal. These results therefore strongly suggest that having information about the economic costs of policy will put restraints on bureaucrats’ decision-making and force them toward an outcome that is closer to a social optimum. To examine the issue further, we next turn to regression analysis.

4.2. Regression analysis of the influence of both institutional norms and individual characteristics

To further investigate the response behavior, we undertook a multinomial logistic regression. The results are presented in Table 8. We present five models, the first with only the two treatment groups (*Infotext*), the second with SEPA, STAgency, and STAdmin added, and SEA and Trafa thus being treated as the base agencies, the third with individual characteristics added, the fourth with an indicator of being risk neutral/loving, and finally a model that includes an interaction between being risk neutral/loving and economic and environmental preferences.¹⁷ The base program in the regressions is P2 (see Table 2).

Table 8 Results from a multinomial logistic regression

		INFOTEXT ONLY	+ AGENCIES	+ INDIVIDUAL CHARACTE- RISTICS	+ RISK	+ RISK INTERACTE D WITH PREFERENC ES
P 1	Infotext	0.338	0.398	0.287	0.286	0.213
		(0.441)	(0.452)	(0.477)	(0.483)	(0.475)
	SEPA		0.479	0.123	0.118	0.265
			(1.021)	(1.073)	(1.065)	(1.031)
	STAgency		0.830	0.724	0.726	0.618
			(1.272)	(1.271)	(1.272)	(1.357)
	STADMIN		1.751**	1.323*	1.331	1.487*
			(0.764)	(0.795)	(0.814)	(0.765)
	Sex (1=Woman)			-0.880*	-0.872*	-0.912*
				(0.518)	(0.522)	(0.542)
	Work experience			0.0434*	0.0433*	0.0435*
				(0.0237)	(0.0235)	(0.0238)
	Economic prefs			-0.272	-0.276	-0.405*
				(0.188)	(0.185)	(0.207)
	Environment prefs			0.155	0.155	0.381*
				(0.192)	(0.190)	(0.216)

¹⁷ We also tested separate estimation for the two treatment groups (*Infotext* = 0 or 1). Since there were only few observations in some categories the models were sensitive to the specification and were therefore not included.

	Risk neutral/loving				0.0857 (0.494)	0.166 (0.512)
	RNRL*econ prefs					-0.565** (0.287)
	RNRL*env prefs					0.459 (0.339)
	Econ prefs*env prefs					-0.103 (0.0981)
P 3	Infotext	0.327 (0.284)	0.345 (0.281)	0.327 (0.286)	0.324 (0.286)	0.350 (0.292)
	SEPA		0.144 (0.453)	0.295 (0.467)	0.284 (0.470)	0.400 (0.468)
	STAgency		0.273 (0.635)	0.319 (0.648)	0.318 (0.651)	0.259 (0.701)
	STADMIN		0.497 (0.353)	0.303 (0.378)	0.326 (0.373)	0.280 (0.375)
	Sex (1=Woman)			-0.0198 (0.295)	-0.00329 (0.297)	-0.0980 (0.311)
	Work experience			0.0165 (0.0153)	0.0161 (0.0155)	0.0192 (0.0150)
	Economic prefs			0.0964 (0.116)	0.0890 (0.114)	-0.139 (0.151)
	Environment prefs			-0.353*** (0.0935)	-0.349*** (0.0936)	-0.380** (0.150)
	Risk neutral/loving				0.196 (0.298)	0.0405 (0.337)
	RNRL*econ prefs					-0.0551 (0.206)
	RNRL*env prefs					0.656*** (0.239)
	Econ prefs*env prefs					0.0649 (0.0688)
P 4	Infotext	-0.460 (0.288)	-0.461 (0.291)	-0.494* (0.296)	-0.495* (0.296)	-0.487 (0.297)
	SEPA		0.967** (0.448)	0.666 (0.455)	0.655 (0.454)	0.788* (0.464)
	STAgency		0.868 (0.615)	0.752 (0.648)	0.754 (0.648)	0.771 (0.691)
	STADMIN		0.746* (0.392)	0.728* (0.403)	0.738* (0.403)	0.781* (0.423)
	Sex (1=Woman)			-0.499 (0.314)	-0.486 (0.314)	-0.636** (0.321)
	Work experience			0.00766	0.00752	0.00522

				(0.0146)	(0.0146)	(0.0150)
	Economic prefs			-0.199**	-0.206**	-0.429***
				(0.100)	(0.102)	(0.148)
	Environment prefs			0.411**	0.408**	0.866***
				(0.163)	(0.165)	(0.233)
	Risk neutral/loving				0.139	0.405
					(0.311)	(0.341)
	RNRL*econ prefs					-0.697**
						(0.282)
	RNRL*env prefs					0.356*
						(0.207)
	Econ prefs*env prefs					0.132
						(0.0913)
P	Infotext	0.813**	0.781**	0.738*	0.737*	0.733*
5		(0.389)	(0.392)	(0.395)	(0.395)	(0.395)
	SEPA		0.559	0.558	0.549	0.580
			(0.457)	(0.462)	(0.458)	(0.464)
	STAgency		-0.890	-0.678	-0.675	-0.653
			(1.112)	(1.117)	(1.117)	(1.108)
	STADMIN		-0.528	-0.475	-0.462	-0.508
			(0.463)	(0.484)	(0.491)	(0.505)
	Sex (1=Woman)			0.417	0.442	0.419
				(0.378)	(0.381)	(0.379)
	Work experience			-0.0157	-0.0163	-0.0151
				(0.0189)	(0.0190)	(0.0196)
	Economic prefs			-0.117	-0.126	-0.152
				(0.149)	(0.152)	(0.223)
	Environment prefs			-0.117	-0.116	-0.204
				(0.165)	(0.163)	(0.232)
	Risk neutral/loving				0.176	0.140
					(0.390)	(0.391)
	RNRL*econ prefs					0.157
						(0.330)
	RNRL*env prefs					0.0721
						(0.342)
	Econ prefs*env prefs					0.0361
						(0.130)
	N	425	425	425	425	425

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Looking at the results for the first model, they confirm the findings from the non-parametric analysis. Including additional information (*Infotext*) implies that respondents are less likely to choose P4 and more likely to choose the status quo option (= P5 in the table). Including the government agencies (the second model), we find that respondents at SEPA are more likely to choose P4 than those at SEA and Trafa.

To aid the interpretation of the rest of the models, we summarize the properties of the five programs and the predicted properties these have in the left-hand panel of Table 9, which is based on Table 1. The right-hand panel of the table contains a summary of the significant regression results from Table 8, model 5. The base case, against which we compare the results, is P2, which has the profile of being chosen by a risk-averse bureaucrat with medium environmental preferences and a low cost of doing a CBA. From Table 6, we see that the majority of bureaucrats are risk averse, and a majority of the bureaucrats also chose P2 (56.24% of the respondents). Moreover, the average bureaucrat has slightly negative economic (-0.003) and environmental preferences (-0.005).

Table 9 Properties predicted to raise the probability of choosing the respective programs in the left-hand panel, and an interpretation of the regression results from model 5 in the right-hand panel.

PROGRAM	Properties of the programs	PREDICTED			REGRESSION RESULTS				
		Risk profile H1 (H2)	Environmental profile	Economic profile	RN/RL	Econ prefs (#RA)	Env prefs (#RA)	RN/RL # Env prefs	RN/RL # Econ prefs
P1	The irrational choice	RN/RL (RA)	Low	Low		-	+		-
P2	Cost-efficient, greater environmental benefits, higher cost than P3 – BASE	RA (RN/RL)	Medium	High					
P3	Cost-efficient	RA (RN/RL)	Low	High			-	+	
P4	Reaches the environmental goal	RN/RL (RA)	High	Low		-	+	+	-
P5	Status quo	RN/RL (RA)	Low	Low					

Interpreting the right-hand side of Table 9, we note that the impact of the cost of doing a CBA (*economic preferences*) has the expected sign for P1 – those with a low cost of doing a CBA are less likely to choose the inefficient P1. Moreover, the finding that the risk-averse individuals with high environmental preferences prefer P1 lends support to Hypothesis 2.

The impact of *environmental preferences* on the probability of choosing P3 over P2 is as predicted by Proposition 2 and lowers the probability of choosing the cost-efficient alternative P3. The other significant coefficient, the interaction between *RN/RL* and *economic preferences* indicates that risk neutral/loving individuals with low cost of doing a CBA choose P3. This finding, too, lends support to Hypothesis 2, besides supporting Proposition 3.

Finally, the impact of the cost of doing a CBA (*economic preferences*) on the probability of choosing P4 is as expected according to Proposition 3, i.e., bureaucrats with a low cost of doing a CBA are less likely to choose the cost-inefficient alternative. Even the impact of *environmental preferences* is as predicted by Proposition 2, i.e., bureaucrats with high ideological beliefs choose the program that reaches the environmental goal. Moreover, the fact that the risk-neutral/loving individuals with high environmental preferences are less likely than their risk-averse peers to choose P4 lends support to Hypothesis 2 and Proposition 2. Finally, the risk-neutral/loving individuals with high economic preferences (low cost of doing a CBA) were in fact predicted to choose P2 or P3 by Hypothesis 2. That they are also less likely to choose P4 than the risk-averse individuals with a low cost of doing a CBA is in line with the model.

We conclude that the model fares very well when confronted with data. Thus, we find support for all three of the tested Propositions, i.e., 2, 3, and 4. Moreover, the data lends support to Hypothesis 2. We thus reject Hypothesis 1 and conclude that the bureaucrats behave as if they are risk averse with respect to environmental outcome.

5. Summary and conclusions

This paper has examined a bureaucrat's incentives to carry out or to take into consideration information from a cost-benefit analysis (CBA). The theoretical framework for this choice is a delegation model, where CBA is a form of delegation since we assume that not doing a CBA leads to decision-making under uncertainty. The main contribution of the paper is the surveying of civil servants at five Swedish government agencies, data from which is used to test the theoretical model against empirical data.

The theoretical model in the paper rests on a few assumptions. The most important is that the bureaucrats' assessment of the uncertainty pertaining to the policy outcome is heterogeneous among bureaucrats. The second one is that the bureaucrats are risk averse. Without risk aversion, the civil servants would be indifferent between obtaining the expected value of their preferred policy with and without certainty. The third assumption is that uncertainty about the policy outcome can be mitigated by doing a CBA. We do not assume a specific distribution of the shock. The model therefore applies for fairly general circumstances.

According to theory, the three main factors driving a bureaucrat's propensity to do a CBA are their risk averseness, their preferences for environmental quality, and the cost of doing a CBA. The data lends support to these hypotheses. Thus, a bureaucrat who is risk averse with respect to the environmental outcome, i.e., who is afraid of not reaching their desired environmental outcome, is less likely to do a CBA than a risk-neutral/loving one. Moreover, a bureaucrat with high preferences for environmental quality is less likely to do a CBA than a bureaucrat with less extreme environmental preferences. Finally, increasing cost of doing a CBA reduces the probability of doing one. Thus, a risk-averse bureaucrat with high environmental preferences and a high cost of doing a CBA is the least likely candidate to do a CBA and tends to choose the most environmentally far-reaching alternative with a greater probability than other bureaucrats. On the other hand, bureaucrats who are more neutral in their preferences, who are risk neutral/loving, and who have a

low cost of doing a CBA are more likely to choose a cost-efficient environmental policy, however with less environmental benefits than the equally cost efficient base case.

We also examine a fourth possible explanation to the propensity to do a CBA, namely an institutional aspect. The presence of a governmental budget constraint may raise the probability of a bureaucrat doing/using information from a CBA. We find that a reminder of the existence of a budget constraint makes the bureaucrats more likely to choose less costly alternatives or even the status quo. Thus, we find support for this hypothesis.

CBA as a delegation mechanism within this simple model can explain some circumstances in which a bureaucrat would not be interested in doing/using information from a CBA. These include risk aversion with regard to the environmental outcome, high preferences for the environment, and the cost of doing a CBA. Other reasons for the lacking use of CBAs have been studied in a sister paper, Jussila Hammes (2017). That paper identifies cognitive dissonance as an important factor and notes that a binding governmental budget constraint can induce an otherwise unwilling bureaucrat to do a CBA. The present paper adds the importance of educating bureaucrats about the uses of a CBA.

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Appendix

A1: Decision-making under uncertainty

Prior to the decision-making task, the respondents were given the following information (the text in the brackets was excluded from half of the questionnaires):

Imagine that you work as a bureaucrat in year 2020 and you are tasked with proposing one out of several programs for reducing the emissions of GHGs from the transport sector. The programs will reduce the average energy use per kilometer and also the emissions of CO₂ by the year 2030. [The goal is to reduce emissions by 70% by the year 2030]. The benefit of reducing CO₂ emissions to society are estimated to lie in the interval of 0.8 and 1.2 SEK per kilogram. The interval indicates that there is an uncertainty because the means used for reducing emissions can impact other societal goals such as biodiversity or accessibility. The other assumptions are as before. [As a bureaucrat, you should economize with public funds because they can also be used for other purposes.]

The different programs contribute to increased use of alternative fuels including electricity. Increased use of electricity in the transportation system leads to a lower level of energy use (kWh) per kilometer. Increased use of alternative fuels would reduce total CO₂ emissions from 11 billion kg in the year 2020. The impact and costs of the different programs differ, however, since different technical solutions are used. The impacts and costs are influenced for instance by whether byproducts from other production are used to produce alternative fuels, or whether there is a need to invest in new infrastructure.

A2: Data and assumptions underlying the graphical illustrations with empirical survival functions

Since we are presenting the respondents to alternatives that involve different kinds of investments, the programs presented include both fixed and variable costs. Therefore, unlike ordinary willingness-to-pay studies, we calculate the average cost for per kg CO₂ reduction over the 10 years assuming a linear decrease over the period, see calculations and results in Table 10. The average cost estimate can be directly compared with the benefit per kg (0.8–1.2 SEK per kg). To provide a graphical

illustration of the response behaviors, we use this average cost estimate as the bid that was presented to the respondents.

Table 10. Calculation of costs and benefits from the different programs presented to the respondents.

	EMISSIONS	TOTAL REDUCTION	TOTAL COST	AVERAGE	TOTAL
	IN 2030	IN CO₂ UNTIL 2030		COST	BENEFIT
				(THE BID)	
PROGRAM	9.1 billion kg	$(1.9 \text{ billion}/2)*10 =$	5 billion SEK	0.52 SEK/kg	7.6 – 10.64
1		9.5 billion kg		CO ₂	billion SEK
PROGRAM	4.5 billion kg	$(6.5 \text{ billion}/2)*10 =$	20 billion SEK	0.62 SEK/kg	26 – 39
2		32.5 billion kg		CO ₂	billion SEK
PROGRAM	8.4 billion kg	$(2.6 \text{ billion} /2)*10 =$	0.5 billion SEK	0.03 SEK/kg	10.4 – 15.6
3		13 billion kg		CO ₂	billion SEK
PROGRAM	1.9 billion kg	$(9.1 \text{ billion}/2)*10 =$	200 billion SEK	4.39 SEK/kg	36.4 – 54.6
4		45.5 billion kg		CO ₂	billion SEK

From Table 10 it is clear that Program 3 is superior to Program 1 since the reduction in CO₂ is larger but comes at a much lower total and average cost. Hence, respondents choosing Program 1 have not behaved according to the expectations from economic theory and were therefore excluded from the non-parametric analysis. Program 4 achieves a somewhat larger reduction in emissions than Program 2 but at a much higher total and average cost. Which of Programs 2 and 3 that is superior depends on the assumptions used in the calculation. The following six net present value results are possible:

- If B=1.2 SEK per kg the NPV for program 2 is 19 billion SEK.
- If B=1.2 SEK per kg the NPV for program 3 is 15.1 billion SEK.
- If B=1.0 SEK per kg the NPV for program 2 is 12.5 billion SEK.

- If B=1.0 SEK per kg the NPV for program 3 is 12.5 billion SEK.
- If B=0.8 SEK per kg the NPV for program 2 is 6 billion SEK.
- If B=0.8 SEK per kg the NPV for program 3 is 9.9 billion SEK.

Hence, with a preference for larger reductions in CO₂ emissions, Program 2 is preferred. Program 3 is preferred if the low benefit estimate is used, or if the decision rule is the benefit cost ratio. In the latter case if the benefit estimate used is 1 SEK per kg, the benefit cost ratio is 0.625 for Program 2 and 25 for Program 3.

A3: Non parametric analysis – data and test results

In Table 11 we present for each participating governmental agency the number of respondents choosing each program (freq.) and the share of the total responses for each agency (percent). Zero indicates the group without *Infotext*, 1 those with. For alternative P2, the total benefit is approximately equal to total cost. It receives the highest share of responses for all agencies except for Transport Analysis group 0, for which we have very few observations.

Table 11. Summary statistics per agency for program choice frequency with and without Infotext.

PROGRAM	AGENCY	FREQ.(0)	PERCENT(0)	FREQ.(1)	PERCENT(1)
P2	STAdmin	58	55.77	52	61.18
P3	STAdmin	20	19.23	16	18.82
P4	STAdmin	20	19.23	13	15.29
SQ	STAdmin	6	5.77	4	04.71
TOTAL		104	100.00	85	100.00
P2	STAgency	6	54.55	9	64.29
P3	STAgency	1	09.09	3	21.43
P4	STAgency	3	27.27	2	14.29

SQ	STAgency	1	09.09	0	0.00
TOTAL		11	100.00	14	100.00
P2	SEA	32	68.09	32	68.09
P3	SEA	5	10.64	5	10.64
P4	SEA	8	17.02	2	04.26
SQ	SEA	2	04.26	8	17.02
TOTAL		47	100.00	47	100.00
P2	SEPA	25	67.57	17	39.53
P3	SEPA	0	00.00	10	23.26
P4	SEPA	10	27.03	6	13.95
SQ	SEPA	2	05.41	10	23.26
TOTAL		37	100.00	43	100.00
P2	Trafa	1	33.33	4	57.14
P3	Trafa	2	66.67	2	28.57
P4	Trafa	0	0.00	0	0.00
SQ	Trafa	0	0.00	1	14.29
TOTAL		3	100.00	7	100.00

Information in Table 11 has been used to provide input to the empirical survival functions shown in Table 12. We have assumed that the respondents choosing a higher bid, for example Program 4, would also be willing to accept Programs 2 and 3. Again, 1 indicates the groups for each agency receiving *Infotext*. The numbers in the rows for each agency and for each treatment group (0 or 1) are the shares accepting a certain bid. In the non-parametric tests, we compare the number of respondents accepting a certain bid for the two treatment groups for each agency.

Table 12 Data used for the empirical survival functions.

AC (BID)	0	0.03	0.62	4.39	AC (BID)	0	0.03	0.62	4.39
STADMIN0	0.94	0.75	0.19	0.00	STADMIN1	0.95	0.76	0.15	0.00
STAGENCY0	0.91	0.82	0.27	0.00	STAGENCY1	1.00	0.79	0.14	0.00
SEA0	0.96	0.85	0.17	0.00	SEA1	0.83	0.72	0.04	0.00
SEPA0	0.95	0.95	0.27	0.00	SEPA1	0.77	0.54	0.14	0.00