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der Christian-Albrechts-Universität zu Kiel

# Essays on the Political Economy of Animal Welfare

## Empirical Studies on Voter Behaviour and Stakeholder Participation

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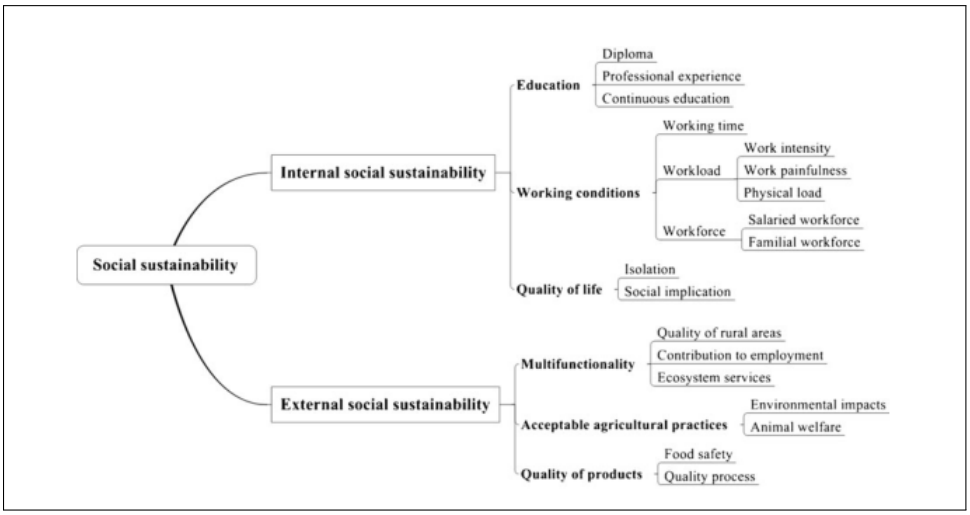
# Chapter 1

# Introduction & Summary

## 1.1 Introduction

An important aspect of nowadays sustainable livestock production is farm animal welfare (Keeling, 2005). Agricultural systems are sustainable, if they are "in harmony with the environment, the animals, the workers and the community and if they are efficient and economically competitive" (McGlone, 2001, p. 79). Thus, McGlone (2001) links animal welfare[1] to other issues reflecting the three dimensions of sustainability[2]. Another definition states that a livestock system is sustainable "if it is acceptable now and if its effects will be acceptable in the future, particularly in relation to resource availability, consequences of functioning, and morality of action" (Broom, 2001, 2010; Broom et al., 2013). Hence, the time horizon also plays a key role. Both definitions have in common that they consider public acceptance, i.e. moral judgment as well as public evaluation. Animal welfare is an indicator for acceptance of production systems and therefore for the "external social sustainability" that addresses public's demands (figure 1.1). These demands depend on values and norms (Lebacq et al., 2013; Dirscherl, 2013).

Figure 1.1: Classification of social indicators




Source: Lebacq et al. (2013)

Thus, farm animal welfare (FAW) is an issue of increasing importance in developed countries (Cornish et al., 2016; European Court of Auditors,

[1] Please note that for simplification I use the terms "farm animal welfare" and "animal welfare" synonymously.

[2] Ecology, economy and social concerns (see von Hauff and Kleine, 2009, p. 15-23).

2018). For Germany, this importance was pointed out by WBA (2015): the (perceived) low level of farm animal welfare decreases acceptance for the current status of animal husbandry. Driven by a rather negative media coverage of a productivity-oriented agriculture (Kayser et al., 2012; Grossarth, 2014), today's practice of German animal husbandry is associated with terms like "factory farming" (Kayser et al., 2011; Salamon et al., 2014). This is especially true for pig husbandry (Zander et al., 2013; Rovers et al., 2017, 2019). Issues discussed are space per animal (Rovers et al., 2018) as well as outdoor access and floor conditions[3] (Rovers et al., 2019). Accordingly, German citizens state higher demand for farm animal welfare (BMEL, 2017a, 2018).

As Grethe (2017) points out, there is an debate about the economic conceptualization of animal welfare[4]. Nevertheless, there are good reasons to consider animal welfare as a public good (Bennett, 1995; Fawaz, 1997; Harvey and Hubbard, 2013; Lusk and Norwood, 2011; WBA, 2015). Following Lusk and Norwood (2011), FAW fulfils the two main criteria for public goods: One's benefit from knowing about good welfare of animals doesn't prohibit others from this benefit (*non-rival*) and no one can be kept from benefits of animals' good welfare (*non-excludable*). Moreover, farm animal welfare is seen as plagued by market failure due to consumption externalities (Harvey and Hubbard, 2013; WBA, 2015). Uehleke and Hüttel (2018) address the problem of free riding behaviour, distinguishing between individual and collective decision. The authors show that the willingness to pay (WTP) in a collective situation exceeds individual, voluntary WTP. The latter refers to the somewhat "classical" WTP, i.e. the willignness to pay more money for animal friendly products. Several studies show a stated willingness to pay more money for animal welfare products (Lagerkvist and Hess, 2011; Clark et al., 2017). But this stated WTP doesn't transform into purchase behaviour. This refers to the citizen-consumer gap: The share of people demanding more animal welfare is higher than the share of people buying according products (Grethe, 2017).

Since markets fail to provide a sufficient animal welfare level, political

[3]This reflects two animal welfare frames identified by Deimel et al. (2012): Biological-technical and behaviour oriented considerations.

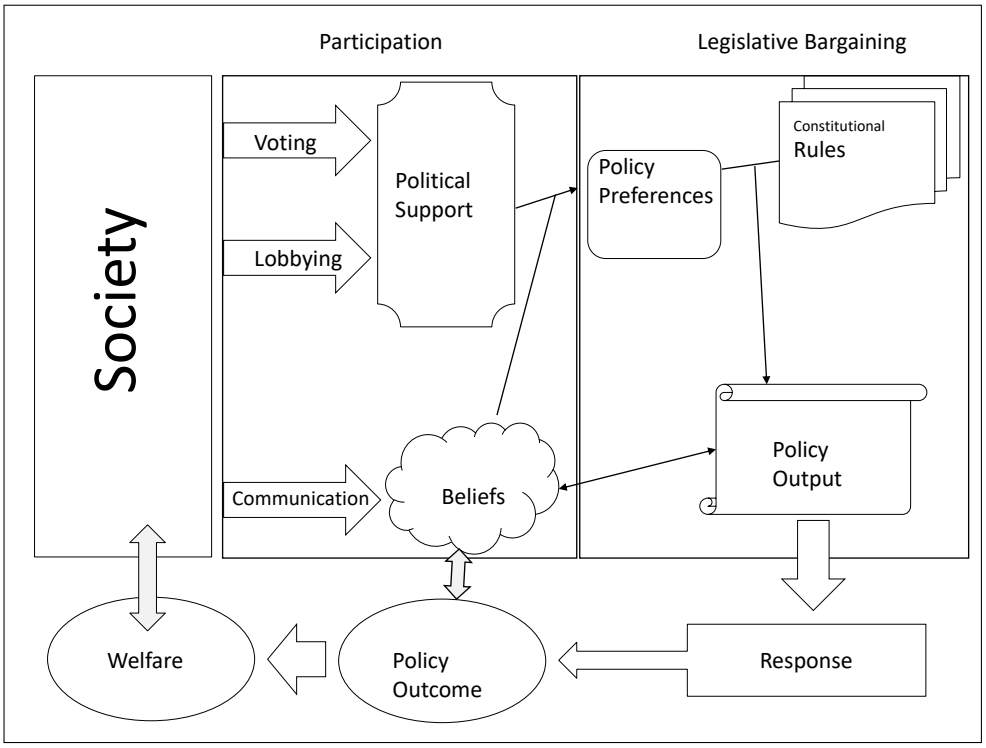
[4]One argument against animal welfare being a public good is that the former is a relation between farmer and animals. Even if considering this relation as a good, it would be a private good (Mann, 2005). Beyond this assumption, the argument of Mann (2005) challenges the role of externalities. While animal welfare is not connected to a technological externality, there might be psychological externalities linked to FAW. They are psychological effects that lead to good or bad feelings caused by a transaction (Mann, 2005).

solutions are necessary. A classical way consists of regulation and laws (Harvey and Hubbard, 2013), so "[p]ublic legislation is the main traditional instrument to address farm animal welfare issues" (Grethe, 2017). This is in line with the fact that consumers shift responsibility for animal welfare to retailers and the state (Te Velde et al., 2002). Indeed, the German legal framework is criticized by citizens (Schulze et al., 2006; Rovers et al., 2017) as well as non-governmental organizations (NGO) as for example Greenpeace (2017). Regulatory and legal questions discussed (beside increased husbandry standards) are the collective right of action for animal protection groups (see Kloepfer, 2016; Rossi, 2016; Schürmeier, 2017), a standardized testing and approval procedure for mass-produced livestock facilities (see Gauly et al., 2006; BMEL, 2017b) or the validation of competence regarding animal husbandry (WBA, 2015). Moreover, animal protection groups claim a ban of transport of living animals in non-EU member states (Bündnis für Tierschutzpolitik, 2017). Accordingly, also for political solutions, one has to know voters' preferences. This holds for the policy contents, but also for the financing of higher animal husbandry standards. Here it is important to know peoples' willingness to pay for higher legal standards in general and not for animal based products.

Regarding politics, political science literature shows evidence for the validity of the party difference hypothesis at the state level in Germany. Ewert et al. (2018) show that coalition agreements with green participation state especially multifunctionality positions in agricultural politics. This also includes animal welfare and animal protection. Accordingly, if the green party is part of a government, the government focus on the topic animal protection (Vogeler, 2017b). Hence, the party serves as driver for enhanced animal protection. Parties matter also at the national level. Especially the green party stresses farm animal welfare policies (Vogeler, 2017a). Moreover, the level of social concerns drives parties' animal welfare agenda. Accordingly, parties in Germany and United Kingdom take up these concerns in their platforms (Vogeler, 2019). Thus, parties matter in German FAW policy.

But the question occurs, under which conditions political provision of farm animal welfare can be efficient. Democratic policy making takes place in a rather complex and dynamic environment (Henning and Hedtrich, 2018). This also applies for agricultural policy, especially when considering the question of sustainability and thus, farm animal welfare. Classical approaches of political economy model governmental policy making as a political game between parties, interest groups and voters (Brock and Magee, 1978; Grossman and Helpman, 1996; Henning and Hedtrich, 2018).

Figure 1.2: Framework of political decision making




Source: Own presentation.

In representative democratic systems, the mechanism of *voting* (figure 1.2) is the most crucial since legitimacy of political agents' actions depends on voters' support. Following Downs (1957), the former as well as the latter are utility maximizing actors. In particular, voters vote for candidates whose programs they expect to bring the greatest benefit. Political agents (candidates and parties), on the other hand, seek for the benefits from governmental offices. Hence, they offer party platforms which they consider as the vote maximizing ones (Downs, 1957). This idea has been extended to the spatial models of voting (with the historical foundations in the work of Hotelling (1929)), in which parties as well as voters are assigned along policy dimensions. Hence, a voter would decide for a party that is next to his own position, i.e. the party with the smallest distance to him (Enelow and Hinich, 1984; Adams et al., 2005). In real world, voting behaviour is barely driven by pure policy oriented motives. Rather, as suggested by the Michigan model (Campbell et al., 1960), voters' decisions at the ballot box are the result of a funnel of causality consisting of social, psychological factors and issues. Accordingly, probabilistic voting models

(Adams et al., 2005) combine policy oriented with retrospective as well as non-policy motivation. Retrospective voting (Fiorina, 1981) is an evaluational process which considers the past legislature(s): Voters evaluate governmental performance using observable indicators of welfare. The better the evaluation of the performance is, the higher the probability to cast a vote for incumbents. Non-policy voting refers to several factors that are linked to parties characteristics beside policy platforms. Accordingly, loyalty to a party (Bartels, 2000) as well as characteristics of candidates or party leaders (Schoenfeld, 1982) can drive voting behaviour. All of these three components of voting behaviour enter a voter's utility function.

As can be seen in figure 1.2, voting for parties is not the only channel of political participation. Members of the society form organized interest groups to influence politics (Olson, 1965; Becker, 1983). Group members may share the same profession, age and/or social concerns (Grossman and Helpman, 1996). Political agents are interested in the support of these interest groups. In models of political exchange, interest groups provide political support resources in order to get control over certain policy issues (Grossman and Helpman, 1996; Henning, 2000, 2009). This is reflected through *lobbying* in figure 1.2. Interest groups' starting point here is the non-policy voting component mentioned above. In particular, Grossman and Helpman (1996) argue that voters are at least partially swayed by campaign spendings from interest groups to parties. Interest groups can use this channel to support political agents. This reflects political campaign actions' influence (as for example advertisement or events) that mobilize voters' support (Henning and Hedtrich, 2018). A political agent's political support function in the equilibrium state of the political game then corresponds the weighted utility functions of voters as well as interest groups (Henning and Hedtrich, 2018). Accordingly, political failure in providing sustainability goods is seen as caused by special interest group influence (Anderson, 1995; Swinnen et al., 2000).

Moreover, empirical work shows that stakeholder organizations' participation plays an important role in African development policy (Stark, 2017; Henning et al., 2017, 2019). For the European Common Agricultural Policy (CAP), previous research identified substantial influence patterns of interest groups (Pappi and Henning, 1999; Krause, 2005; Henning, 2009). Hence, it is straightforward to assume that stakeholder participation also influences German livestock policy. Indeed, the national strategy for animal husbandry of German government includes stakeholder participation (BMEL, 2017b) and follows scientific recommendation from WBA (2015). This opens the door for interest groups to influence animal welfare policy.

So far, the role of *policy beliefs* has not been addressed. As argued by

Caplan (2001, 2002, 2007), the relation between economic policies and implied political outcomes, i.e. the "political technology", is rather complex. Laymen apply naive mental models to cope with this complexity and to understand how policies translate into policy outcomes. These heuristics determine the preferred policy position. Due to cognitive biases (Akerlof, 1989), these policy beliefs can systematically differ from those of experts (Caplan, 2002). If voters' weight is large in politicians' support function and voters strongly vote policy oriented, policy decisions would follow corresponding positions. Accordingly, strongly biased policy beliefs of voters could cause basic democratic policy failure (Caplan, 2001, 2007). Hence, beside the classical questions regarding voting behaviour and corresponding political support for party platforms, modern political economy approaches have to address voters' underlying beliefs. Interest group representatives and politicians also apply policy beliefs. While politicians may not be sure regarding the political technology, interest groups mostly have the professional and technical expertise of those they represent. Accordingly, Henning et al. (2019) suggest "informational lobbying" as an additional influence mechanism. It refers to the communication of expert knowledge in order to affect political agents' policy beliefs (see arrow *communication* in figure 1.2). Here the same argument as for voters holds: If beliefs are biased and weight of interest groups for political agents is large, political decisions would follow interest groups' beliefs. Hence, policies would not promote an optimal state of the world. Therefore, it is interesting how interest groups are able to influence political agents' beliefs.

Farm animal welfare is an issue that is especially vulnerable for biased beliefs. While the meaning of the term "animal welfare" changed over the time, it is a keystone of sustainable agriculture (Keeling, 2005). Thus, there is a lack of the concept's clear definition. Instead, all existing approaches address the three dimensions natural living, emotional state and physiological functioning (Fraser et al., 1997; Fraser, 2008). These different views are reflected by approaches of measuring animal welfare. For example, the Welfare Quality® Protocol for pigs consists of four welfare principles. They reflect the physical needs (e.g. hunger, thirst, health), behavioural patterns (e.g. social behaviour) and emotional state of animals (Welfare Quality ®, 2009). Overall, the protocol suggests more than 30 assessment indicators. Hence, it illustrates the complexity of animal welfare. Here the problem of biased policy beliefs can occur. Since there is no singular definition of animal welfare's concept, different voter groups and/or stakeholder organizations might put emphasis on different aspects. This holds not only for technical or legal aspects (e.g. space per animal,

management procedures, collective right for action), but also for financing higher husbandry standards.

All in all, empirical investigation of animal welfare policy has to deal with three main questions:

1. How important is farm animal welfare for voters' decisions at the ballot box and how much are they willing to pay for increased legal animal welfare standards?
2. How important are the policy beliefs and how can they be assessed?
3. Which role play stakeholder organizations in belief formation at the political stage?

In order to answer these questions, this work consists of six essays, i.e. six chapters. While the first part deals with citizens and their voting/paying behaviour as well as their beliefs, the second part addresses stakeholder influence on belief updating. The policy space of interest are financing

Table 1.1: Contribution of the Chapters

| **Part** | | **Voter** | | | | **Stakeholder** | |
|---|---|---|---|---|---|---|---|
| *Chapter* | | 2 | 3 | 4 | 5 | 6 | 7 |
| *Policy space* | Financing | √ | √ | √ | √ | | |
| | Husbandry standards | | √ | √ | | | |
| | Test procedure | | | | | √ | √ |
| | Collective action | | | | | | √ |
| | Certificate | | | | | | √ |
| | Third country ban | | | | | | √ |
| *Question* | Voting behaviour | √ | | | √ | | |
| | WTP | | √ | √ | √ | | |
| | Beliefs | | | | √ | √ | √ |
| | Stakeholder | | | | | √ | √ |
| *Level* | Theory | | √ | | √ | | |
| | Empirical | √ | √ | √ | √ | √ | √ |

Source: Own presentation.

animal welfare, standards of husbandry, a standardized testing and approval procedure for mass-produced livestock facilities (test and approval procedure), the right for collective action (collective action), validation of competence regarding animal husbandry (husbandry certificate) and ban of living animals transport in countries outside the EU (third country ban). Thus, the work contributes to empirical as well as theoretical research. Table 1.1 presents the assignment of each chapter.

## 1.2 Summary

### 1.2.1 Ecological Voting in Germany? Animal Welfare, Climate and Water Protection as Drivers of Voting Behaviour

Voters' decisions in elections are not determined by one single issue. Rather, several issues can influence voting behaviour according the priorities of society. Hence, measuring animal welfare's influence on voter decisions only makes sense if it's compared to other topics. Therefore, this chapter quantifies not only the influence of animal welfare on voting behaviour, but also contrasts it with the ecological topics climate and water protection. In particular, the nitrogen surplus pollutes the groundwater. A high concentration of reactive nitrogen compounds may not only lower biodiversity, but also harm human health (Sachverständigenrat für Umweltfragen , 2015, p. 33). As the UBA (2018) states, the biggest share of nitrogen emissions comes from the agricultural sector. Beyond sectoral and national borders, climate change is in public's focus nowadays. Driver of the climate change are greenhouse gas emissions. Accordingly, the German government wants to decrease emissions by 55% until 2030, i.e. 562 million tons of $CO_2$ equivalents (BMU, 2019). Using data from a representative online survey among German citizens, a probabilistic voter model is applied (see Thurner, 1998; Thurner and Eymann, 2000; Adams et al., 2005). At an econometric level, we use a nested multinomial logit model since the decision not to vote should be treated different to the decision for a party (see Thurner and Eymann, 2000). Based on the estimation results we calculate marginal effects, i.e. the amount the probability to vote for an alternative changes by changing a variable by one unit. Beside the mentioned ecological issues, other issues might also drive voters' decisions. Hence, we control for several social and economic issues. Moreover, we also integrate retrospective voting and party loyalty as well as socio-economic characteristics.

The results show that the climate protection effect is 1.09 times higher than farm animal welfare while the estimate for N-surplus reduction is not significant. We show that all ecological issues offset economic growth (also having a non-significant estimate). Moreover, animal welfare and climate protection are more important than education. No policy issue is as strong as the party loyalty. But since this only applies for people who identify with a party, parties only gain additional votes if they move along policy dimensions. Especially climate protection and animal welfare are

sensitive dimensions in this regard.

### 1.2.2 The Price for Happy Pigs: Private and Collective Willingness to Pay for Animal Welfare in Germany & About Bus Drivers and Happy Pigs: Collective and Private Willingness to Pay for Animal Welfare

Both papers address the problem of financing increased animal husbandry standards. A problem of existing studies (see for example Liljenstolpe, 2008, 2011; Lagerkvist and Hess, 2011; Clark et al., 2017) corresponds to the fact that they base on the assumption that animal welfare is (part or attribute of) a private good. It is unclear how free riding is treated within this setting. Thereby, we argue that markets fail to provide the appropriate level of animal welfare. In particular, we first suggest a theoretical framework of financing animal welfare. Following Uehleke and Hüttel (2016), it considers the free rider problem and hence takes budget reallocation into account. Accordingly, the empirical part consists of two discrete choice experiments: First, the private WTP for three husbandry system components (space per animal, play opportunities and climate regulation for stables) is asked. Second, respondents have to decide which governmental budgets (security, education or public transport) should be shortened in order to finance additional animal welfare.

Results imply that WTP measurements are rather heterogeneous and vary not only across socio-economic characteristics, but also across specific attitudes towards animal welfare. They also show clear patterns regarding husbandry standards and the source of financing: Most important is the husbandry aspect of stable's climate regulation, where the average WTP is 3.03 Euro per kilogram carcass weight. Second important is space per animal. Here, the mean WTP equals 2.25 Euro. Compared to these measurements, playing opportunities (1.50 Euro) are rather unimportant. Regarding collective WTP, respondents rather prefer to cut off public transport than education or security. Interestingly, we identify a big gap between estimated private WTP for financing certain husbandry components and the collective WTP for financing animal welfare. Nevertheless, there is a positive relationship between private and collective WTP. In this regard, respondents who want to pay more for single husbandry components also want to spend more money for overall animal welfare by budget reallocation.

### 1.2.3 Possible Democratic Policy Failure in Sustainability? Measuring German Voters' Policy Beliefs

This paper is the attempt to link the approaches of the previous chapters: It suggests a theoretical framework that combines voting behaviour with economic analysis of willingness to pay (WTP). From this approach we derive the measurement of policy belief parameters based on a Cobb-Douglas production function of public good provision. Empirical foundations are discrete choice experiments and voting behaviour data in issues of ecology. This approach is motivated by the role of policy beliefs (Akerlof, 1989; Caplan, 2001, 2002, 2007). The relation between policies and the intended outcomes is a complex one. In order to reduce this complexity, laymen apply policy beliefs, i.e. naive mental models, to understand how policies translate into outcomes. These beliefs can be biased due to psychological factors and hence differ from expert judgements (corresponding true political technologies).

The empirical results show that belief parameters vary. For example, climate protection cost elasticities on average correspond 1.37, 2.83 or 4.3, depending on chosen cost elasticity for animal welfare. This pattern in general holds for water protection. At the same time we measure nearly proportional elasticities for this issue. A second finding is that we measure heterogeneity by gender: on average, men have higher climate cost elasticity parameters. Moreover, results show evidence that voters of FDP, SPD and UNION in general seem to have increased belief parameters. Third, simulating new policy positions changing parameters gave interesting results. Setting the fixed $\gamma$ for animal welfare from 0.5 to 0.48, i.e. increasing cost elasticity from 2 to 2.08, we observe decreased policy positions of voters regarding governmental spending for animal welfare (from 1.714 billion to 0.692 billion Euro on average). Hence, animal welfare spending strongly depends on underlying parameters regarding costs and efficiency. The study also shows that if beliefs change they strongly influence voters' stated position regarding a public good. Therefore, one can conclude that policy positions of voters seem to strongly depend *on the beliefs* regarding the costs.

### 1.2.4 Belief Formation in German Farm Animal Politics: An Illustrative Example From A Stakeholder Network Survey

Animal welfare is a complex concept that includes several aspects of health and physically functioning, natural living as well as affective states (Fraser, 2008). Hence, *policy beliefs* play a key role in animal welfare policy. They help political actors to cope with the issue's complexity. If beliefs are biased, they may lead to political failure (Caplan, 2001). Existing studies considering stakeholders (see for example Heise and Theuvsen, 2017; Verbeke, 2009; Ventura et al., 2015) mostly focus on the comparison of stakeholder views along the supply chain. Unfortunately, they do not contribute to the belief building process in politics. Hence, how stakeholders involved in animal welfare policy form these beliefs is unknown. We use a framework of political participation and corresponding network data to quantify communication effects within German farm animal politics. Furthermore, we use stakeholders' evaluation of a standardized testing and approval procedure for mass-produced livestock facilities to illustrate these effects.

The results show a dense expert communication network, where more than 26 percent of possible ties are realised. Moreover, we see that agriculture and animal production as well as animal protection groups drive the belief updating process and that the meat industry is the most open to external expertise. At the same time, agricultural producers put the most weight on their own expertise, i.e. having a mean own-control of 0.853. Finally, the structural effects lead to a slight convergence of positions regarding the standardized testing and approval procedure for mass-produced livestock facilities. Overall, the stakeholders evaluate this policy slightly more positive than initially, i.e. moving the median from 3 (which is the middle point of the scale) to 3.2 (in the direction of "rather useful").

### 1.2.5 Communicational Lobbying and German Animal Welfare Regulation: A Network Approach

In principle, this study is an extension of chapter 6. Again, the theoretical framework is the network based theory of informational lobbying (Henning et al., 2019). At an empirical level, the study addresses three additional issues of animal welfare regulation. As in the area of environmental law, federal legislators as well as the states have the right to implement a law that

allows animal protection groups to sue in court against animal welfare violations (Kloepfer, 2016). Additionally, there is the question of a validation of competence regarding animal husbandry, as addressed by WBA (2015). The German farm animal husbandry strategy includes such a validation (BMEL, 2017b). Another topic is the ban of living animals' transport in countries outside the EU as claimed by animal protection groups (Bündnis für Tierschutzpolitik, 2017). As a methodological extension of the previous chapter we check results regarding their robustness. Hence, a Bayesian Exponential Random Graph Model is used to first identify drivers of the network generating process. Based on the estimation results, we subsequently simulate 10,000 network configurations.

Our results imply that in the realised network agricultural producers are the main drivers of expert knowledge in German livestock politics. Animal protection organizations seem to be their counterparts when it comes to knowledge communication: Estimation results mirror these patterns since they show significant positive impact if a sender of a tie belongs to *Agric_Animal* or *AniProt*. Moreover, coefficients for political agent groups as knowledge demander are also positive, confirming that legislative actors as well as executive branch seek for expert information. Regarding policy beliefs, we show that empirical data in general capture the simulated values. This is especially true for the certificate of animal husbandry as well as the standardized testing and approval procedure where the means are nearly perfectly matched. Only few means of the final beliefs are not significant at group level, so we consider the interview based results to be robust. Moreover, results imply that the group of public administration is easy to move depending on the network configuration. In general, belief change results showed that groups evaluating a policy with a neutral position are groups that can be moved in both directions. Comparing the range of delta means per group per simulation with the reported own control, the study shows that range is wider for low own-control groups.

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# Part I

# Voters

# Chapter 2

# Ecological Voting in Germany? Animal Welfare, Climate and Water Protection as Drivers of Voting Behaviour

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# Abstract

Farm animal welfare, water protection and climate protection are in the focus of public's attention. Especially the former two challenge agriculture. But how do these ecological issues affect voter's decision? Based on a probabilistic voter model, we try to answer this question. In particular, we estimate a nested multinomial logit model and derive marginal effects quantifying the influence on party probabilities. Effects of ecological policies are compared to non-ecological issues in economic and social dimension. In the ecological policy space climate protection overweights farm animal welfare while the estimate for water protection is not significant. Furthermore, party identification exceeds all policy motives of voting.


**Keywords:** farm animal welfare, climate, water protection, voting behaviour, Germany


## 2.1 Introduction

Questions of sustainability and ecology become more and more important in the public debate. Especially agriculture is challenged by increasing social requirements. This is especially true for livestock production, where animal husbandry is criticized due to a lack of farm animal welfare (FAW) (WBA, 2015). In particular, husbandry systems are perceived as offering not enough space per animal (Rovers et al., 2018, 2019) or opportunities to express natural behaviour. Furthermore, painful management procedures like piglet castration without anaesthesia are criticized. At the same time, surveys show that German citizens want more animal welfare (BMEL, 2017a,b). Economic studies suggest that the willingness to pay more money for FAW (Clark et al., 2017; Lagerkvist and Hess, 2011) exists. Nevertheless, the scientific advisory board of the German ministry of agriculture suggests a policy mix including three to five billion euro to finance husbandry changes (WBA, 2015). Another sustainability issue regarding agriculture is the nitrogen surplus, which pollutes the groundwater. A high concentration of reactive nitrogen compounds may not only lower biodiversity, but also harm human health (Sachverständigenrat für Umweltfragen , 2015, p. 33). The biggest share of nitrogen emissions comes from agricultural production (UBA, 2018): With a N-balance around 100 kilogram (kg) per ha surplus per year, the German government failed to reach its reduction goal (Taube, 2016). An important ecological topic beyond sectoral and national borders is climate change. Greenhous gas emissions drive the climate change, i.e. an increasing earth temperature.

In order to reduce global warming, the Paris Agreement was adopted in 2015: for Germany the goal is a decrease of emissions by 55% until 2030, i.e. 562 million tons of CO2 equivalents (BMU, 2019).

Facing these environmental challenges, one might ask how they affect the voting behaviour of German citizens. Political science literature suggests that for example votes in presidential elections in United States of America are only slightly influenced by "green issues" (Davis et al., 2008). For Germany it was noted that environmental issues influence elections and the political landscape as a whole (Fietkau, 1979). Hence, a new political culture including environmental issues has overcome traditional class voting (Achterberg, 2006). But to our best knowledge, there are no recent studies investigating and comparing the magnitude of ecological issues' effects on voting behaviour. Thus, we want to contribute to the literature by quantifying the effect of these issues on voting behaviour using a probabilistic model of voting behaviour which is briefly described in the next section, followed by the description of the econometric approach and the data in section 3. Subsequently, we show the main results. A conclusion follows in the last section.

## 2.2 Voting Behaviour

Citizens are assumed to be rational utility maximizers. They vote for the party from which they expect the highest utility $V$. Thus, if

$$V_{ij} > V_{ij'} \tag{2.1}$$

voter $i$ would chose party $j$. Voting behaviour is driven by three motivational components. Accordingly, we divide $V_{ij}$ into three sub-utilities reflecting these components. First, voters decide policy-oriented. This refers to the work of Anthony Downs (1957): Citizens evaluate the platforms of competing parties regarding the expected utility, if the program is transformed into policies. Based on Hotelling (1929), spatial models of voting behaviour assign voters and parties along $n$ policy dimensions (or just one). A voter would decide for a party that is next to his own position, i.e. having the smallest distance (Adams et al., 2005; Enelow and Hinich, 1984). Hence, the policy component corresponds

$$V_{ij}^{POL} = -\sum_{n} \mu_n \sqrt{(x_{in} - c_{ijn})^2} \tag{2.2}$$

with $x_{in}$ denoting voter position and $c_{ijn}$ denoting party $j$s position in policy dimension $n$ where $\mu_n$ denotes the weight of the policy dimension. Second,

voters evaluate governmental performance using observable indicators or state of satisfaction with situation in certain policy domains. This evaluation process and its effect on voting behaviour are labelled as *retrospective voting* (Fiorina, 1981)

$$V_{ij}^{RETRO} = \sum_{k} \theta_k z_{ik} \tag{2.3}$$

with $z_{ik}$ as the evaluation of issue $k$ by voter $i$ and $\theta_k$ as the corresponding weight. Third, *non-policy* motives also drive voter decisions. In particular, the identification with a party can influence the decision at the ballot box (Bartels, 2000) as well as characteristics of candidates or party leaders (Schofield, 2007). Although sociostructurally class voting (Schoen, 2014) is seen as weakened through a new political culture (Achterberg, 2006) social and economic voter characteristics can still influene the choice of a party. If $r_{is}$ denotes the characteristics $s$ of a voter $i$ and $w_{mj}$ the non-policy characteristics $m$ of a party $j$, then

$$V_{ij}^{NONPOL} = \sum_{m} \varphi_m w_{mj} + \sum_{s} \varphi_s r_{is} \tag{2.4}$$

where $\varphi_m$ is voter's weight of party characteristic $m$ and $\varphi_s$ is the weight of voter's characteristic $s$. If considering all kind of voting motives, overall utility corresponds to

$$V_{ij} = V_{ij}^{POL} + V_{ij}^{RETRO} + V_{ij}^{NONPOL} \tag{2.5}$$

which corresponds to "a unified theory of party competition, which integrates the behavioralist's perspective on voting into the spatial-modeling framework" (Adams et al., 2005, p.3). In the next section we first outline how theory is transformed into an econometric model, derive corresponding marginal effects and describe our data.

## 2.3 Modelling and Data

### 2.3.1 Econometric Model

We use the random utility framework to model the decision of voters. In particular, we model the voting decision in a probabilistic fashion. Thus, we do not predict voter's choice precisely, but the probability of choosing a certain party. Assume a voter $i$ who has to choose between a set of $J$ parties, where $J \geq 2$. The utility that $i$ receives from party $j$ consists of two components (Hensher et al., 2015, p. 45): $V_{ij}$ refers to the deterministic

part of voter $i's$ utility, which is based on observable characteristics. In contrast, $\varepsilon_{ij}$ is the unobserved stochastic error component. Thus,

$$U_{ij} = V_{ij} + \varepsilon_{ij}. \tag{2.6}$$

The probability to vote for party $j$ then corresponds to

$$P_{ij} = Prob(U_{ij} > U_{ij'}) = Prob(U_{ij} - U_{ij'} > 0). \tag{2.7}$$

If assuming $\varepsilon_{ij}$ is independently, identically extreme value distributed, the conditional logit (CL) or multinomial logit model (MNL) can be used (Greene, 2009). The former takes attributes of alternatives into account, while the latter considers individual's characteristics. Both kind of models are established in studying voting behaviour (see for example Thurner, 1998; Thurner and Eymann, 2000; Thurner and Linhart, 2004; Dow and Endersby, 2004; Adams, 2006). Consider the voting motives mentioned above. While the policy and (parts of) the non-policy component consist of varying attributes of the parties, retrospective voting and non-policy voting include voters' characteristics. Thus, a mixture of both approaches is used (see Greene, 2012, pp. 801-807). Hence,

$$P_{ij} = \frac{exp(V_{ij})}{\sum_{j=1}^{J} exp(V_{ij})} \tag{2.8}$$

where

$$V_{ij} = \alpha j + \beta \mathbf{x_{ji}} + \gamma \mathbf{z_i}. \tag{2.9}$$

Note that $\mathbf{x_{ji}}$ here refers to a vector of party attributes while $\mathbf{z_i}$ refers to the vector with individual characteristics. The parameter sets $\beta$ and $\gamma$ as well as the alternative specific constant (ASC) $\alpha_j$ are estimated. The distance between voter and party in a policy dimension $x_{jin}$ is treated as an attribute (see Thurner, 1998; Thurner and Eymann, 2000):

$$x_{ijn} = \sqrt{(x_{in} - c_{ijn})^2}. \tag{2.10}$$

The model described relies on the assumption of independence of irrelevant alternatives (IIA), which states that ratio of two alternatives probabilities are independent of the set containing both alternatives. If this assumption holds only for subsets of all alternatives, the nested multinomial logit model (NMNL) is more appropriate (Greene, 2009; Hensher et al., 2015). This applies for the consideration of non-voting as an alternative, since it differs from parties. Particularly, one can think of a nested decision: A voter not only decides which party to vote, but also whether he

or she wants to participate at the election at all (Thurner and Eymann, 2000). We follow this approach and implement a nested model structure. Thus, the probability to vote party $j$ now depends on the corresponding nest (Greene, 2012):

$$P_{ij} = P_{ij|b} P_b \tag{2.11}$$

where

$$P_{ij|b} = \frac{exp(\alpha_j + \beta \mathbf{x_{ji|b}} + \gamma \mathbf{z_i})}{\sum_{j=1}^{J_b} exp(\alpha_j + \beta \mathbf{x_{ji|b}} + \gamma \mathbf{z_i})} \tag{2.12}$$

and

$$P_b = \frac{exp(\lambda_b IV_b)}{\sum_{b=1}^{B} exp(\lambda_b IV_b)}. \tag{2.13}$$

The term $IV_b$ refers to the inclusive value for nest $b$ and corresponds

$$IV_b = log(\sum_{j=1}^{J_b} exp(V_{ij|b})). \tag{2.14}$$

As all other parameters, $\lambda_b$ is estimated by the researcher.

We derived the marginal effects which quantify the effect of a change in an independent variable by one unit on the probability to vote a party. For variables with a generic coefficient (the attributes), we get:

$$\begin{aligned} \frac{\partial P_j}{\partial x_{ijn}} &= \frac{\partial P_{j|b}}{\partial x_{ijn}} P_b + \frac{\partial P_b}{\partial x_{ijn}} P_{j|b} \\ &= P_j(1 - P_j)\beta_n [\frac{(1 - P_{j|b})}{(1 - P_j)} + \lambda_b \frac{P_{j|b} - P_j}{1 - P_j}] \end{aligned} \tag{2.15}$$

### 2.3.2 Data

Data for the study come from an online survey regarding sustainability. It was carried out by the company *infratest dimap* in November 2018 using a representative sample of 1002 German people in the age of 18 – 93 years. The following question sets up our dependent variable: Respondents had to state for which party they would vote, if a national election would take place on the next Sunday. According to the econometric model we set up two nests: we assigned the parties to the nest "Participation (yes)" and the alternative NOTVOTE to the "No participation (no)" nest (table 2.1).

Table 2.1: Categories of Dependent Variable

| **Nest** | **Alternative** | **Answer** |
|---|---|---|
| Participation (yes) | AfD | Alternative für Deutschland |
| | FDP | Freie Demokratische Partei |
| | GREEN | Bündnis 90/Die Grünen |
| | LEFT | Die Linke |
| | SPD | Sozialdemokratische Partei Deutschland |
| | UNION | Christlich Demokratische Union Deutschlands (CDU) |
| | | Christlich-Soziale Union in Bayern e. V. (CSU) |
| No Participation (no) | NOTVOTE | Aussage: “Ich würde nicht wählen.” |

Source: Own presentation.

Subsequently, participants of the study were asked to state their positions in different policy issues as well as how they perceive the positions of every party being part of the national parliament "Deutscher Bundestag". From the stated own position and the party positions we calculated distances according equation 10. Moreover, we set up the negative of a respondents' minimal distance to the parties as the distance for the alternative NOTVOTE. This is due to the expected negative signs of estimated parameters for distances and the assumption that people would rather not vote if the distance to the party system (i.e. the minimal distance used) increases. There are only perceived positions for the six parliamentary groups in the federal parliament and the non-voting alternative available. Thus, we removed 193 cases which stated that they would vote for other parties or did not know which party they would vote for. The sample used then consists of 809 cases. Table 2.2 presents all distance variables, which we assigned to the three dimensions of sustainability. Please note that the suffix "*.percentage*" labels the variables we converted into a percentage scale as described below since our variables have different scales and different units.

Table 2.2: Overview Policy Issues

| **Dimension** | **Issue** | **Variable** |
|---|---|---|
| Ecology | Farm Animal Welfare | *ANIMALWELFARE.percentage* |
| | CO2 Emissions | *CLIMATE.percentage* |
| | Water protection (reduce nitrogen surplus) | *WATER* |
| Social | Educational spending | *EDUCATION.percentage* |
| | Security | *SECURITY.percentage* |
| | Social policy | *SOCIALSECURITY.percentage* |
| | Development aid | *GROWTH.percentage* |
| Economy | Economic growth | *GLOBALJUSTICE.percentage* |

Source: Own presentation.

Within the ecological policy space, *ANIMALWELFARE.percentage* deals with the questions how much money the government should spend in order to promote farm animal welfare. The original variable's absolute values range from zero (current) to 4.5 billion euro governmental spending for animal welfare improvements. This is in line with suggestions of WBA (2015): the report states, that up to 3-5 billion euro per year are needed to change livestock conditions. For the distances, we transformed animal welfare positions into percentage of maximum value (4.5 billion euro). Moreover, *CLIMATE.percentage* addresses reduction of greenhouse gas emissions. The final unit of measurement is the reduction in percentage, with values between 0 and 63.3 compared to the status quo. The reference here are the 909 million tons CO2 equivalent in 2016 (BMU, 2019). Our third issue of interest is reduction of nitrogen surplus in order to protect water which is measured in kg of nitrogen (N) per hectare (ha). The corresponding Variable *WATER* contains the distance in kg N per ha. Since the variable describes the reduction and thus, has an equal numeric scale as percentage measured variables, we did not convert it. We also control for the influence of the social and economic dimension. The corresponding issues are listed in table 2.2 . With governmental spending for education, security, social policy and development aid (social dimension) as well as economic growth (economic dimension) we selected governmental key issues. Note that we also converted the original variables into percentage where we set the current spending as reference point.

Beyond policy voting, we also integrate a variable that measures the identification with a party. The corresponding variable *PI* is a dummy coded attribute of the parties with value 1 if a voter identifies with party and 0 otherwise. We control for gender effects (dummy variable *man*) and the age in years (variable *age*). These three variables and the alternative specific constants ASC form the non-policy component.

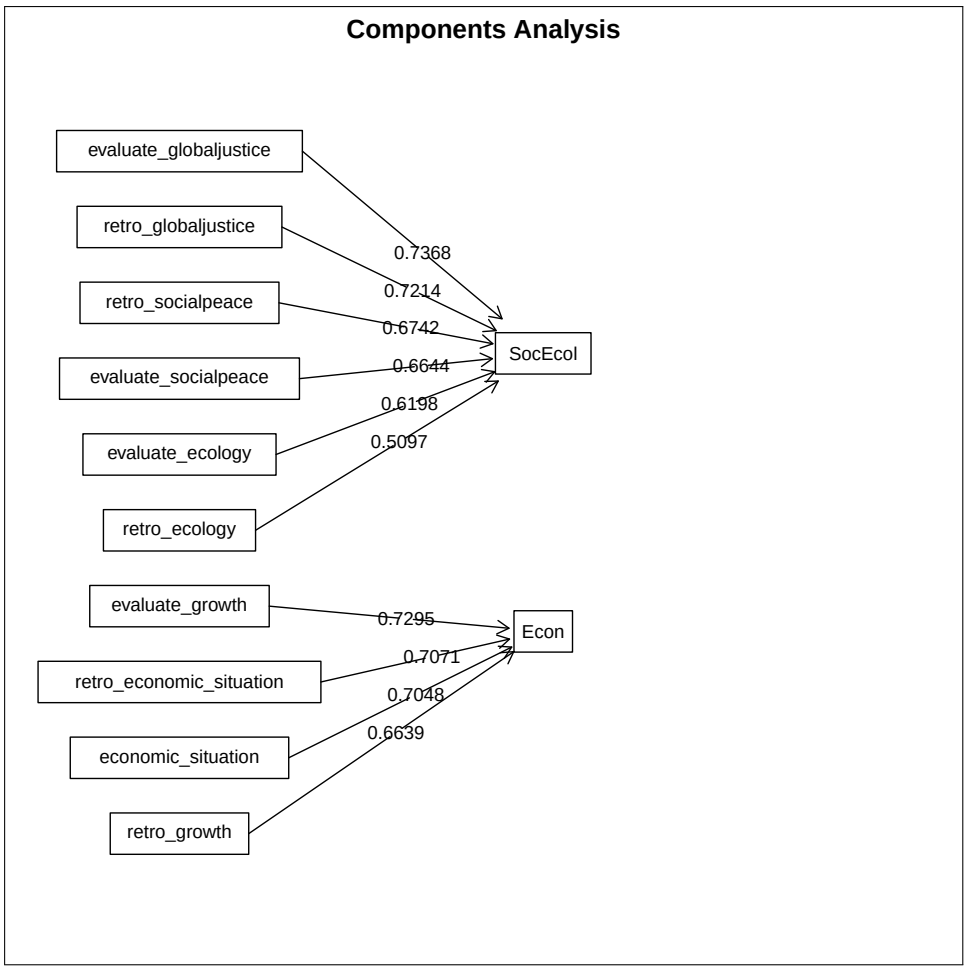
The projects database provides a set of ten retrospective variables. Each issue was evaluated from a current perspective as well as in comparison to situation five years ago (prefix "retro"), with a range from 1 ("very good" or "much better") to 5 ("very bad" or "much worse"). The variables

- *economic_situation*,
- *retro_economic_situation*,
- *evaluate_growth* and
- *retro_growth*

deal with the own economic situation as well as the state of economic growth in Germany. Furthermore, *evaluate_globaljustice* and *retro_globaljustice* are judgements towards global justice while *evaluate_socialpeace* and *retro_socialpeace* address the state of the social peace in Germany. Finally, *evaluate_ecology* and *retro_ecology* are evaluations of the state of ecology.

In order to reduce the dimensions, we conducted a principal component analysis (PCA). We decided for a two component solution as parallel analysis suggested. Figure 2.1 shows that all economic variables load on one component. We label the corresponding variable *Econ*.

Figure 2.1: PCA Loadings




Source: Own presentation.

Furthermore, social related and environmental judgements load on the same component, resulting in the variable *SocEcol* (social ecological con-

cerns). Interestingly, we only have issue components, but no time components. Hence, *Econ* and *SocEcol* set up our retrospective component. We performed PCA, estimation and post-estimation analysis using the statistical environment R (3.6.1). In the following section we present our results.

## 2.4 Results

### 2.4.1 Estimation

We estimated the specified model for 809 cases (see table 2.3). The model was selected based on Akaike information criterion (AIC). Compared with other specifications, this model has the lowest AIC.

Table 2.3: Model fit

| N | Log-Likelihood | AIC | McFadden $R^2$ |
|---|---|---|---|
| 809 | -748.26 | 1578.52 | 0.481 |

Source: Own presentation.

Table 2.4 presents the generic and the party specific coefficients as well as the lambda parameters for the nests. Note that we set the alternative UNION as the reference alternative. Hence, the party specific coefficients have to be interpreted in relation to this party. The estimated parameters of the attributes behave as expected. As one can easily see in table 2.4, all distances in the policy space have a negative sign. The effect of animal welfare is highly significant. Moreover, the effect of climate protection is significant on a five percent level. On the other hand, water protection has no significant effect. The control variable *GROWTH.percentage* also delivers a non-significant estimate. As expected, the identification with a party increases the choice probability. Economic concerns increase the probability to vote for AfD significantly, compared to the choice probability of the alternative UNION (table 2.4). As table 2.4 show, this also applies for LEFT and NOTVOTE. In contrast, only the positive effect of negative evaluation of social ecological situation for the probability to vote the left party is significant. Regarding the other predictors, one can see a negative effect of age on the probability to vote for the green party and for the non-voting option when compared to UNION. This implies that it is more likely, that younger people vote green or do not participate in election. Moreover, being a man has a positive effect on all parties compared to UNION, where only the parameter for FDP is not significant.

Table 2.4: Estimation Results

| Nested Multinomial Logit Model | | | | | |
|---|---|---|---|---|---|
| **Generic coefficients** | | | | | |
| *PI* | | | 2.9725466*** | | |
| | | | (-0.1587886) | | |
| *ANIMALWELFARE.percentage* | | | -0.0092424*** | | |
| | | | (-0.0034481) | | |
| *CLIMATE.percentage* | | | -0.0100824** | | |
| | | | (-0.0051017) | | |
| *WATER* | | | -0.0033195 | | |
| | | | (-0.0028367) | | |
| *EDUCATION.percentage* | | | -0.0083410*** | | |
| | | | (-0.0021612) | | |
| *SECURITY.percentage* | | | -0.0103498*** | | |
| | | | (-0.0021584) | | |
| *SOCIALSECURITY.percentage* | | | -0.0790581*** | | |
| | | | (-0.0193037) | | |
| *GROWTH.percentage* | | | -0.0029507 | | |
| | | | (-0.0026101) | | |
| *GLOBALJUSTICE.percentage* | | | -0.0071517*** | | |
| | | | (-0.0021945) | | |
| **Party specific coefficients** | | | | | |
| | *ASC* | *age* | *man* | *Econ* | *SocEcol* |
| *AfD* | 0.1750522 | -0.0043618 | 1.0048967*** | 0.6236013*** | 0.2468747 |
| | -0.6559577 | -0.0111198 | -0.3624503 | -0.2164142 | -0.1772427 |
| *FDP* | -0.1113056 | -0.0082456 | 0.4423195 | 0.1245194 | 0.3105806 |
| | -0.6892734 | -0.0127964 | -0.4109347 | -0.2431356 | -0.2320232 |
| *GREEN* | 1.1363529** | -0.0183168* | 0.8621904*** | 0.0953518 | 0.2918229 |
| | -0.5637948 | -0.0099508 | -0.3199301 | -0.2043939 | -0.1924583 |
| *LEFT* | -1.2207657 | -0.0028549 | 1.5635602** | 0.8725184** | 0.8854244** |
| | -1.0318779 | -0.0164534 | -0.6421833 | -0.3592242 | -0.3455413 |
| *NOTVOTE* | -3.2081950*** | -0.0333411** | 1.5159473*** | 0.4541247* | 0.102973 |
| | -0.7671033 | -0.0146551 | -0.5008617 | -0.2373717 | -0.2134351 |
| *SPD* | -0.9486043 | 0.0005422 | 0.6668723* | 0.2744299 | -0.1909698 |
| | -0.6346426 | -0.0111437 | -0.3630819 | -0.2162499 | -0.2083315 |
| **Lambda** | | | | | |
| *iv:no* | 0.8569388*** | | | | |
| | (0.1198975) | | | | |
| *iv:yes* | 1.4360750*** | | | | |
| | (0.2558212) | | | | |
| ***p < 0.01, **p < 0.05, *p < 0.1 | | | | | |

Source: Own presentation.

## 2.4.2 Marginal Effects

We calculated the marginal effects for all policy issues according equations 2.15. The median values for the marginal effects of animal welfare and climate protection are presented in table 2.5.

As one can easily see, a distance change by one percentage point regarding animal welfare affects probability to vote for the green party by 0.0007, and UNION by 0.0006 (table 2.5). Thus, probabilities for these two parties react most sensitive. The overall average marginal effect of animal welfare equals a probability change of 0.00031. Regarding climate protection, we see a median effect of 0.0008 for the GREEN probability if distance is changing by one percentage point (table 2.5). For the UNION alternative, the corresponding effect is 0.0007, for non-voting 0.000034 (table 2.5). Overall, the median effect of climate protection is 1.09 times higher than animal welfare.

With figure 2.2 we compare the marginal effects of animal welfare (green bar), climate (orange) and water protection (blue). In particular, the

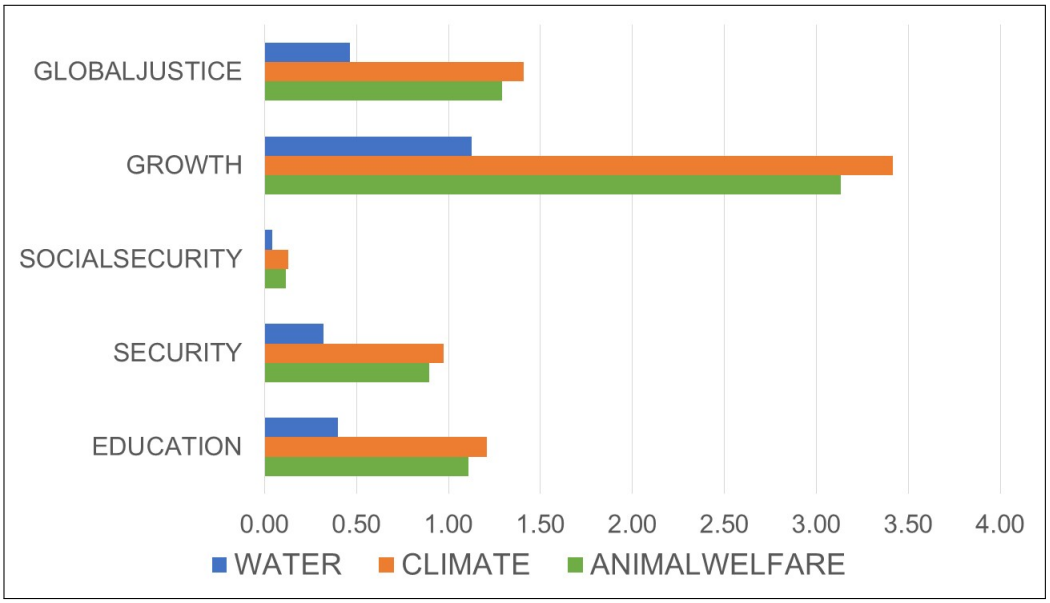
Table 2.5: Median values for marginal effects of animal welfare and climate protection

| | Animal welfare | Climate protection |
|---|---|---|
| **Overall** | 0.000305 | 0.000332 |
| **Alternative** | | |
| *AfD* | 0.000333 | 0.000363 |
| *FDP* | 0.000261 | 0.000284 |
| *GREEN* | 0.000728 | 0.000794 |
| *LEFT* | 0.000215 | 0.000234 |
| *NOTVOTE* | 0.000032 | 0.000034 |
| *SPD* | 0.000388 | 0.000423 |
| *UNION* | 0.000601 | 0.000656 |

Source: Own presentation.

bars represent the ratio of the medians of ecological issues and the control issues which are placed at the y-axis. The average marginal effect of a distance change regarding animal welfare is 3.13 times higher than economic growth and 1.29 times higher than global justice. Moreover, it is also 1.11 times higher than education. The average effect of climate protection

Figure 2.2: Ratio of ecological and control issues

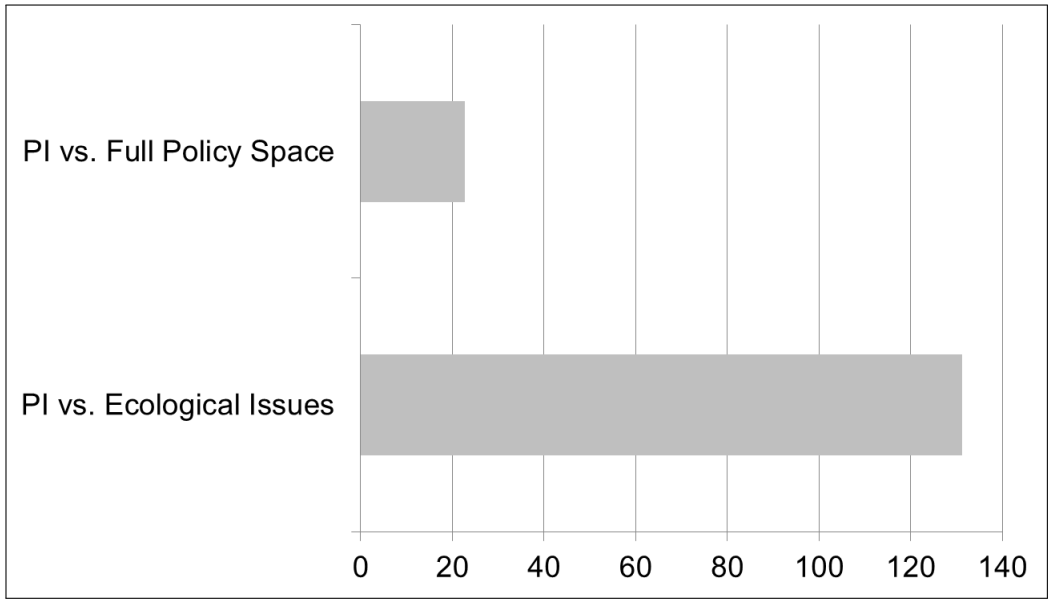



Source: Own presentation.

is 3.42 times higher than economic growth, 1.41 times higher than global

justice and 1.21 times higher than education spending's effect. Thus, climate protection has a stronger influence on voting behaviour than animal welfare. We summed up the marginal effects of the ecological issues as well as the full policy space (including *all* policy distances) and compared them with the marginal effect of PI. The latter is 131.27 times higher than the ecological issues (figure 2.3). Moreover, it outweighs the effect of the full policy space by a factor of 22.78. Thus, neither the ecological nor all policy issues together are more important than party identity.

Figure 2.3: Ratio of PI and summed up marginal effects in policy space




Source: Own presentation.

## 2.5 Conclusion

Ecological issues gained importance in public debates the last decades. Using a probabilistic model of voting behaviour, we quantified the effects of farm animal welfare, climate and water protection on voting behaviour. Our results suggest that climate protection overweights farm animal welfare by factor 1.09 and the effect of water protection is not significant. Furthermore, we could show that economic growth (non-significant estimate) is offset by all environmental issues. Nevertheless, party identification is more important than policy oriented voting. Of course, this only applies for people who identify with a party. Thus, parties have to move

along policy dimensions in order to gain additional votes. The effect of climate protection might be explained by the cross-sectoral nature of the issue: while financing animal welfare and N-surplus are agricultural specific questions, greenhouse gas emissions address also other economic sectors. Hence, it is no surprise that the issue affects voters' behaviour more than farm animal welfare or reduction of N-surplus. One limitation of our study might be the econometric model used. The MNL-family assumes homogeneous preferences for attributes and predictors. To deal with heterogeneous weighting of the single policy issues, latent class models of choice have already been applied to voters' choice (Petri, 2015; Henning et al., 2018). But one crucial part here is the modelling of nested decision structures. Here we see room for future work.

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# Chapter 3

# The Price for Happy Pigs: Private and Collective Willingness to Pay for Animal Welfare in Germany

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*Paper prepared for submission to the "German Journal of Agricultural Economics"*

# Abstract

In both, politics and society there is still the open question about farm animal welfare. Since markets fail to provide the appropriate level of animal welfare, political solutions are needed. An important role is played by financing, which depends on citizens' willingness to pay. In this context, this paper contributes to the literature. First, we suggest a theoretical framework for the political provision of animal welfare. Second, based on a latent class approach, we estimate private WTP for legal fattening pig husbandry standards as well as collective WTP for animal welfare itself. Estimation results imply that WTPs are rather heterogeneous and vary not only across socioeconomic characteristics but also across specific attitudes towards animal welfare. They also show clear patterns regarding husbandry standards and the source of financing. Additionally, we identify a big gap between estimated private and collective WTP.



**Keywords:** Animal welfare, public goods, willingness to pay for husbandry systems, social acceptance of husbandry systems, financing animal welfare, budget reallocation


## 3.1 Introduction

Nowadays, animal welfare is high on both the political and academic agenda in Germany as well as many other highly industrialized countries around the world. For example in Germany, farm animal husbandry is challenged by a decreasing social acceptance (WBA, 2015). Media coverage about bad practice cases in the agricultural sector and the observed alienation of society and agriculture imply that the demand for animal welfare is constantly rising over the last decade (Balmann, 2016; Kayser et al., 2011; Spiller et al., 2016). Presumably, the criticism of the status-quo is based on a change of values in developed countries and ethical concerns about conventional farming (Dirscherl, 2013). The latest nutrition reports of the German government not only express a higher demand for animal welfare among the population but also propose the concept of a state-run animal welfare label (BMEL, 2017a, 2018). Especially pig husbandry and the corresponding legal framework are criticized by citizens (Rovers et al., 2017; Schulze et al., 2006; Weible et al., 2016; Wildkraut et al., 2015). Social movements and non-governmental organizations like Greenpeace (2017) claim that the German pig husbandry is illegal and unconstitutional. Therefore, it is not a surprise that the German government has formulated a

comprehensive strategy for animal husbandry including an animal welfare label (BMEL, 2017b).

However, despite an intensive political debate and political activism, very little has been effectively changed, yet. Thus, the question arises why is it so difficult to adapt animal production to changed consumer preferences for a higher animal welfare? A first obvious answer to this question corresponds to the fact that consumers' demand for animal welfare is plagued by various collective action dilemmas, i.e. asymmetric information and free riding (see Lusk and Norwood, 2011). The former results since animal welfare corresponds to a product attribute that cannot be directly observed or experienced by consumers as it is a property of the production process and not the final product itself. Thus, the famous "market for lemons" phenomenon applies, i.e. since animal welfare is costly for producers, rational consumers form beliefs expecting a minimum level of animal welfare supplied at the market. Consequently, consumers reveal minimal willingness to pay for animal welfare at the market and producers deliver accordingly. A prominent institutional arrangement that helps to avoid market failure due to asymmetric information corresponds to public or private labels. For example, the German Animal Welfare Federation introduced its animal welfare label back in 2013 and the food retail industry and agriculture sector launched the so-called Animal Welfare Initiative[1] back in 2015 (Initative Tierwohl, 2017). Beyond asymmetric information the demand for animal welfare is also plagued by free riding, due to external effects in consumption. Consumers have incentives to free ride, which is to buy animal products of the same quality that have not been produced under high animal welfare standards at a lower price. This incentive results since individual consumption of high animal welfare products has only a marginal effect on the overall level of animal welfare.

All in all, it is easy to conclude that the markets fundamentally fail to effectively provide a higher level of animal welfare even if this is collectively desired by consumers. Therefore, analogously to any other public good, an efficient provision of animal welfare can only be achieved via appropriate political processes. Such a process includes the implementation of a political mechanism that guarantees both: an efficient production of any desired level of animal welfare as well as the derivation of citizens' true demand for animal welfare. While the former can relatively easy be imple-

[1] Within the program a set of specific animal husbandry standards has been defined to guarantee a higher level of animal welfare. Farms enrolled in the program have to acquire these husbandry standards and in exchange are compensated. Compensation paid to farmers is basically paid by the agribusiness industry (Initative Tierwohl, 2017).

mented, e.g. via contracting[2], the latter is challenging since the invisible hand of the market cannot be used to consistently reveal and aggregate individual consumer demand. Thus, politicians need to know the exact level of animal welfare consumers collectively want to be realized. This is not a trivial endeavor, since consumers have heterogeneous preferences and often are not capable to state their individual preferences accurately. Moreover, animal welfare is a multi-criteria concept (Fraser, 2008; Welfare Quality ®, 2009) which is technically determined by a set of husbandry components including space (see for example O'Connell, 2009), climate and possibilities to express natural behaviour (see Veit et al., 2016, for the relation of raw material and tail-biting). Hence, the effective provision of farm animal welfare depends not only on citizens' evaluation of animal welfare itself, but also on the priorities regarding farm animal welfare dimensions. In this context, economic studies that measure preferences for public goods and animal welfare empirically are of particular interest. Unfortunately, due to a lack of sufficient data, empirical approaches based on revealed consumer preferences are rather rare. Thus, a prominent approach corresponds to the estimation of stated preferences using discrete choice models (Ben-Akiva and Lerman, 1985; Hensher and Greene, 2003).

These approaches have already been widely applied to estimate consumer preferences for animal welfare (see nice overview given by Lagerkvist and Hess, 2011; Clark et al., 2017). The standard approach corresponds to the estimation of the parameters of a probabilistic utility function applying different variants of a logit approach. Generally, consumer preferences are estimated in terms of willingness to pay (WTP) or willingness to accept (WTA) for specific commodity attributes derived as the marginal rate of substitution (MRS) from the estimated probabilistic utility function. A comprehensive overview on empirical studies estimating WTP for animal welfare is given by Lagerkvist and Hess (2011) as well as Clark et al. (2017), who conducted meta-studies on the WTP for animal welfare. Further, Tonsor et al. (2009) analyze Michigan consumers' preferences for (not) banning gestation crates as an attribute of a hypothetical purchasing situation for pork, while Grunert et al. (2018) estimate weights and WTP for production characteristics like animal welfare for German and Polish consumers. Very interesting studies have been undertaken by Liljenstolpe (2008, 2011). In particular, (Liljenstolpe, 2008, ibid.) examines the WTP

[2]This is done for objectives regarding biodiversity within the scope of contractual nature conservation management (see Ministerium für Energiewende, Landwirtschaft, Umwelt, Natur und Digitalisierung des Landes Schleswig-Holstein (MELUND), 2016)

for improved husbandry components for pork in Sweden, e.g. enlarged space per animal, avoidance of castration, mobile slaughter and specific improved feeding regulations. At a methodological level these studies explicitly take heterogeneity of consumer preferences into account applying MNL-, RPL- and LC-models, respectively. However, Liljenstolpe (2008) concluded that her studies only apply to Sweden and have only very limited implications for other European countries, as consumer preferences are heterogeneous especially across different countries. Moreover, a general problem of existing studies including the one of Liljenstolpe (2008) corresponds to the fact that undertaken social choice experiments assume that animal welfare is a private good, e.g. they assume that individual consumers can choose between different commodities with different attributes corresponding to specific components determining animal welfare (e.g. enlarged space, no castration or mobile slaughter). The problem is that it is unclear how free riding is treated within this setting: Do respondents take into account that beyond their own individual realized choices animal welfare levels are determined by choices of other consumers? Or do they answer assuming that their individual consumer choices determine the level of animal welfare?

A political provision of farm animal welfare implies regulation of husbandry standards as well as the compensation of additional costs by the state[3]. Hence, since individual choice express respondents' preferences as citizen for a specific policy regulation of animal welfare free riding cannot occur under this scenario. A more appropriate design would provide choice options differing in levels of *legal* standards for animal husbandry. Additionally, alternative schemes of public spending should be offered. Accordingly, WTPs derived within this approach can be interpreted as collective WTPs (see Uehleke and Hüttel, 2016). Estimating collective WTP implies a further problem: In particular, the government provides many different public goods and services. Governmental budgets are allocated to different areas like security, education or climate protection. Money used for farm animal welfare is not available for these other services. Given this fact, one has to decide about the *relative* value of a public good, since the acceptance of animal welfare policies depends also on the relative value of animal welfare. Thus, citizen choices correspond to a nested choice among private and public consumption: At a first stage, citizen have to choose the share of their income they want to allocate to the provision of public goods versus the share of income they like to spend on private con-

[3] In fact, payments from public budgets seem conceivable for the government as part of livestock strategy (BMEL, 2017b).

sumption. At a second stage, citizen have to allocate total public expenditure among specific public goods and total private expenditure among different private consumer goods. In this setting the estimation of WTP for a specific public good, i.e. animal welfare, which equals to the marginal rate of substitution between this good and the aggregate bundle of private consumer goods, is a not appropriate measure for relevant consumer preferences for animal welfare. Furthermore, the measurement of collective WTPs for animal welfare vary significantly depending on how animal welfare is financed, i.e. by additional taxes or via reallocation of governmental expenditures across different public goods.

Thus, overall it is fair to conclude, although many interesting studies exist, which estimate empirically WTP for animal welfare and specific components of animal husbandry, the understanding of relevant consumer preferences determining political regulations is still vague. In this context this paper aims to contribute to the literature. In particular, we estimate the private WTP for different husbandry standards as well as collective WTP for overall animal welfare applying two discrete choice experiments. While the former is the classical trade-off between animal welfare components and private consumption, the latter is the trade-off between animal welfare and three public services: education, public transport and security. The latter implies interesting differences between estimated collective WTPs depending on the source of finance.

## 3.2 Theoretical Background

### 3.2.1 Modelling the public provision of animal welfare

To model consumer preferences regarding the provision of animal welfare consider the following utility function

$$U(z, M) = z^{\alpha} M^{1-\alpha} \tag{3.1}$$
$$z = \prod_i Z_i^{\alpha_i}$$

For simplicity we assume that public goods can be provided implying the same log-linear cost function, $C_i(Z_i)$, thus from the viewpoint of an individual consumer with a total income of $Y$ optimal consumption of public ($z$)

and private goods $M$ follows from

$$z^*, M^* = argmax\, U(z, M) = z^\alpha M^{(1-\alpha)} \tag{3.2}$$
$$s.t.$$
$$\sum_i C_i(Z_i)Z_i + M = Y$$
$$C_i(Z_i) = C_i^\gamma$$

Resulting in

$$Z_i = [\frac{k_i}{1 + k_i\alpha_i \sum_j \frac{1}{\alpha_j}}]^{\frac{1}{\gamma}} \tag{3.3}$$
$$M = (1 - K)Y$$

$M$ is the total expenditure for private consumption. Assuming for simplicity that $\alpha_i = \alpha_j, \forall i, j$, results in symmetric demand for public goods:

$$Z_i = [\frac{k}{n(1 + k)}]^{\frac{1}{\gamma}} \tag{3.4}$$
$$M = (1 - \frac{k}{1 + k})Y$$
$$k = \frac{\frac{\alpha}{(1-\alpha)\gamma}}{(1 + \frac{\alpha}{(1-\alpha)\gamma})}$$

(3.5)

Note that the optimal provision of a specific public good just follows results, where the WTP for this good equals the marginal costs

$$WTP_i = \frac{\alpha\alpha_i}{(1 - \alpha)} \frac{M}{z_i} = \gamma Z_i^{(\gamma-1)} = C_i'(Z_i) \tag{3.6}$$

Please note that the $WTP_i$ is derived for the private consumption resulting in the utility optimum, i.e. given the optimal consumption of all $n$ public goods. Therefore, designing a choice experiment, where only the demand for one specific public good is varied results in a WTP estimation for this good that is not appropriate for the true optimal consumer choices as it neglects consumer preferences for other relevant public goods. Especially comparing estimated WTPs with marginal cost of providing the public good to derive optimal provision of this specific public good is misleading as WTPs for other public goods might be much higher implying that consumers would prefer to allocate expenditure towards the consumption of

these other public goods. To see this formally consider the utility maximization assuming that consumers can only choose between private consumption and one specific public good, say $i$=1, then it follows:

$$Z_1 = [\frac{k}{n(1+k)}]^{\frac{1}{\gamma}} \tag{3.7}$$
$$M = (1 - \frac{k}{1+k})Y$$
$$k = \frac{\frac{\alpha}{(1-\alpha)\gamma}}{(1 + \frac{\alpha}{(1-\alpha)\gamma})}$$

Note that the derived demand for the public good 1 is $n$ times higher when compared to corresponding optimal demand considering simultaneously all relevant public goods. Accordingly, the estimation of WTPs based on choice experiment data focusing on only one specific public good implies a bias when compared to the optimal provision for this good. Undertaking an additional choice experiment that allows the estimation of relative WTPs between different public goods reveals the direction and magnitude of this bias. In other words, even if the locally estimated WTP for animal welfare would be much higher than the marginal cost to provide an additional amount of this good, this does not necessarily imply that an additional supply of animal welfare is optimal in maximizing consumer's welfare. Therefore, to test for this bias empirically we undertake additional choice experiments to estimate the relative WTP for animal welfare when compared to other public goods (see section 3 below).

### 3.2.2 Assessing WTP for Animal Welfare empirically

To asses WTP for animal welfare or specific components of animal husbandry that determine animal welfare empirically, we follow the standard approach of stated preferences. Let $X$ denote a certain farm animal policy, e.g. legal husbandry standards or financing schemes, and $U$ individual $n$'s utility derived from this policy, i.e. $U_n(X)$. Given a set of alternative policies *J*, rational decision maker will always choose the alternative with the highest utility corresponding to their preferences. If

$$U(X_i) > U(X_j) \forall j \in j = 1...J, \tag{3.8}$$

a decision maker would choose alternative $i$, therefore the probability of choosing $i$ is

$$P_i = Prob(U(X_i) > U(X_j)). \tag{3.9}$$

Following random utility theory, the utility function of a certain good $i$ can be divided into two components: the observable deterministic component $V(X_i)$ and the error term $\epsilon$ (Hensher et al., 2005). So, $U(X_i)$ is written as

$$U(X_i) = V(X_i) + \epsilon. \tag{3.10}$$

As mentioned above, farm animal welfare is affected by the physical and psychological dimension as well as the natural behaviour of an animal. Physical and mental states together with the opportunity to express natural behaviour are determined by the husbandry system. Thus, one has to choose a policy which defines standards for husbandry systems that lead to an increase of farm animal welfare. Like other goods, a husbandry system is described by its components, e.g. stocking density or structure of pig boxes. According to the characteristics of value theory (Lancaster, 1966), a person's utility from a husbandry system is driven by the value of its characteristics. Which animal welfare policy people choose is therefore determined by the quality and quantity of components. Thus, $V(X_i)$ is an additive function of the $K$ attributes of the animal welfare policy $X$. Thus,

$$V(X_i) = \alpha_i + \sum_{k=1}^{K} \beta_k X_k, \tag{3.11}$$

with $\beta_k$ denoting the weight of the attribute $k$ and $\alpha_i$ denoting the constant.

Below, we will use the term *private* WTP to refer to the willingness to pay in a more or less classical choice scenario (additional cost per kg carcass weight), but specifically for legal standards of animal husbandry systems[4]. In contrast, the term *collective* WTP denotes the willingness pay for animal welfare improvements in exchange for other public goods. This terminology is inspired by Uehleke and Hüttel (2016) who compare individual purchase situations with a collective referendum. To avoid misconceptions, we emphasize that the collective WTP is not an aggregated WTP of all respondents. Rather, the collective WTP indicates the individual MRS between animal welfare and another public good of individual consumers, i.e. the number of units of a public good a person would give up in exchange for one additional unit of animal welfare. Technically, the

[4]Trying to identify the key problems associated with livestock systems, the public does focus rather on resource-based conditions of husbandry systems than on management procedures – apart from the use of antibiotics – and therefore demands barn specific adaptation to improve the well-being of farm animals (Zander et al., 2013). Since scientists and political advisors recommend the inclusion of the citizens' view on animal welfare (WBA, 2015), this paper focuses on resource-based husbandry preferences, even though we acknowledge the importance of management aspects for animal welfare.

latter is mimicked in the choice set-up via a hypothetical reallocation of public expenditures among the two public goods (see section 3 below).

In general, as well as for animal welfare, WTP analyses are confronted with much criticism concerning their explanatory power in regard to real preferences. That is the case because the willingness to pay for animal welfare stated in a survey or an interview situation doesn't match the overall observed consumer behaviour in the market. There are several explanations for this empirical discrepancy that is commonly called "citizen-consumer gap" (a comprehensive literature review on this phenomenon is provided by Grethe, 2017). On the one hand, social desirability or the so-called hypothetical bias could displace financial calculations and may lead to an overly inflated WTP. On the other hand, the phenomenon occurs because primarily purchasing decisions are biased, whenever citizens suppress unpleasant facts about slaughtering with the effect of consuming behaviour deviating from intrinsic beliefs (Grethe, 2017; Loomis, 2014; Lusk and Norwood, 2011). However, the objective of choice experiments is to extract real WTPs. This is especially relevant for public goods, because their provision is a question of appropriate political regulation, since they suffer from market failure. Of course, choice experiments are always hypothetical and one can doubt the methodological suitability for realistic WTP studies. But a choice design, that reminds probands of relevant decision criteria, they base their decision on, may be the right way for extracting honest WTPs. Corresponding, in case of animal welfare, it is important that choice sets present costs of animal welfare improvements in a way that reminds probands of their public good nature.

A further problem of estimating WTPs empirically corresponds to preference heterogeneity. For example, existing studies show that women have a higher WTP for animal welfare than men (see Clark et al., 2017; Heise and Theuvsen, 2017). A possible reason might be that women are more sympathetic towards animal welfare than men (Herzog, 2007). Compared to latter, women rather express agreement to statements denying morally justification of using animals for food. Also, they agree that the suffering of animal in food production should be minimized (Beardsworth et al., 2002). Therefore, we assume that sex has an influence on the heterogeneity of preferences about animal welfare standards and financing and thus, on private and collective WTP. Additionally, although not well tested, we assume certain attitudes and values to be drivers for heterogeneous preferences. The extent of WTP for animal welfare husbandry systems presumably depends on the personal importance of the issue as well as the perceived need for improvements in husbandry. The worse people evaluate the current level of farm animals, the higher the willing-

ness to pay for improvements should be. As we know from literature, WTP is affected negatively if the animal welfare standards are implemented by law (Lagerkvist and Hess, 2011). In this regard, political ideology seems to have an influence, i.e. consumers' general attitude towards state interventions in a market economy measured on a left-right scale. In our empirical analyses we take potential heterogeneity into account applying a latent class approach.

## 3.3 Econometric Model and Data

### 3.3.1 Econometric Model

In our empirical analysis we apply the conditional logit model as the standard model for discrete choice analysis based on generic attributes (Greene, 2012; Train, 2003; Wooldridge, 2002). The probability to choose alternative $i$ is

$$P(y_{nt} = i) = \frac{exp(V_{it})}{\sum_{j=1}^{J}(V_{jt})}. \tag{3.12}$$

In the case of discrete choice experiments, one has to consider $\alpha$ as the alternative-specific constant (ASC) in $V$ (see equation 3.11). Using labelled experiments, where people have to select one alternative from a set of husbandry systems which are also described by their name like "free range husbandry" and "stabling", the ASC represents characteristics which are not included in the model but nevertheless can possibly influence the decision. Here, husbandry systems could be described in terms of space and feeding, but people may also see benefits from the fact that there is more fresh air for pigs in free range systems. Therefore, they will choose this kind of farm animal husbandry. In the case of unlabelled experiments, in which the alternatives are labelled as A, B or C, individuals do not obtain a specific benefit from the names of the alternatives. In this sense, the constant can be omitted (Hensher et al., 2005). The disadvantage of the standard conditional logit model is the assumption of homogeneous preferences for all individuals, while mixed logit and latent class models are able to capture heterogeneous preferences. When using the mixed logit model, the researcher has to define the form of preference distribution, whereas with the latent class approach only the number of groups must be decided. (Greene and Hensher, 2003). The coefficient of

the attributes varies for each $Q$ classes, so we can rewrite[5] (3.11) as

$$V_{i|q} = \sum_{k=1}^{K} \beta_{k|q} x_k \tag{3.13}$$

and define the choice probability for $i$ depending on class $q$ as

$$P(y_{n|q} = i) = \frac{exp(V_{i|q})}{\sum_{j=1}^{J}(V_{j|q})}. \tag{3.14}$$

Thus, the choice probability depends on the class membership, which can be determined by observable covariates like age, sex, economic status or attitudes and values (Swait, 1994; Boxall and Adamowicz, 2002; Greene and Hensher, 2003). The probability to belong to class $q$ then is

$$P_{nq} = \frac{exp(\lambda_q + \sum_{z=1}^{Z} \gamma_{qz} zn)}{\sum_{q=1}^{Q} exp(\lambda_q + \sum_{z=1}^{Z} \gamma_{qz} z_n)}, \tag{3.15}$$

with $Z$ characteristics of individual $n$. The class constant $\lambda_q$ and the characteristics' coefficients are estimated by the researcher. Finally,

$$P(y_n = 1) = \sum_{q=1}^{Q} P_{nq} P(y_{n|q} = i). \tag{3.16}$$

For conditional logit models the average WTP for attribute $k$ is

$$WTP_k = -\frac{\beta_k}{\beta_c}, \tag{3.17}$$

with $\beta_c$ as the parameter of a cost attribute. The use of a latent class model allows the calculation of an individual willingness to pay. We weight the ratio of class coefficients for attribute and costs (which equals the average WTP within the class) by $P_{nq}$ to calculate individual WTP:

$$WTP_{nk} = \sum_{q=1}^{Q} P_{nq}(-\frac{\beta_{k|q}}{\beta_{c|q}}). \tag{3.18}$$

[5]Please note that there is no need for a constant in our model because of the use of unlabelled experiments.

### 3.3.2 Data and Design of Discrete Choice Experiments

To apply our models, we used data from an online survey of the AniFair project. AniFair is a research project funded by the German Federal Office for Agriculture and Food (BLE) and executed by Kiel University that evaluates the relative relevance of various animal welfare indicator variables with the objective to develop a comprehensive animal welfare assessment tool. Among other methods, the project applies elite surveys and online-choice experiments to analyze preferences of different stakeholders and voters. These surveys concern husbandry techniques that need to be aggregated in order to achieve a common measurement of animal welfare. In the first part of the online questionnaire respondents have to answer questions about farm animal welfare in general and the measurement of pigs' animal welfare. These questions are followed by the first choice experiment regarding preferred husbandry system components. The second part contains questions about politics in general followed by the third part which evaluates the attitude towards financing animal welfare and introduces the second experiment about budget reallocation. Policy issues regarding sustainability and agriculture constitute part four, which is followed by the last part with general socioeconomic questions. The data were collected in March 2017, and the final dataset contains answers from employees and students of the University of Kiel.

To measure private and collective WTPs for husbandry system components we implemented two discrete choice experiments. In the first experiment, five choice sets with each three alternative husbandry systems were presented to respondents, described by the following attributes: space per animal, climate system, manipulable material to explore/dig into, and additional costs. We chose space as attribute because sufficient space fits physical needs of an animal and provides a certain quality of live in terms of expressing natural behaviour or maintaining discrete pen areas (O'Connell, 2009). Offering straw to dig into is an important factor to express natural behaviour and to experience positive emotions (Tuyttens, 2005). Because pigs are not able to regulate their body temperature, they need a climate regulation system within the stable. Therefore, we include climate regulation as a factor directly related to physical needs. All of these attributes are regulated by the German Animal Protection Livestock Decree, so developing levels was straightforward. To make sure that the attributes and levels make sense we consulted a veterinarian working on the project during the development process. The third alternative in the choice sets contained the current legal status in Germany as an opt-out

option. The variable costs equals the weighted[6] sum of additional costs of the attribute levels (Table 3.1). Please note that we did not ask the respondents to choose a product that fits better husbandry conditions, but to choose the future legal standard for husbandry systems in Germany and the corresponding additionally costs which lead to higher prices. Given this design we avoid that respondents anticipate economic externalities or market failure. Thus, we created the discrete choice setting in way that no free-riding can occur.

[6]The additional costs of every attribute level have been estimated, based on own research and different sources. Because of the insufficient availability of data in this area we can't preclude overestimation and underestimation of costs. Therefore, we multiplied with 0.8, 1 or 1.2 to weaken possible overestimations and underestimations.

Table 3.1: Attributes of husbandry systems in the first experiment

| Attribute | Levels |
|---|---|
| Variable | |
| Space per animal | 1: 0.75 m |
| Space | 2: 1.3 m |
| | 3: 2 m |
| Climate | 1: Air system |
| Climate | 2: Swine shower |
| | 3: Outdoor area with opportunity to wallow |
| Manipulable material | 1: Manipulable material |
| Play | 2: Straw two times per day (machine) |
| | 3: Straw three times per day (human) |
| Costs | Costs of attribute combination $\times$ 0.8, 1 or 2; status quo: 0 |
| Costs | (€/kg carcass weight) |

Source: Authors' own presentation

The second choice experiment basically equals the first, but the costs of additional animal welfare are no more stated in higher costs for pig meat, but rather in the reduction of the provision of other public goods, namely education, public transportation and public security (represented by teachers, bus drivers and police officers in Table 3.2). The idea proposed here is to divide a fixed governmental budget and thus, to reallocate existing state budget expenditures (an approach based on Bergstrom et al., 2004) to an animal welfare budget which leads to an increase of farm animal welfare of pigs. We offer different choice sets that could possibly merge into a political regulative for minimum animal welfare standards. The only payment option is a trade-off between budgets for education, public transportation and public security. Respondents must deal with high, though realistic, costs for animal welfare within this scenario. Moreover, assuming respondents consider social surveys to be influential for policy makers, this methodology sets the respondents into a situation, in which stated preferences may become influential in reality. Hence, we presume a binding purchasing character. We consider the design of the second choice experiment to better mimic real political processes when compared to the first. In detail we offered six choice sets with each three alternatives in the second experiment. Every alternative suggests a budget reallocation scheme. The attributes and levels are presented in Table 3.2. In the case that jobs respectively salaries shall be cut down, the saved money is offset with the cost of the most expensive option of Experiment 1 and the number of fattening pigs in Germany. As explained above, we interpret the marginal rate of substitution between animal welfare and the different other public goods as the collective WTP. Formally, the MRS corresponds to relation of the WTP (expressed in money) of animal welfare and the other public good, respectively. This relation corresponds to the relative evaluation of animal welfare compared to other public goods from the viewpoint of consumers and hence will give further insights regarding the potential bias of private WTP measures as explained in the theory section above. The variable *AnimalWelfare* was measured based on the option defined for the first choice experiment[7]. The italic printed levels in Tables 3.1 and 3.2 are the status quo in Germany. As already described, participants had to choose one of three options per choice set in each experiment. The alternatives are marked as A, B or C. Thus, we have unlabelled experi-

[7] Original variable *AnimalWelfare* was presented as an amount of Euro per animal (pig) to half of the sample while a hypothetical increase in animal welfare based on the best option of the first experiment was presented to the other half. To treat them equal in analysis the variable had to be unified through transformation by certain thresholds for both variants (Appendix 3.11)

ments (see above). The option C is always the status quo, which means no increase of husbandry components and no budget reallocation.

Table 3.2: Attributes of policies to finance animal welfare

| Attribute | Levels |
|---|---|
| Variable | |
| Teacher per district | *0* |
| Teacher | -1 |
| | -2 |
| | -3 |
| Bus driver per district | *0* |
| BusDriver | -1 |
| | -2 |
| | -3 |
| Police officer per district | *0* |
| PoliceOfficer | -1 |
| | -2 |
| | -3 |
| Animal welfare increase | 0-3 |
| AnimalWelfare | |

Source: Authors' own presentation

As argued above, preference heterogeneity may stem from socioeconomic characteristics as well as attitudes. Thus, we included the socioeconomic variables SEX (as dummy for women) and STUDENT (a dummy for students) as well as four attitude variables. One question within the survey was, whether farm animal welfare is not important, less important, important or very important to respondents, which we included via the variable IMPORTANCE_ANIMAL_WELFARE. Following our exposition above, the perceived need for action in the area of animal husbandry is another potentially important attitude that could affect preferences for animal welfare. Thus, we include the variables NEED_ACTION_HUSBANDRY as well as the variable EVALUATE_AW_LEVEL. The latter measures how people evaluate the current level of animal welfare in agriculture. The fourth attitude variable that we included in our study is REGULATION_MARKET. This variable measures to what extend respondents agree that problems of animal welfare should be solved by the market or regulated by the government/parliament. We used the Stata module DCREATE (Hole, 2017) for design of experiments as well as R (R Core Team, 2017) and the gmnl package (Sarrias and Daziano, 2017) for analysis and estimation.

## 3.4 Results

Our sample includes 1673 people with a student share of 61.9 percent (Table 3.3). A third of the respondents are men. Please note that this sample is by no means representative for the German population, as one can easily see in Table 3.3.

Table 3.3: Descriptive statistics of the sample

| | **Sample (n=1673), share (%)** | **German population (%)** |
|---|---|---|
| **Sex** | | |
| Men | 33.9 | 49.3 |
| Women | 66.1 | 50.7 |
| **Students** | 61.9 | 3.39 |
| | **Sample, mean (sd)** | **German population (mean)** |
| **Age** | 29.88 (10.5) | 44 years and 3 months |

Source: Author's own presentation of sample; Statistisches Bundesamt (Destatis) (2017, 2018a,b)

### 3.4.1 First Choice Experiment: Private WTP

The estimation results for class membership of a two-class model for husbandry systems are presented in Table 3.4. Class 1 is the reference class. Therefore coefficients for the covariates[8] are set to zero. Compared to this reference class, for people in class 2 farm animal welfare is a more important topic. They also see a higher need for action in the area of husbandry systems. The probability to be in class 2 decreases with a better evaluation of the current state of farm animal welfare in Germany as well as with a preference for animal welfare support by the market. While women rather belong to class 2, being student decreases class probability.

Please note that most respondents are assigned to class 2. In this class all estimated parameters for the husbandry system attributes result as expected: higher levels of space, play and climate are positive while costs decrease the benefit (table 3.4). For class 1, one can see some unexpected patterns of preferences. Higher levels of opportunity to play and climate regulation have a negative effect, only space seems to increase respondents' benefit. The cost attribute has the most surprising effect:

[8]Please note, that we only show estimates of the model with covariates that have a significant effect on class membership.

Table 3.4: Estimation results for class membership (husbandry systems)

| Variable | Class 1 (Reference) | Class 2 |
|---|---|---|
| Constant | 0 | -2.871*** |
| IMPORTANCE_ANIMAL_WELFARE | 0 | 1.351*** |
| NEED_ACTION_HUSBANDRY | 0 | 0.506*** |
| EVALUATE_AW_LEVEL | 0 | -.0892*** |
| REGULATION_MARKET | 0 | -0.219*** |
| SEX | 0 | 0.270** |
| STUDENT | 0 | -0.468*** |
| Share | 0.153 | 0.847 |

p < 0.10 * p < 0.05 ** p < 0.01 ***

Source: Authors' analysis of survey data

contrary to the assumption that costs are a lost benefit, the coefficient for this attribute is also positive. Hence, higher costs increase the perceived benefit of people belonging to class 1. In case of private goods, a possible explanation for positive cost coefficient might be that prices have more than one function. Leavitt (1954) argues, that people perceive price as an indicator for quality or choose higher prices to meet social expectations. In the case of farm animal welfare, the social dimension deserves special attention. If we assume that animal welfare is an issue where individual behaviour might be judged by others, people may select more expensive standards to fulfill society's requirements. But it is also fair to assume that the mental patterns follow a simple relation like "the more money, the more animal welfare". Thus, they ignore the technical aspects (as implied by negative coefficients for climate and play) and just chose the most expensive alternative.

Based on estimation results we calculated the individual WTP for every husbandry system component. As shown in Figure 3.1, the willingness to pay for better climate regulation is the highest (more than three Euro), followed by space (more than two Euro). For better play opportunities through manipulable material respondents want to pay less than two Euro per kg carcass weight.

Comparing classes 1 and 2, total private WTP[9] within the latter is higher than among members of the former (Figure 3.2). Figures 3.1 and

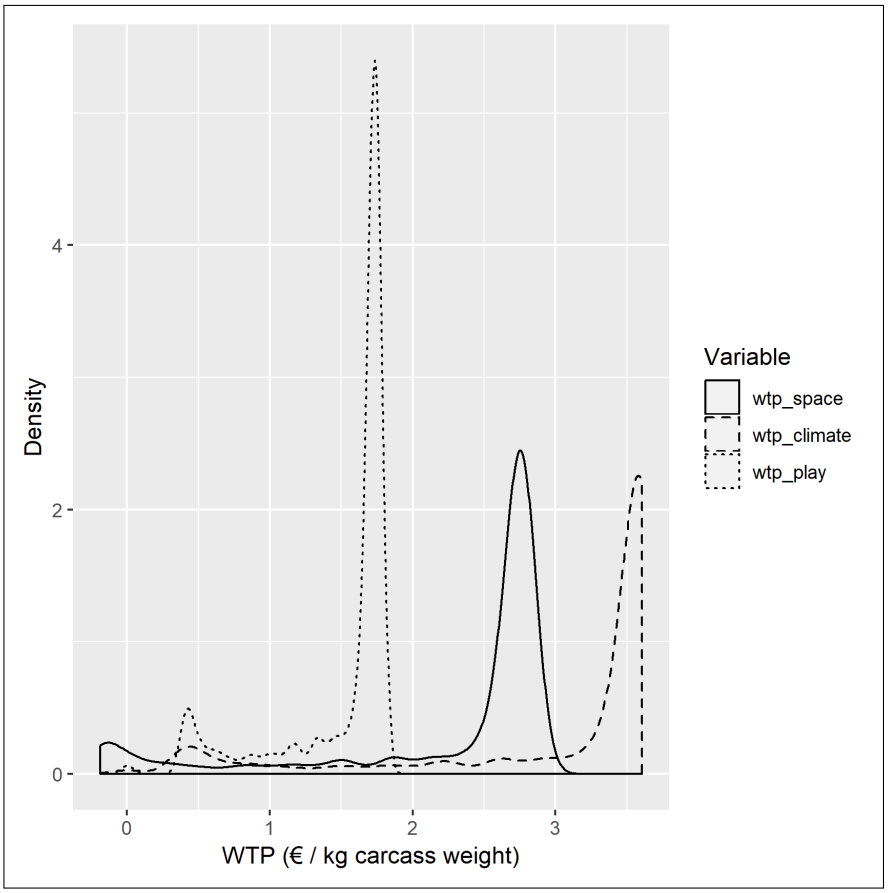
[9]Total private WTP denotes the sum of the WTPs for the three components.

Table 3.5: Estimated parameters of husbandry system attributes

| Attribute | Class 1 | Class 2 |
|---|---|---|
| Space | 0.162* | 1.44*** |
| Play | -0.350* | 0.906*** |
| Climate | -0.336*** | 1.872*** |
| Costs | 0.863*** | -0.519*** |
| p < 0.10 * p < 0.05 ** p < 0.01 *** | | |

Source: authors' analysis of survey data

Figure 3.1: WTP for husbandry system components

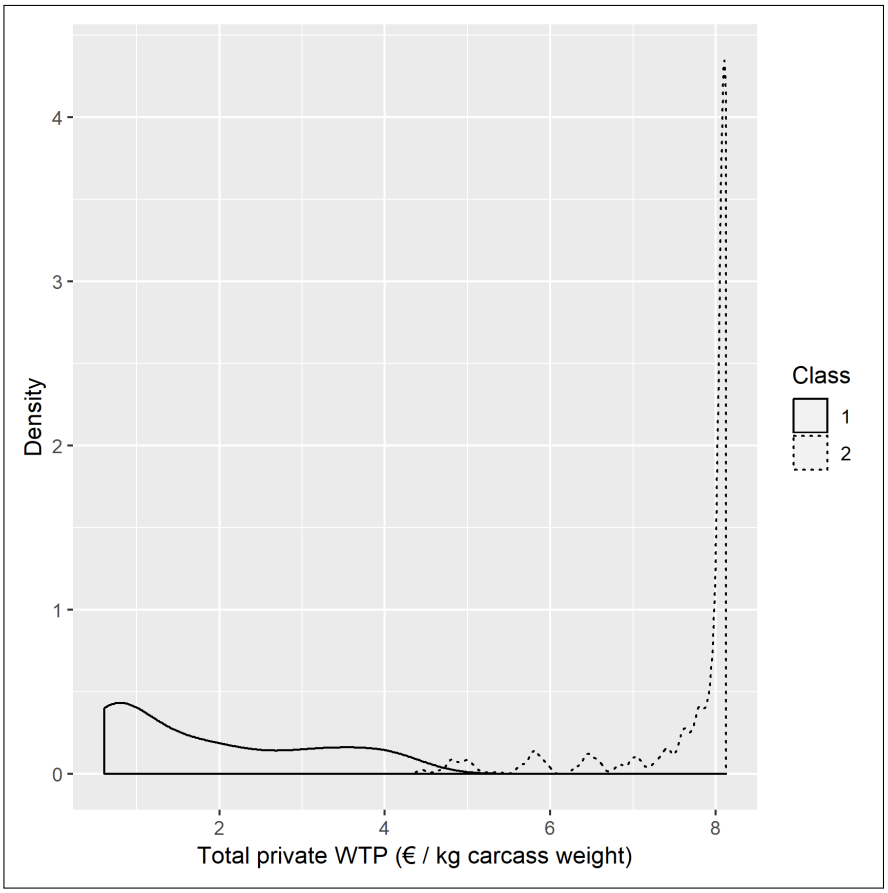



Source: Authors' own presentation.

3.2 also show negative willingness to pay for some system components. They are due to the unexpected coefficients in class 1. However, since the majority of the respondents belong to class 2 as can be seen in table 3.4,

willingness to pay is dominated by constant estimates.

Figure 3.2: Total private WTP by class membership




Source: Authors' own presentation.

Comparing students and non-students, we see that the latter have a higher WTP than the former (Table 3.6). There is also a difference between means for men and women: the latter are willing to pay more for climate regulation (0.50 Euro), play (0.21 Euro) and space (0.46 Euro). A Mann-Whitney-Wilcoxon test confirms the significance of the mean differences.

Overall, we consider the estimated relative WTP values for the different husbandry components as more interesting and reliable when compared to the absolute values. According to our estimation, consumers evaluate climate regulation standards as most important followed by space, while they express the lowest relative WTP for the possibility to express natural behaviour.

Table 3.6: Comparing mean private WTP by socio-economic characteristics

| | Climate | Space | Play |
|---|---|---|---|
| Overall mean | 3.03 | 2.25 | 1.5 |
| Students | 2.93 | 2.16 | 1.46 |
| Non-students | 3.18 | 2.39 | 1.57 |
| Men | 2.69 | 1.94 | 1.36 |
| Women | 3.19 | 2.4 | 1.57 |

Source: Authors' own calculation

### 3.4.2 Second Choice Experiment: Collective WTP

Unlike the estimation results for the first experiment, parameters for the second all show the expected signs, e.g. parameters for teachers, bus drivers and police officers per district all have a negative sign implying that consumers evaluate a reduction of public expenditure for these goods as costs, while estimated parameters for animal welfare are positive for both classes (Table 3.7).

Table 3.7: Estimated parameters of LC-Model for public goods

| Attribute | Class 1 |
|---|---|
| Teacher | -1.344*** |
| BusDriver | -0.228 |
| PoliceOfficer | -0.813*** |
| AnimalWelfare | 0.177 |
| | |
| p < 0.10 * p < 0.05 ** p < 0.01 *** | |

Source: Authors' analysis of survey data

Results for class membership show that now students belong to class 2 (Table 3.8). All other covariates have the same direction like in the husbandry model, meaning that class 2 can be described in the same way for both models.

We used the estimation results to calculate the trade-off between animal welfare and the other public goods as the collective WTP. Therefore, we were able to evaluate the relative value of animal welfare compared to other public services relevant in daily life. Figure 3.3 shows these trade-offs as a density plot.

Based on calculations one can see that respondents are rather willing to reduce bus drivers, teachers or policy men, i.e. reallocate education

Table 3.8: Estimation results for class membership (public goods)

| Variable | Class 1 (Reference) | Class 2 |
|---|---|---|
| Constant | 0 | -3.379 *** |
| IMPORTANCE_ANIMAL_WELFARE | 0 | 0.878*** |
| NEED_ACTION_HUSBANDRY | 0 | 0.176*** |
| EVALUATE_AW_LEVEL | 0 | -0.442*** |
| REGULATION_MARKET | 0 | -0.051** |
| SEX | 0 | 0.901** |
| STUDENT | 0 | 0.404*** |
| Share | 0.428 | 0.572 |

p < 0.10 * p < 0.05 ** p < 0.01 ***

Source: Authors' analysis of survey data

or security budgets in exchange for a higher animal welfare level. Summary statistics for the trade-off variables can be found in appendix 3.12. Again, there is a clear difference between both classes regarding the WTP. No matter if teachers, bus drivers or policemen, the collective WTP is the highest in the second class (Figure 3.4). Theoretically, these empirical results reflect consumer's different shadow prices for public transport, security and education, respectively.

Table 3.9: Mean collective WTP by socio-economic characteristics

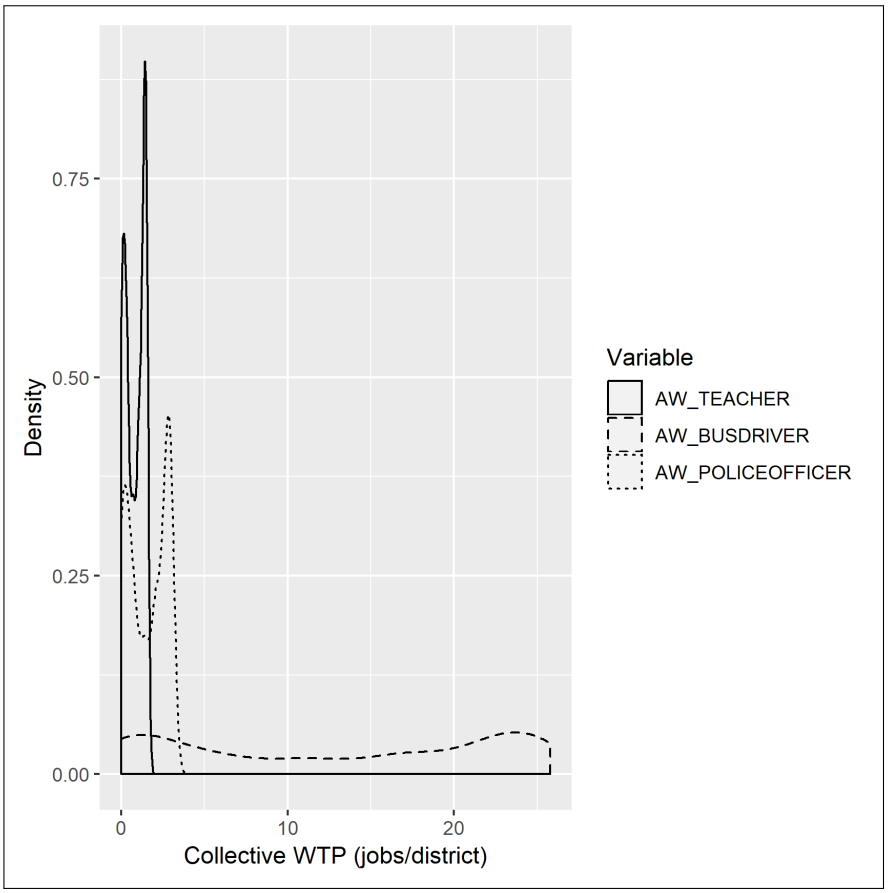
| | Teacher | Bus drivers | Police officers |
|---|---|---|---|
| Overall mean | 0.8 | 12.86 | 1.58 |
| Students | 0.96 | 15.47 | 1.9 |
| Non-students | 0.82 | 13.03 | 1.61 |
| Men | 0.51 | 7.57 | 0.99 |
| Women | 1.08 | 17.54 | 2.13 |

Source: Authors' own calculation

Looking at the socio-economic characteristics[10] again, we observe a higher collective WTP for animal welfare for students when compared to non-students (Table 3.9). As already observed for the private WTPs for husbandry components, estimations reveal a higher collective WTP for women when compared to men. Furthermore, our results imply a weak

[10]Again, a Mann-Whitney-Wilcoxon test confirms the significance of the mean differences.

Figure 3.3: Collective WTP for increase of animal welfare in terms of jobs per district

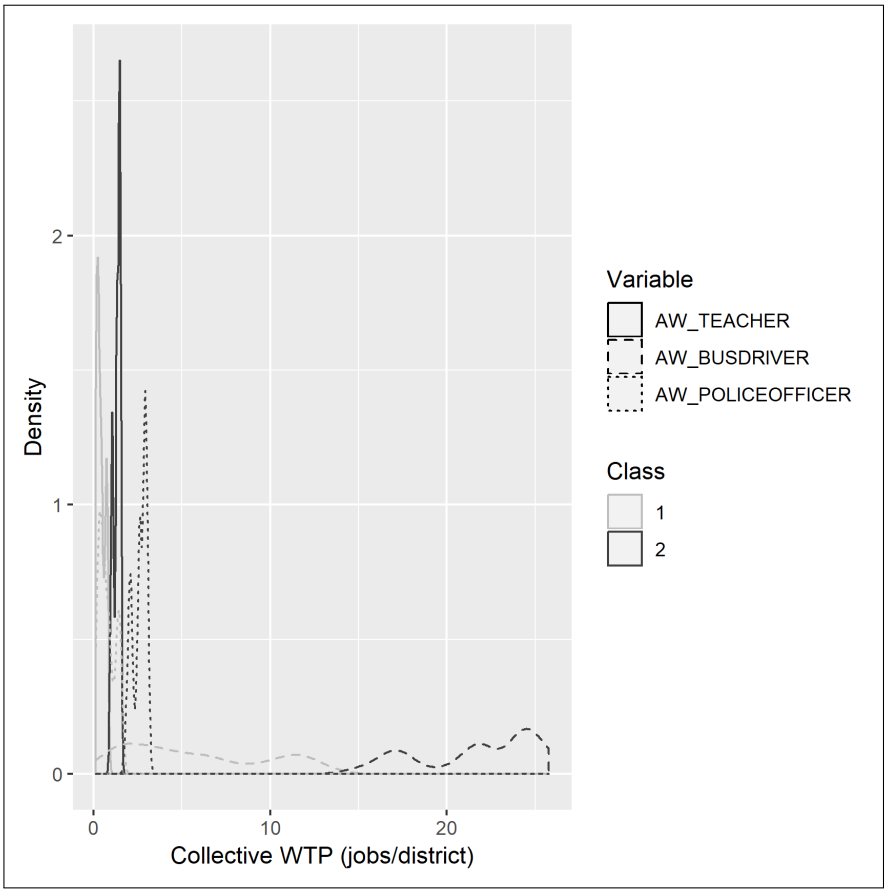



Source: Authors' own presentation.

but significant negative correlation of roughly -0.28 between respondent's attitude in favor of a market-based implementation of animal welfare and the collective WTP based on education, public transport and security, respectively (see appendix 3.13 ).

Finally, we compared the collective WTP with the private WTP. To this end we transformed estimated collective WTPs in corresponding values measured as Euros per kg of pig meat. In particular based on average salaries for teachers, policy men and bus drivers, respectively, as well as total number of pigs in Germany and the average carcass weight we were able to transform originally estimated collective WTP into Euros per kilogram of carcass weight. The means of the transformed collective WTPs are presented in Table 3.10. Please note that in Table 3.10 "Private Total" WTP has been calculated as the mean of the sum of the WTPs for the

Figure 3.4: Collective WTP for animal welfare by class membership




Source: Authors' own presentation.

three components estimated at the first stage.

Table 3.10: Means of transformed collective WTP and private WTP

| WTP | € / kg carcass weight |
|---|---|
| Collective | |
| AW_TEACHER | 0.012 |
| AW_BUSDRIVER | 0.098 |
| AW_POLICEOFFICER | 0.012 |
| Private Total | 6.771 |

Source: Authors' own calculation

As one can easily see from Table 3.10, there is a big gap between private and collective WTP, where the latter is much lower than the former. These patterns indicate that citizens' WTP for animal welfare is ne-

glectable, when compared to the other public goods, i.e. education, public transport or security. Furthermore, assuming the WTPs for the other public goods roughly correspond to their costs (i.e. the average salaries of teachers, policy men and bus drivers used in the calculations) implies that the estimated private WTP exceeds the collective WTP by the factor ranging between 69.9 (bus drivers) and 564.25 (teacher/police officers). Following our theoretical expositions, this indicates a significant bias resulting from a mismatched design of choice experiments focusing only on animal welfare and neglecting other public goods. However, please note that based on our second choice experiment data we are unable to identify absolute WTP neither for animal welfare nor for the other public goods. Thus, reported values in Table 3.10 could only be calculated assuming that absolute WTPs for the other public goods correspond to their costs. This is, of course, only an ad hoc assumption. Hence, we conclude that further analyses are needed.

Moreover, at a theoretical level, also other theoretical explanations for our results are conceivable. For example, the difference between the private and collective WTPs could be explained following the prospect theory of Kahneman and Tversky (1979). People tend to judge losses larger than gains (Kahneman et al., 1991). In the case of collective WTP for farm animal welfare, citizens might judge the loss of teachers, bus drivers and police officers higher than the gain of farm animal welfare, respectively the "consumption" of farm animal welfare which is expressed in private WTP. Thus, they refuse to pay for animal welfare through reducing for example police officers in the district.

Finally, please note that the collective WTPs differ significantly depending on the assumption how animal welfare is financed. In particular, assuming animal welfare is financed via budget reallocations cutting expenditures for education or security results in a significant lower collective WTP when compared to cuts in expenditure for public transport (see Tables 3.9 and 3.10). This might reflect different shadow prices for these goods. Further, it indicates that the WTP for animal welfare also depends on the way the latter is financed. Overall, we conclude from our findings that the empirical measurement of WTP for animal welfare remains a problem, which has not been fully solved yet. Hence, we still consider WTP analyses as a very interesting and relevant topic for future research.

## 3.5 Discussion and Conclusion

What do we learn from these results? Measured by private WTP, i.e. the trade-off between animal welfare related husbandry systems and private consumption, consumers are most concerned about climate regulation, followed by a comfortable environment in terms of freedom of movement. Interestingly, the opportunity to express natural behaviour and to avoid boredom seems to be less important, at least from the citizens' point of view. The finding for the relation of WTP for space and WTP for play is in line with empirical results regarding perception of fattening pig production in Germany: Consumer evaluate pig husbandry on the basis of several criteria, from which "space per animal" is perceived as very important, while manipulable material seems to be unimportant (Rovers et al., 2018). Wildkraut et al. (2015) report, that consumers confronted with video recordings also rely on space per animal as most important evaluation criteria. Hence, citizens' acceptance of fattening pig husbandry systems could be increased more effectively if standards focus on higher levels of climate regulation or space per animal instead of implementing better activity supplies for pigs. Therefore, policies defining husbandry standards should focus on the former two criteria. Analysing collective WTP, i.e. the trade-offs between public expenditure for animal welfare and other public goods, reveals another set of interesting findings. Our estimation results clearly indicate that consumers have distinct preferences regarding the sources of public finance. More specifically, for a given level of animal welfare people would rather cut public transport than public expenditure for education or security. Vice-versa the maximal level of animal welfare that consumers are willing to accept significantly varies with the financial scheme, i.e. financing animal welfare programs by reallocating state budget from public transport would lead to much higher accepted levels of animal welfare when compared to reallocation budget from security or education.

However, WTPs are heterogeneous among citizens. According to our estimations, relative high private and collective WTPs are observed for women and relative low private WTPs are estimated for students[11] confirming results of existing studies (see Clark et al., 2017; Heise and Theuvsen, 2017). Beside socioeconomic characteristics, private and collective WTP depend on attitude and values of people. Citizens, who are more concerned about farm animal welfare, have a higher WTP for husbandry systems and a higher willingness to reallocate government budgets. The latter is also influenced by the attitude towards regulation of animal welfare:

[11] Please note that collective WTP is higher for students.

Support for the “invisible hand of the market” leads to a lower collective WTP. We think that this consideration of attitudes and values explaining heterogeneity of preferences is an interesting approach at the methodical/modelling level. One might question that the absolute values of our measurements express the real absolute WTP, because there is the risk to underestimate or overestimate the realizable amounts of money for animal welfare. But discrete choice experiments are undeniably appropriate to depict relative WTPs. Our results show clear patterns regarding the relative value of farm animal welfare. Nevertheless, we definitely see the need for further research here. Furthermore, comparing private and collective WTPs our estimation results indicate some interesting differences. In particular, our estimation results imply that neglecting other relevant public goods leads to WTPs for animal welfare standards, which are overestimated by a factor ranging from 70 to over 560 compared to financing schemes. Shadow prices for education, public transport and security are higher than farm animal welfare. This finding raises support for our theoretical assumptions. In context of market failure and the following political provision of farm animal welfare, people don't choose between private consumption and animal welfare. Rather, they first choose between private and public consumption. Subsequently, citizen choose between different public goods to allocate governmental spending. Following this theoretical model, choice settings focusing only on animal welfare and neglecting other public goods implies a significant bias in estimated WTPs. Integrating other public goods leads to more reliable results. An appropriate choice design for farm animal welfare policies should therefore include both: legal standards and the source of financing additional costs. However, we also discussed alternative explanations for our finding. Beside shadow prices, loss aversion might be an explanation for the large gap between private and collective WTP. In line with the prospect theory (Kahneman and Tversky, 1979), individuals in our experiments might judge the loss of teachers, bus drivers and police officers higher than the gain of more farm animal welfare (see Kahneman et al., 1991).

Finally, we see the following limitation of our analysis which we don't want to conceal: First of all, the data used are not representative; therefore, the findings are not valid for the whole population in Germany or even Schleswig-Holstein. Second, drawing general conclusions from our estimation results regarding future organization of animal husbandry systems has to be done with caution for the following reason: Estimated WTPs for different components of husbandry systems, e.g. focusing on the issue of climate regulation and space, rather than on activity material, reflect consumers naive perception of how different components impact on animal

welfare. Accordingly, these are misleading to the extent that consumers' perceptions are biased. In particular, consumers are laymen regarding animal welfare. Therefore, their perceptions generally do not match corresponding expert opinions or scientific findings. Veterinarians and scientists might have concerns about neglecting manipulable material for play, because especially straw "is used as a substrate for the expression of various behaviour patterns such as exploring, rooting, foraging and chewing" (Tuyttens, 2005) and can support farmers to avoid tail biting. Hence, in the worst case, the systems implemented will fail to reach better animal welfare because of public's naive beliefs. Thus, a mechanistic orientation of future animal husbandry systems towards revealed consumer preferences would certainly lead to failure. In this regard, adequate communication with and providing information for citizens is a very important aspect. A third limitation of our study is the missing link to the political arena. Since markets fail to efficiently supply animal welfare, the latter has to be provided via adequate policy programs. However, just like markets, politics feature a complex process structure. Accordingly, to guarantee an optimal design of future animal welfare policies, one needs to understand how political processes work.

Overall, our findings might contribute to an improved comprehension of the political economy of animal welfare. This applies especially to the assessment of collective and private WTP, which should be extended by future empirical and theoretical work. Particularly, our approach should be tested and advanced based on representative data. At the same time, follow-up studies should not neglect the influence of citizens' attitudes and values, i.e. the intrinsic factors, at the methodical/modelling level. Due to the third limitation, we want to encourage researchers to focus on the politics of farm animal welfare. A first step could be the investigation of voters' political support for parties to implement animal welfare policies. Within the random utility framework, probabilistic voter models seem to be a promising approach to identify specific political processes that allow citizens to express their support for promoting farm animal welfare policies. All in all, the topic "animal welfare" provides interesting fields of activity for economics and social science.

# 3.A Appendix

Table 3.11: Unified AnimalWelfare

| Euro per Animal | Animal welfare increase | AnimalWelfare level |
|---|---|---|
| 0 | 0 | 0 |
| > 0 | > 0 | 1 |
| > 2.93 | > 2.06 | 2 |
| > 5.86 | > 4.13 | 3 |

Source: Authors' own calculation

Table 3.12: Summary statistics for collective WTP

| Variable | Mean (standard deviation) | Max |
|---|---|---|
| AW_TEACHER | 0.8 (-0.56) | 1.54 |
| AW_BUSDRIVER | 12.86 (-9.52) | 25.77 |
| AW_POLICEOFFICER | 1.58 (-1.11) | 3.07 |

Source: Authors' own calculation

Table 3.13: Correlation coefficients REGULATION_MARKET and collective WTP

| | AW_TEACHER | AW_BUSDRIVER | AW_POLICEOFFICER |
|---|---|---|---|
| REGULATION_MARKET | -0.283 | -0.286 | -0.284 |

Source: Authors' own calculation

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# Chapter 4

# About Bus Drivers and Happy Pigs: Collective and Private Willingness to Pay for Animal Welfare

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# Abstract

We analyse econometrically the WTP for animal welfare of fattening pigs in Germany using a latent class model. Based on the trade-off between different husbandry system components and private consumption we estimated a private WTP while a collective WTP for animal welfare increase of all pigs in Germany is estimated by using budget reallocation schemes regarding education, public transport and security. Results show relatively high WTPs for better climate regulation or space. We also show a willingness to rather cut down payments for public transport than salaries of teachers or police officers. Moreover, we show that the collective WTP (converted into euros per kg carcass weight) for animal welfare is much lower than private WTP.



**Keywords** Animal welfare, willingness to pay, latent class model, budget reallocation


## 4.1 Introduction

Spurred on by a negative media coverage (Kayser et al., 2011) and an observed alienation of society and agriculture (Balmann, 2016) traditional housing systems in agriculture are facing increasing criticism in Germany (Spiller et al., 2016; WBA, 2015). Based on a change of values in developed countries ethical concerns lead to a questioning of conventional husbandry practices (Dirscherl, 2013), the demand for animal welfare is increasing. GREENPEACE (2017) claims current standards of pig fattening to be illegal as well as unconstitutional. The latest nutrition reports of the German government express a higher demand for animal welfare among population (BMEL, 2017a, 2018). While food retail industry launched the Animal Welfare Initiative back in 2015 (Initative Tierwohl, 2017), the German Animal Welfare Federation introduced its animal welfare label two years before. Finally, the German government developed a livestock strategy including an animal welfare label (BMEL, 2017b). In fact, the Animal Welfare Initiative as well as the government driven label cannot come as a surprise, especially considering that consumers shift responsibility for animal welfare to state and retailers (Te Velde et al., 2002).

Consequently, the scientific council for agricultural policy recommends a policy mix that includes not only industry solutions but also state funding for animal welfare and explicitly states that the taxpayer will pay for it (WBA, 2015). This raises the question of how much the state is allowed to spend on animal welfare. The answer to this question, in turn, depends on the

value attributed to animal welfare (also compared to other areas of life). The first question to be answered is therefore: What is the value of an increase of animal welfare?

From an economic point of view we consider animal welfare to be a public good, since for consumers it is a non-rival and non-excludable by-product of agricultural production (Grethe, 2017; Lusk and Norwood, 2011; Bennett, 1995). People can be concerned about animal suffering in livestock production, even if they do not consume (certain) animal products. Thus, they can experience pleasure from better animal husbandry (Norwood and Lusk, 2009). Especially these and all other animal welfare concerned people are affected by the behaviour of consumers at the market who buy products from livestock production where animal suffer. This consumption externality leads to market failure (Harvey and Hubbard, 2013). Additionally, the (stated) attitude towards higher animal welfare does not lead to a corresponding consuming behaviour (see nice overview by Harvey and Hubbard, 2013, p.109). Generally, many people state that they want better animal husbandry conditions, but few people buy corresponding products (Grethe, 2017). This so called 'citizen-consumer gap' may be caused by free-riding. Uehleke and Hüttel (2016) show that demand for animal welfare labelled meat is higher in a collective scenario where free-riding is excluded due to governmental regulation.

Contemporary animal science definitions of animal welfare mainly agree on the characteristics of the concept. Accordingly, farm animal welfare is perceived as a physiological, behavioural and emotional state of being that is affected by resources and management procedures on-farm as well as off-farm (Welfare Quality ®, 2009). The public does focus rather on resource based conditions of husbandry systems to improve the wellbeing of farm animals (Zander et al., 2013). Scientists and political advisors recommend the inclusion of the citizens' view on animal welfare (WBA, 2015), so we take a closer look on this public view. Increasing costs for husbandry systems are only accepted if the purchased husbandry components match citizens' beliefs and animal welfare improving factors. So the second question is quite intuitive: What's the value of single husbandry system components?

To answer both questions we will analyse people's willingness to pay for an increase of animal welfare as well as for certain components of husbandry systems based on two discrete choice experiments. Based on characteristics of value theory (Lancaster, 1966), goods are described by certain attributes which create the utility of a good. This theory perfectly matches with the idea that people evaluate husbandry systems based on their beliefs regarding which aspects of husbandry are essential for the

wellbeing of animals. It also fits the aim of the second experiment: While the first experiment can be described as a more or less classical shopping cart scenario, where people have to choose their preferred husbandry system described by components and additional costs to assess preferences for components, the second experiment is a budget reallocation scenario that could possibly merge into a political regulative for minimum animal welfare standards. The offered payment option for animal welfare improvements is a trade-off between other public goods. Assuming that people consider social surveys to be influential for policy makers and so their choices may become reality, we presume a binding character in this experiment. Below, we will use the term *private WTP* to refer to the willingness to pay in a classical shopping cart scenario (additional cost per kg carcass weight), but specifically for animal husbandry system components. In contrast, the term *collective WTP* denotes the willingness pay for animal welfare improvements in exchange for other public objectives. To avoid misconceptions, we emphasize that the collective WTP is not an aggregated WTP of all probands. Rather, the collective WTP indicates how many units of a public good an individual person or class would spend for animal welfare under the condition that these spending concern all citizens throughout Germany and thus be collective.

## 4.2 Data

The data comes from an online survey of the AniFair project and have been collected in March 2017. A total of 1673 students and employees of Kiel University took part in the survey. Majority of respondents are students and women (table 4.1). For analysis of data we used *R* (R Core Team, 2017) with *gmnl* (Sarrias and Daziano, 2017) for model estimation.

Table 4.1: Characteristics of Data Set

| **Characteristics** | **(Relative) Frequency / Mean (sd)** |
|---|---|
| **N** | 1673 |
| **Men** | 0.339 |
| **Women** | 0.661 |
| **Students** | 0.619 |
| **Age** | 29.88 |
| | (10.5) |

Source: Authors' own presentation

As mentioned above we used two discrete choice experiments to analyse people's preferences and WTP for animal welfare and husbandry system components. Attributes and levels of both experiments are presented in table 4.2. The first experiment addressed the private WTP and contained five choice sets with each three alternative husbandry systems, only described by the attributes space per animal (*Space*), climate system (*Climate*), manipulable material to explore and to dig into (*Play*), and additional costs (*Costs*). Please note that each Level 1 of the attributes and additional costs of zero are the current legal status in Germany, a combination of these current levels have been presented as an opt-out option to respondents. The attributes describing husbandry systems are in line with the guidelines recommended by the scientific council for agricultural policy (WBA, 2015, p. 285).

Table 4.2: Attributes of Experiments

| **Experiment 1: Private WTP** | | |
|---|---|---|
| **Attribute** | **Levels** | |
| *Space* | 1 | 0.75 m |
| | 2 | 1.3 m |
| | 3 | 2 m |
| *Climate* | 1 | air system |
| | 2 | swine shower |
| | 3 | outdoor area with opportunity to wallow |
| *Play* | 1 | manipulable material |
| | 2 | straw two times per day (machine) |
| | 3 | straw three times per day (human) |
| *Costs* | Costs of attribute combination | |
| | (€/kg carcass weight) | |
| **Experiment 2: Collective WTP** | | |
| **Attribute** | **Levels** | |
| *Teacher* | 1 | 0 |
| (sector of education) | 2 | -1 |
| | 3 | -2 |
| | 4 | -3 |
| | | |
| *BusDriver* | 1 | 0 |
| (sector of public transport) | 2 | -1 |
| | 3 | -2 |
| | 4 | -3 |
| *PoliceOfficer* | 1 | 0 |
| (sector of security) | 2 | -1 |
| | 3 | -2 |
| | 4 | -3 |
| *AnimalWelfare* | 0 3 | |

Source: Authors' own presentation

The second experiment, dealing with the collective WTP for animal welfare, offers six choice sets with each three alternatives containing a hypothetically budget reallocation from the sectors education, public transportation and security for animal welfare purpose. To finance an increase of animal welfare for all fattening pigs in Germany (*AnimalWelfare*), up to three teachers (*Teacher*), bus drivers (*BusDriver*) and police officers (*PoliceOfficer*) should be cut down in each of the 318 German districts. Again the first level of each attribute and zero animal welfare increase are the current state (no budget reallocation as mentioned by the scenario) and an opt-out option was offered containing this status quo.

## 4.3 Modelling Approach

As mentioned in section 2, our sample only contains students and university staff. Although this is a very limited sample, different preferences among respondents are also possible. For example, gender differences could occur that have already been uncovered in the literature (see Clark et al., 2017). Also, students may have other preferences than employees. Additionally, attitudes towards animal welfare and financing may vary among university members. Thus, we assume heterogeneous preferences among the individuals in our sample. The utility of an alternative $i$ can be divided into two components, namely the observable part $V_i$ and the error term $\epsilon$. Taking into account the characteristics of value theory the utility function is

$$U_i = V_i + \epsilon = \alpha_i + \sum_{k=1}^{K} \beta_k x_k + \epsilon \,, \tag{4.1}$$

with $K$ attributes $X$ and the estimated constant $\alpha$ and the estimated attribute parameters $\beta$. We use a latent class model to take preference heterogeneity into account. Latent class models not only allow the measurement of preference heterogeneity, but also capturing its origin using covariates. Unlike random parameter models (see Hensher and Greene, 2003) latent class models need no distributional assumptions about preferences.

Assuming $Q$ segments or classes within the sample the constant and the coefficients now vary about the classes (Greene and Hensher, 2003), therefore $V$ is rewritten as

$$V_{i|q} = \alpha_{i|q} + \sum_{k=1}^{K} \beta_{k|q} x_k. \tag{4.2}$$

The choice probability for alternative $i$ now depends on membership in class $q$ of individual $n$:

$$P(y_{n|q} = i) = \frac{exp(V_{i|q})}{\sum_{j=1}^{J}(V_{i|q})} \tag{4.3}$$

The probability for individual $n$ belonging to class $q$ is determined by a set of covariates $Z$ like socioeconomic characteristics or attitudes (Boxall and Adamowicz, 2002; Greene and Hensher, 2003; Swait, 1994):

$$P_{nq} = \frac{exp(\lambda_q + \sum_{z=1}^{Z} \gamma_{qz} z_n)}{\sum_{q=1}^{Q} exp(\lambda_q + \sum_{z=1}^{Z} \gamma_{qz} z_n)} \tag{4.4}$$

The class constant $\lambda_q$ and the characteristics' coefficients $\gamma$ are estimated by the researcher. So the probability to choose $i$ now is

$$P(y_n = i) = \sum_{q=1}^{Q} P_{nq} P(y_{n|q} = i). \tag{4.5}$$

To make the models for both experiments as comparable as possible, we decided to use the following covariates for both models. Since there is evidence for women being more sympathetic towards animal welfare then men (Herzog, 2007), stronger rejecting animal suffering in food production (Beardsworth et al., 2002) and a stronger WTP for animal friendly products (Heise and Theuvsen, 2017), it is straightforward to assume that preferences for animal welfare depend on individual's sex (SEX). Since we use data collected at the university we also want to check weather students' preferences are different to others, so we included a dummy variable for being student (STUDENT). Preferences should also vary by the personal importance of animal welfare; therefore a corresponding variable IMPORTANCE_ANIMAL_WELFARE is included. The perceived need for action in the area of animal husbandry could also affect preferences as well as how people evaluate the current level animal welfare in agriculture, so both attitudes are included, too (NEED_ACTION_HUSBANDRY and EVALUATE_AW_LEVEL). Especially preferences about budget reallocation should depend on the attitude towards financing and regulating animal welfare. Therefore our last covariate represents the question, whether problems of animal welfare should be solved by the market or regulated by the government (REGULATION_MARKET).

Given the attributes listed in table 2 and formula 4.2,

$$U_{i|q} = \beta_{Space|q} \times Space + \beta_{Climate|q} \times Climate + \beta_{Play|q} \times Play + \beta_{Costs|q} \times Costs + \epsilon \tag{4.6}$$

is the utility function of husbandry system $i$ in the first experiment for class $q$. The utility function of a budget reallocation scheme $i$ in experiment two is

$$U_{i|q} = \beta_{Teacher|q} \times Teacher + \beta_{BusDriver|q} \times BusDriver + \beta_{PoliceOfficer|q} \times PoliceOfficer + \beta_{AnimalWelfare|q} \times AnimalWelfare + \epsilon \quad (4.7)$$

Please note that since we use unlabelled experiments the constant is omitted (Hensher et al., 2005).

## 4.4 Results

Estimation results of a two class model for private WTP are surprising. While we would expect a negative effect of costs and a positive effect of space, climate regulation or manipulable material, class 1 doesn't fit these expectations (table 4.3).

Table 4.3: Estimation Results for Husbandry System Components

| Attribute | Class 1 | Class 2 |
|---|---|---|
| Space | 0.162* | 1.44*** |
| Play | -0.350* | 0.906*** |
| Climate | -0.336*** | 1.872*** |
| Costs | 0.863*** | -0.519*** |
| p < 0.10 * p < 0.05 ** p < 0.01 *** | | |

Source: Authors' own presentation

While costs seem to increase perceived benefit of respondents, straw for play or better climate regulation have a negative effect. Only space has the expected direction. However, in class 2 all estimated parameters behave like expected: increasing costs lead to decreasing benefit of a husbandry system while more space, better climate regulation or a better level of play opportunities have a positive effect.

Table 4.4: Estimation Results for Class Membership (Experiment 1)

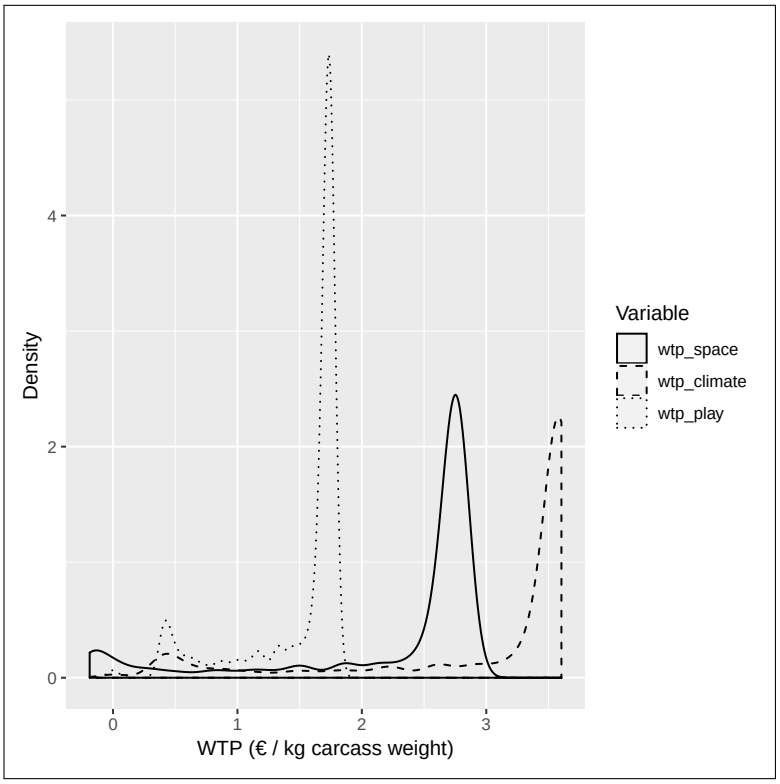
| **Variable** | **Class 1** (Reference) | **Class 2** |
|---|---|---|
| Constant | 0 | -2.871*** |
| IMPORTANCE_ANIMAL_WELFARE | 0 | 1.351*** |
| NEED_ACTION_HUSBANDRY | 0 | 0.506*** |
| EVALUATE_AW_LEVEL | 0 | -0.892*** |
| REGULATION_MARKET | 0 | -0.219*** |
| SEX | 0 | 0.270** |
| STUDENT | 0 | -0.468*** |
| Share | 0.153 | 0.847 |
| p < 0.10 * p < 0.05 ** p < 0.01 *** | | |

Source: Authors' own presentation

Looking at the estimation results for class membership in table 4.4 we see that the stated importance of animal welfare raises the probability of being in class 2. The more people perceive a need for action in the area of pig housing the more they are related to class 2, while a positive evaluation of the current state decreases class membership. Preferring market based solutions of animal welfare problems also lowers the class membership probability for class 2. Finally one can see that women rather belong to class 2 than men and that being student has a negative effect. All in all, we can call class 2 'animal welfare oriented'-class.

We used these estimation results to calculate the private willingness to pay. The respondents would spend the most amount of money (more than three euro per kg carcass weight) for better climate regulation, a component directly related to pigs' physical needs (figure 4.1). While there is a WTP of more than two euros/kg for more space per animal, activity material seems not important compared to the other components. Negative values are due to the unexpected coefficients in class 1. However, since the majority of the respondents belong to class 2 as can be seen in table 4.4, willingness to pay is dominated by constant estimates. For the second experiment the estimated coefficients behave like expected. Table 4.5 shows negative parameters for the public goods education, public transport and security, being the sources of budget reallocation for better animal welfare and therefore being cost attributes. A higher level of animal welfare increases decision makers' benefit.

Figure 4.1: Private WTP (husbandry system components)




Source: Own presentation.

Table 4.5: Estimation Results for Public Goods

| **Attribute** | **Class 1** | **Class 2** |
|---|---|---|
| Teacher | -1.344*** | -0.666*** |
| BusDriver | -0.228 | -0.04** |
| PoliceOfficer | -0.813*** | -0.335*** |
| AnimalWelfare | 0.177 | 1.066*** |
| p < 0.10 * p < 0.05 ** p < 0.01 *** | | |

Source: Authors' own presentation

With the exception of the students, who also belong to class 2 now, the classes can be described in a similar way as for the first experiment (table 4.6). Another difference is the size of classes. Class 2 is still the biggest one, but the share isn't as high as in the first experiment.

Table 4.6: Estimation Results for Class Membership (Experiment 2)

| **Variable** | **Class 1** (Reference) | **Class 2** |
|---|---|---|
| Constant | 0 | -3.379 *** |
| IMPORTANCE_ANIMAL_WELFARE | 0 | 0.878*** |
| NEED_ACTION_HUSBANDRY | 0 | 0.176*** |
| EVALUATE_AW_LEVEL | 0 | -0.442*** |
| REGULATION_MARKET | 0 | -0.051** |
| SEX | 0 | 0.901** |
| STUDENT | 0 | 0.404*** |
| Share | 0.428 | 0.572 |
| p < 0.10 * p < 0.05 ** p < 0.01 *** | | |

Source: Authors' own presentation

The calculation of the collective WTP, i.e. the trade-offs between animal welfare and the other public goods, shows that respondents would give up more bus drivers than police officers or teacher. Table 4.7 also shows that students have a lower private WTP while their collective WTP is higher. On average, women have a higher collective WTP as well as private WTP than men.

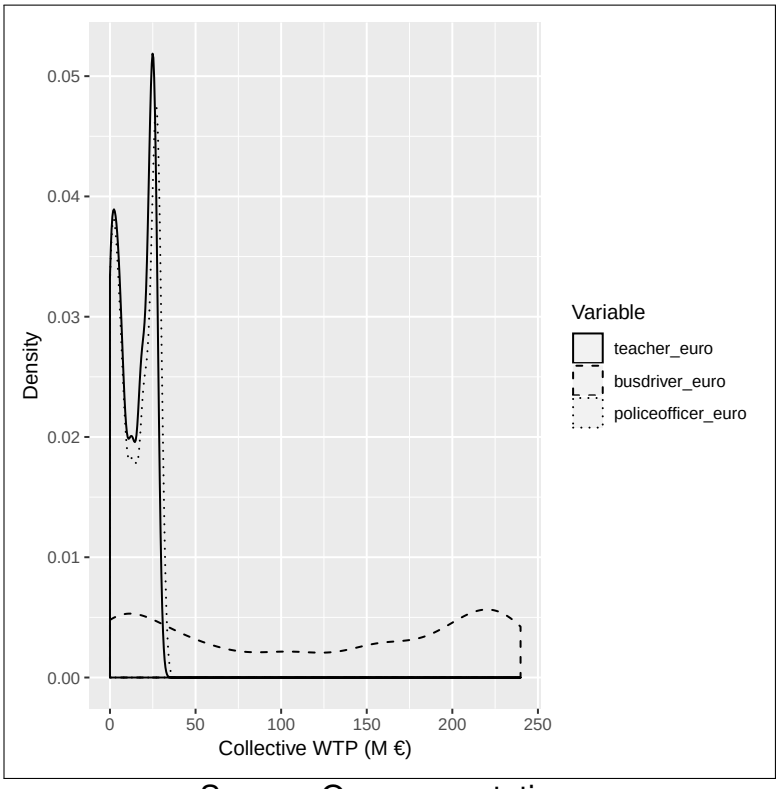
Table 4.7: Mean collective and private WTP

| | **Private WTP** | | | **Collective WTP** | | |
|---|---|---|---|---|---|---|
| | ***Climate*** | ***Space*** | ***Play*** | ***Teacher*** | ***Bus drivers*** | ***Police officers*** |
| Overall | 3,03 | 2,25 | 1,5 | 0.80 | 12,86 | 1,58 |
| Men | 2,69 | 1,94 | 1,36 | 0.51 | 7,57 | 0.99 |
| Women | 3,19 | 2,4 | 1,57 | 1,08 | 17,54 | 2,13 |
| No Students | 3,18 | 2,39 | 1,57 | 0,82 | 13,03 | 1,61 |
| Students | 2,93 | 2,16 | 1,46 | 0.96 | 15.47 | 1,9 |

Source: Authors' own presentation

Knowing the average salaries of the individual occupations and the number of districts in Germany allows us to calculate the amount of euro that is saved by people's willingness to cut off public goods. Figure 4.2 presents the budget in millions of euros that would be available for increased animal welfare. As one can easily see, the highest amount of money would be available if public transport budgets are cut down. Finally

Figure 4.2: Collective WTP (Millions of Euros)



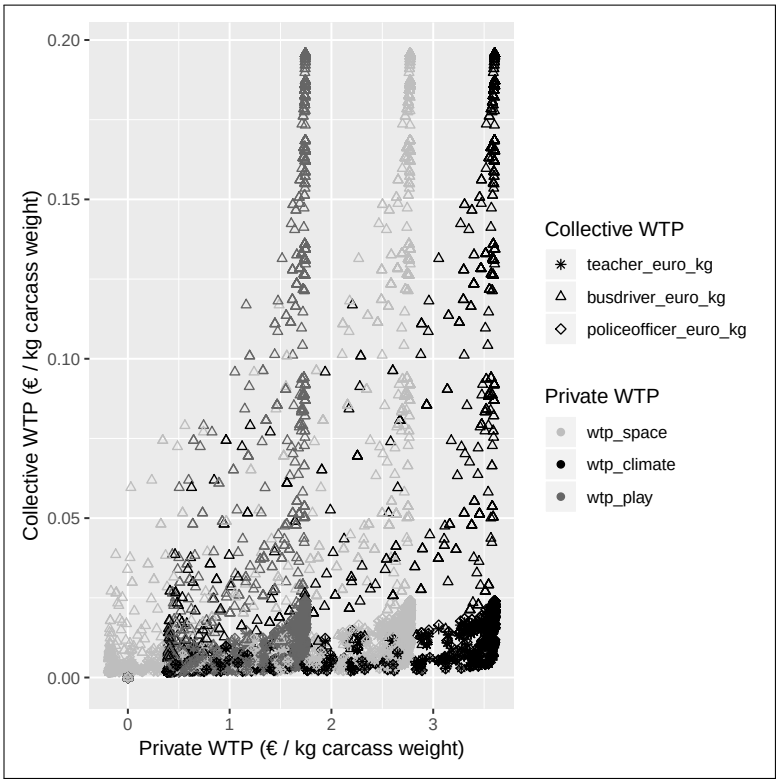

Source: Own presentation.

we divided respondents collective WTP, i.e. the amount of euros available from cutting budgets, by the number of fattening pigs in Germany and then divided the amount of euros per animal by 100 kg to get the collective WTP in terms of euros per kg carcass weight. So both WTP measurements have the same dimension.

As can be seen from figure 4.3, there is a positive relationship between private and collective WTP. Generally, people who want to pay more for single husbandry components also want to give more money for overall animal welfare by budget reallocation. But there is a clear difference regarding the absolute values of euros per kg slaughter weight: while re-

spondents would pay up to more than three euros for better climate regulation, the amount for better animal welfare is quite small. Cutting education budgets leads to a maximum of 0.022 euros, while even saved bus driver salaries only generate up to 0.20 euros. In other words, respondents are willing to pay more money for single components of livestock systems than they are willing to pay for overall animal welfare by budget reallocation.

Figure 4.3: Collectiveand Private WTP




Source: Own presentation.

## 4.5 Conclusion

We can derive several conclusions from our results. With regard to the first research question we found evidence that the value of animal welfare itself depends on the source of money: While policies cutting off budgets for education or security would hardly be accepted by society, financing animal welfare through budget reallocation from public transport seem to have respondents' support. The value of animal welfare is higher if payed by bus

driver savings, the amount of money which could be reached by budget reallocation is up to 250 M Euros. These results may reflect the different shadow prices for public transport, security and education. Our estimation results indicate an average relative shadow price of 8.5 of education vis-a-vis public transport and 7.9 for security vis-a-vis public transport. The second question addressed the husbandry system components being important for accepted husbandry systems. Our results suggest that the physiological condition of pigs, i.e. climate regulation in our experiment, and a comfortable environment, i.e. space per animal, are the main issues higher standards of livestock should take into account. However, pigs' opportunity to express natural behaviour, i.e. getting straw to dig into, seems to be less important to respondents. Even if the absolute WTP may be biased (due to known problems of stated preferences or the above mentioned "citizen-consumer gap"), the relative patterns are interesting. They show clear preferences for husbandry components as well as source of financing animal welfare.

The comparison of private and collective WTPs delivers also interesting results. Generally, we showed a positive relationship between private and collective WTP. In line with the literature we were able to show that women would pay more for animal welfare than men. But we also found differences between collective and private WTP. First, students seem to have a higher collective WTP compared to the average of the sample but their private WTP is lower than the mean WTP of our sample. One possible theoretical reason for this result may be students' relative low shadow prices for public goods and high shadow prices for private consumption, which could be due to low income of students. Another explanation may be free riding, which is a problem of private WTP. For our first experiment we assumed that WTP includes free riding, while the second experiment should exclude free riding through the binding character of the German wide budget cuts. If we further assume that free riding incentives vary systematically between students and others, the former may have higher incentives to free ride. Second, the collective WTP for increased animal welfare in terms of euros per kg carcass weight is lower than the private WTP for single husbandry aspects. Again the underlying shadow prices of public goods may be responsible for this result, i.e. they are higher than shadow prices of private consumption. So people would rather pay more money in the super-market than give up education, public transport or security. To test for this hypothetical source of the "kg carcass"-gap between collective and private WTP, further research should integrate an additional cost component in the financing scheme, i.e. a new additional tax for animal welfare. If it's the case that public goods have higher shadow prices,

the WTP in terms of an additional tax should be higher than the trade-offs of animal welfare and teachers, bus drivers or police officers. The experimental design could be another reason for differences between private and collective WTP: While in the first experiment concrete housing systems could be selected that in the broadest sense corresponded to one's own ideas about animal-friendly housing systems, the second scenario focused only on the financial side and an more or less abstract animal welfare increase or a special amount of money per animal.

Please note that there are limitations of our study which should not be ignored. First, we used non-representative data for analysis, so our results aren't valid for the whole population in Schleswig-Holstein or Germany. We rather understand our finding as an impetus for future research. Second, the results for husbandry system components should be considered with caution, because they reflect consumers' naive perception of how different components affect animal welfare. Consumers are laymen and therefore their perceptions may not match experts' opinion or scientific findings. Scientists might have concerns about neglecting straw for play, because it can avoid tail biting. In a worst case scenario the public's naive beliefs would lead to the implementation of husbandry systems which fail to increase animal welfare, if they are just orientated on stated consumer preferences. Further research on the topic of animal welfare should therefore include communication with and information of consumers about issues of animal welfare. Third, our analysis lacks of a link to the political dimensions, i.e. an analysis of voting behaviour regarding animal welfare. Optimal designs of animal welfare policies are possible, only if political processes allow citizens to express their true preferences as voters and if these preferences are reflected in policy outcomes, i.e. higher legal standards as well as financing schemes. All in all, the political economy of animal welfare is a very interesting topic of future academic work.

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# Chapter 5

# Possible Democratic Policy Failure in Sustainability? Measuring German Voters' Policy Beliefs

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# Abstract

Nowadays political debates revolve around the issue of sustainability. Regarding agriculture, people call for more animal welfare and reduced nitrogen outflow. Another issue beyond sectoral borders is climate change and the reduction of greenhouse gas emissions. Hence, citizens drive public debates and put pressure on politicians to solve ecological problems. The relation between policies and the intended outcomes is a complex one. In order to reduce this complexity, laymen apply policy beliefs, i.e. naive mental models, to understand how policies translate into outcomes. These beliefs can be biased due to psychological factors and therefore differ from expert judgements (true political technologies).

Combining voting behaviour with economic analysis of willingness to pay (WTP) we are able to measure these voters' beliefs regarding ecological issues. In particular, our empirical approach is embedded in the random utility framework and consists of two key components: First, we use a discrete choice experiment in order to calculate respondents' WTP for the ecological goods climate protection, animal welfare as well as water protection. Second, we estimate a probabilistic voter model using corresponding policy distances between voters and parties. Since we are interested in individual measurements and parameters, the econometric backbone of both parts is a latent class model. It is applied to representative data from an online survey among German citizens. WTP measurements as well as the policy weights allow us to calculate voters' underlying belief parameters. We investigate the relations between these beliefs and the policy position. Moreover, we check for differences between socio-economic groups.


## 5.1 Introduction

Today's political debates in Germany revolve around issues of sustainability, i.e. combining ecological with social and economic demands. This is especially true for agricultural production. In particular, farm animal husbandry is criticized due to a lack of farm animal welfare (WBA, 2015) which is demanded by German citizens according to the last food reports (BMEL, 2017a,b). Despite high reported hypothetical willingness to pay (Clark et al., 2017; Lagerkvist and Hess, 2011), free riding (Uehleke and Hüttel, 2018) and market failure (Harvey and Hubbard, 2013) may promote need for regulation (Grethe, 2017). Another sustainability issue is nitrogen surplus. It pollutes the groundwater since a high concentration of reactive

nitrogen compounds may not only lower biodiversity, but also harm human health (Sachverständigenrat für Umweltfragen , 2015; UBA, 2018). So far, the governmental goal of reducing nitrogen surplus has been missed since N-balance still corresponds 100 kg per ha surplus per year (Taube, 2016). Another topic in the debate on sustainability is the issue of climate change. Greenhouse gas emissions drive an increasing earth temperature. To reduce this global warming, the Paris Agreement was adopted in 2015. Germany's goal is a decrease of emissions by 55% until 2030. This corresponds to 562 million tons of $CO_2$ equivalents (BMU, 2019).

These issues described are examples for rather complex policies. To cope with this complexity laymen apply policy beliefs (Caplan, 2001, 2002, 2007). A comparison of the beliefs of voters with expert judgements in the economic sphere shows that views of voters systematic differ from those of experts (Rhoads, 1985; Blendon et al., 1997; Caplan, 2002). Caplan (2002) argues that these biases result from judgemental anomalies of the general public. Hence, he refers to the idea of cognitive biases (Akerlof, 1989). A the same time, economic experts are considered to have unbiased and true beliefs, at least on average Caplan (2002).

In democratic systems, political agents put weight on voters and their policy positions since they want to be (re-)elected (Downs, 1957; Adams et al., 2005). Hence, they have incentives to follow voters' policy positions that are determined by their beliefs. If the beliefs are strongly biased and policy decisions follow these biased beliefs, they could cause inefficient policy outcomes. This would lead to a *basic democratic policy failure* (Caplan, 2001). This is contrary to the widespread view where the political failure in providing sustainability goods seems to be the result of interest group influence (Swinnen et al., 2000; Anderson, 1995).

Given the importance of beliefs, it would be interesting to measure these beliefs regarding the three mentioned sustainability issues animal welfare, climate protection and water protection. It is unlikely that all voters have the same beliefs, rather we assume that they are heterogeneous. Hence, possible biases are also heterogeneous. Here the question occurs, how we can asses the beliefs empirically as well as the possible biases. To our best knowledge, no studies exist that try to measure these beliefs. Rather, studies on political economy of sustainability focus on voting behaviour (see for example Achterberg, 2006; Grunenberg and Henning, 2019) or willingness to pay (WTP) for ecological issues (see for example Clark et al., 2017; Lagerkvist and Hess, 2011; Liebe, 2007; Liebe and Preisendörfer, 2007).

Hence, we suggest an approach to quantify voters' beliefs based on voting behaviour as well as voters' willingness to pay (WTP). It contributes

to a better understanding of how voters think regarding political technology and hence, helps to evaluate the role of political processes. Assuming that animal welfare, water protection and greenhouse gas emission reduction are public goods, we develop a theoretical framework where the political technology to produce a public good is a function of monetary input. This framework is described in the following section. Subsequently, we show how theory is linked to empirical assessment in section 5.3. We present the results of our study in section 5.4 and finally end with a conclusion.

## 5.2 Theoretical Framework

Modelling real policy processes, governmental policy making corresponds to the Nash equilibrium of a political game between parties, interest groups and voters (Brock and Magee, 1978; Grossman and Helpman, 1996; Grossman, 1994). In particular, parties' positions are driven by strategic behaviour, because they seek for benefits from governmental offices (Downs, 1957). First, we assume a society that consists of a set of $i = 1, 2, ..., n$ voters. Note that the society's political system is considered to be representative. Hence, members of society vote for political agents (i.e. parties) deciding over policies. Additional to the set of voters, consider now a set of $l = 1, 2, ..., L$ interest groups. We define an interest group as a subset of voters who share a common interest in certain policy domains. As Olson (1965) discussed, the mere fact that individuals share a common interest in policies is not enough to ensure that they will engage in collective action due to the free rider problem. However, some interest groups do overcome these free-rider problems and manage to coordinate the lobbying activities. The number of lobby groups is exogenous, where generally multiple interest groups exist.

Let $z$ denote a public good and $X$ the corresponding policy program. Then it follows that the provision of of public good $z$ is the result of a political technology $T(z, X)$ that maps state $z$ to policy $X$. Especially the informed voters value a public good, where $V_i(z)$ denotes voter *i*'s utility derived from public good $z$. Furthermore, we denote voters' income with $y$. For simplicity we assume that voters have quasi-linear preferences. Thus,

$$V_i(z) + y_i - t_i c(z) \tag{5.1}$$

is the utility an individual voter $i$ derives from the provision of a public good assuming a cost share $t_i$. In general, voters' policy preferences can be

derived from the following maximization problem:

$$\begin{aligned} \max_x V_i(z) + y_i - t_i c \\ s.t. \\ T(z, X) = 0 \\ e'X = c \end{aligned} \tag{5.2}$$

Note that $e'X$ denotes political costs here. We assume a simple linear utility function, i.e.

$$V(z) = \kappa_i z. \tag{5.3}$$

We further consider public good provision as the result of a simple Cobb-Douglas production function, hence

$$T(z, X) = F(X) = \Gamma X^{\gamma} = z. \tag{5.4}$$

With $X = c(z)$ the following cost function results:

$$C(z) = \Gamma^{-\frac{1}{\gamma}} z^{\frac{1}{\gamma}}. \tag{5.5}$$

Let $\beta_i$ denote the willingness to pay (WTP) of voter $i$ for a public good. For the net rent

$$NR = \quad \beta * Z - C(z) \quad = \beta * F(X) - X \Rightarrow max! \tag{5.6}$$

$$\Rightarrow FOC: \quad \beta F'(X) - C'(z) \quad = 0 \tag{5.7}$$

$$\Rightarrow SOC: \quad NR'' \quad = (\gamma - 1)\beta\gamma\Gamma X^{(\gamma-2)} \tag{5.8}$$

we assume that the marginal costs of public good provision are equal a monetary unit. Therefore,

$$\beta F'(X) = C'(X) = 1. \tag{5.9}$$

It follows

$$NR' = \beta\gamma\Gamma X^{(\gamma-1)} = 1 \tag{5.10}$$

$$\Rightarrow X^{(\gamma-1)} = (\beta\gamma\Gamma)^{-1} \tag{5.11}$$

$$\Rightarrow X^* = (\beta\gamma\Gamma)^{\frac{1}{1-\gamma}} \tag{5.12}$$

and

$$\max \quad \beta z - C(z) \quad = 0 \tag{5.13}$$

$$\beta - C'(z) \quad = 0 \tag{5.14}$$

$$\beta - \gamma'\Gamma' z^{\gamma'-1} \quad = 0 \tag{5.15}$$

$$\Rightarrow z^* = (\frac{\beta}{\gamma' \Gamma'})^{(\frac{1}{(\gamma'-1)})}. \tag{5.16}$$

Following Caplan (2001, 2007) and others (Akerlof, 1989), one has to consider that voters' beliefs regarding $T$ might differ from the true political technology. Therefore,

$$\tilde{T}(z,x) = \tilde{F}(x) = \tilde{\Gamma} x^{\tilde{\gamma}} = z \tag{5.17}$$

with $[\tilde{\Gamma}, \tilde{\gamma}]$ as the underlying belief parameters.

Another building brick of our theoretical approach refers to probabilistic theory of voting. Voters don't chose policies directly, but vote for one of $j = 1, 2, ...J$ parties. The latter announce different policy platforms including policy positions $x$. Then

$$P_{ij} = Prob(U_{ij} > U_{ij'}) \tag{5.18}$$

$$U_{ij} = V_{ij} + \mu_{ij}, \tag{5.19}$$

where $P_{ij}$ corresponds probability that voter $i$ votes for party $j$ depending on utility $U_{ij}$. $V_{ij}$ denotes the deterministic part of voter $i$'s utility associated with her voting for party $j$. Furthermore, $\mu_{ij}$ corresponds the stochastic component of the utility function. Following the literature, we assume that each $\mu_{ij}$ is drawn from the same probability distribution. We denote the cumulative distribution of errors as $\Psi$. Because of the stochastic assumption, voter behaviour is modelled by a probability vector, where the probability that a voter $i$ votes for party $j$ is:

$$P_{ij} = \int_{\mu} I(\mu_{ij'} - \mu_{ij} < V_{ij} - V_{ij'}) f(\mu_i) d\mu_i. \tag{5.20}$$

$I(\cdot)$ is an indicator function, which equals 1 if the expression in parentheses is true and 0 otherwise. Accordingly,

$$P_j = \frac{1}{n} \sum_{i}^{n} P_{ij} \tag{5.21}$$

corresponds party $j$'s voter share. The deterministic utility component $V_{ij}$ consists of different components:

$$V_{ij} = \alpha_i V_{ij}^P + \theta_i V_{ij}^{NP}, \tag{5.22}$$

with $V^P$ as policy oriented voting and $V^{NP}$ for non policy-oriented voting. $\alpha_i$ and $\theta_i$ are the relative weights of the two components. Policy-oriented

voting refers to the classical voting theory that is founded in the work of Downs (1957), Davis et al. (1970) and Enelow and Hinich (1984). In the Downsian tradition parties announce their policies prior to the election. Once a party is elected, it is assumed to credibly commit to it's stated policy position. Please note that $x_j$ denotes the policy position announced by party $j$.

Interest groups seek for economic welfare. Thus, they support political parties in order to move their positions in the preferred direction. To maximize re-election probability, parties tend to exchange political control over issues against the support offered by interest groups. They have to counterbalance this exchange against the position preferred by voters. The political decision in the equilibrium is the result of a weighted welfare function:

$$X^* = \delta \sum_{i=1}^{n} \omega_i X_i + (1-\delta) \sum_{l} \Omega_l X_l. \tag{5.23}$$

Note that $\delta$ denotes the weight that parties put in the position of voters. With $\omega_i$ we denote the relative weight that voter $i$ puts in policy position $X_i$ and $\Omega_l$ denotes the corresponding relative interest of interest group $l$. It's straightforward to see that the higher the value of $\delta$, the more basic-democratic, i.e. voter oriented, the policy process is. Moreover, $\delta$ becomes higher if voters vote more policy oriented, i.e. $\alpha_i$ from equation 5.22 is higher than $\theta_i$.

Here the potential for basis democratic policy failure occurs: If the weight of policy oriented voting increases, parties tend to put more emphasis on voters' position. Hence, finally a party would more follow $X_i$ than $X_l$. As mentioned above, voters' beliefs regarding public good provision correspond equation 5.17. The underlying parameters may systematic differ (Rhoads, 1985; Akerlof, 1989; Blendon et al., 1997; Caplan, 2002) from those in equation 5.4, e.g. due to overestimating or underestimating costs for provision. Since the policy position $X_i$ depends on the beliefs regarding $[\tilde{\Gamma}, \tilde{\gamma}]$, i.e. how the policy $X$ works, voters' positions can differ from their true $X^*$. Hence, political failure would be a by-product of basic democratic oriented policy decisions. In the next session we suggest how to measure the underlying belief parameters.

## 5.3 Empirical Specification

We assess voters' beliefs regarding three ecological issues. Since it is hard to ask people regarding specific parameters, we have to derive the

underlying belief parameters (see equation 5.17) from econometric results. Following the key components of the theoretical model, i.e. WTP as well as political weights, we first have to assess people's WTP as well as the voting behaviour. Before presenting the corresponding econometrics, we first derive $\gamma$ and $\Gamma$ from estimation results as well as underlying data.

### 5.3.1 Deriving voters' belief parameters

Since issues are related (see theory above), we assume that elasticities of farm animal welfare affect climate's cost elasticities. First, we use Taylor approximation at $X_0$

$$\begin{aligned} f(X^*) &= f(X_0) + f'(X_0)(X^* - X_0) + \frac{1}{2}f''(X_0)(X^* - X_0)^2 \quad (5.24) \\ &= f(X_0) + \frac{1}{2}f''(X_0)(X^* - X_0)^2. \end{aligned}$$

Furthermore, we consider $U_{ij} = \alpha_0 + \alpha^P(X - X_0)^2$ as net utility of public good production. Net rent $NR = \beta F(X) - X = \beta Z - C(z)$ can be Taylor approximated, hence

$$NR(X^*) = NR(X_0) + NR'(X_0)(X^* - X_0) + \frac{1}{2}NR''(X_0)(X^* - X_0)^2 \quad (5.25)$$

$$\Rightarrow NR(X^*) = NR(X_0) + \frac{1}{2}NR''(X_0)(X^* - X_0)^2.$$

If not considering constants,

$$\frac{1}{2}NR''(X_0)(X^* - X_0)^2 = \alpha^p(X - X_0)^2 \quad (5.26)$$

$$\Rightarrow \frac{1}{2}\beta(\Gamma\gamma(\gamma - 1)X^{\gamma-2}) = \alpha^p. \quad (5.27)$$

Consider now two public goods $i$ and $j$. The net rent gives utility in monetary unit which has the same value independent from the good.

$$\begin{aligned} \frac{\frac{\partial Prob_g}{\partial X_i}}{\frac{\partial Prob_g}{\partial X_j}} &= \frac{\frac{\partial Prob_g}{\partial NR_i} \times \frac{\partial NR_i}{\partial X_i}}{\frac{\partial Prob_g}{\partial NR_j} \times \frac{\partial NR_j}{\partial X_j}}, \quad (5.28) \\ &= \frac{2\alpha_i^P(X_i^* - X_i)}{2\alpha_j^P(X_j^* - X_j)} \quad (5.29) \end{aligned}$$

with $Prob_g$ as the probability to vote for government party $g$.

$$\frac{\frac{\partial NR_i}{\partial X_i}}{\frac{\partial NR_j}{\partial X_j}} = \frac{\alpha_i(X_i^* - X_i)}{\alpha_j(X_j^* - X_j)} \tag{5.30}$$

$$= \frac{\frac{1}{2}NR''(X_i^* - X_i^0)}{\frac{1}{2}NR''(X_j^* - X_j^0)} \tag{5.31}$$

$$NR_i = NR_i(X_i^*) + \beta f_i'(X_i^*) - 1 + NR''(X_i^*)(X_i^* - X_i) \tag{5.32}$$

$$\frac{\partial NR_i}{\partial X_i} = \beta_i f_i''(X_i^*) \times 2(X_i^* - X_i) \tag{5.33}$$

$$\frac{\partial NR_i}{\partial X_j} = \beta_j f_j''(X_j^*) 2(X_j^* - X_j) \tag{5.34}$$

$$f_i''(X_i) = \gamma_i(\gamma_i - 1) \times \Gamma_i \times X_i^{\gamma_i - 2} \tag{5.35}$$

$$= \frac{(\gamma_i - 1)}{X_i^*} \times f_i^{'}.$$

(5.37)

From 5.8 follows

$$NR_i'' = \frac{\partial \beta f_i' - 1}{\partial X_i} \tag{5.38}$$

$$= \frac{\partial(\beta\Gamma\gamma X_i^{\gamma-1})}{\partial X_i}$$

$$= \beta\Gamma\gamma(\gamma - 1) \times X^{\gamma-2} \times (\frac{X}{X})$$

$$= \frac{(\gamma - 1)F'(X)}{X^*},$$

and thus

$$\frac{\alpha_i^P}{\alpha_j^P} = \frac{\frac{(\gamma_i - 1) \times F'(X_i)}{X_i^*}}{\frac{(\gamma_j - 1) \times F'(X_j)}{X_j^*}} \tag{5.39}$$

$$\Rightarrow \frac{\alpha_i^P}{\alpha_j^P} = \frac{\gamma_i - 1}{\gamma_j - 1} \times \frac{X_j^*}{X_i^*} \tag{5.40}$$

$$\Leftrightarrow \frac{\alpha_i^P \times X_i^*}{\alpha_j^P \times Z_j^*} = \frac{\gamma_i - 1}{(1-\gamma_j')} \tag{5.41}$$

$$k_{ij} = \frac{\gamma_i}{1-\gamma_j'} \tag{5.42}$$

$$\Rightarrow k_{ij} - k_{ij}\gamma_j' = \gamma_i - 1 \tag{5.43}$$

$$(1-\gamma_j') = \frac{\gamma_i - 1}{k_{ij}} \tag{5.44}$$

$$\gamma_j' = 1 - \frac{\gamma_i - 1}{k_{ij}} = \frac{k_{ij} + (1-\gamma_i)}{k_{ij}}. \tag{5.45}$$

### 5.3.2 Econometric Models

Since we assume heterogeneity among voters, we need individual political weights as well as WTP measurements. In particular, we estimate discrete choice models which are theoretically founded in the random utility framework. We chose a latent class approach to assess both, the economic preferences (the WTP for environmental public goods) and corresponding political weights.

We assume a set of $i = 1, 2, ..., n$ voters which we consider to be utility maximizers. Let then $t$ denote the choice situation and $J$ a set of alternatives. The utility of alternative $j$ is denoted by $U_{itj}$. Hence, $i$ decides for $j$ if

$$U_{itj} > U_{itj'}. \tag{5.46}$$

In particular, utility consists of two components, where $V_{itj}$ refers to the deterministic part of voter $i$'s utility. It is based on observable characteristics while $\epsilon_{itj}$ is the unobserved stochastic error component (Hensher et al., 2015). Hence,

$$U_{itj} = V_{itj} + \epsilon_{itj}. \tag{5.47}$$

Please note that $V_{itj}$ is a linear combination of a $g \times 1$ vector of $g$ explanatory variables $x$ as well as a $g \times 1$ vector of parameters $\beta$:

$$V_{itj} = \beta \mathbf{x}. \tag{5.48}$$

Following (Greene, 2012), the corresponding probability to choose alternative $j$ is

$$P_{itj} = Prob(y = j|it) = Prob(U_{it}(j) > U_{it}(j')) = Prob(U_{it}(j) - U_{it}(j') > 0). \tag{5.49}$$

Standard models for discrete choices are the conditional and the multinomial logit model (McFadden, 1974). The underlying assumption is that the stochastic component $\epsilon_{itj}$ is independent and identically distributed with Gumbel (type 1 extreme value) distributions (Hensher et al., 2015). The *conditional logit model* corresponds

$$\begin{aligned} P_{itj} &= \frac{e^{V_{itj}}}{\sum_j e^{V_{itj}}} \\ &= \frac{e^{(\beta_0 + \sum_g \beta_g x_{itgj})}}{\sum_j e^{(\beta_0 + \sum_g \beta_g x_{itgj})}}, \end{aligned} \tag{5.50}$$

where $x_{itgj}$ denotes the $g$th attribute of alternative $j$ in choice set $t$ for decision maker $i$. Note that attributes vary among alternatives in the choice set. Furthermore, $\beta_0$ corresponds the alternative specific constant (ASC) and is also estimated like $\beta_g$. For considering individual characteristics, the *multinomial logit model* has to be used. Accordingly, a $k \times 1$ vector **z** of individual characteristics now refers to utility's observable part:

$$\begin{aligned} P_{itj} &= \frac{e^{V_{itj}}}{\sum_j e^{V_{itj}}} \\ &= \frac{e^{(\sum_k \alpha_{kj} x_{itk})}}{\sum_j e^{(\sum_k \alpha_{kj} z_{itk})}}, \end{aligned} \tag{5.51}$$

where $z_{itk}$ is the $k$th characteristic of individual $i$ in choice situation $t$[1]. Both models might be combined (Greene, 2009), i.e.

$$\begin{aligned} P_{itj} &= \frac{e^{V_{itj}}}{\sum_j e^{V_{itj}}} \\ &= \frac{e^{(\beta_0 + \sum_g \beta_g x_{itgj} + \sum_k \alpha_{kj} x_{itk})}}{\sum_j e^{(\beta_0 + \sum_n \beta_n x_{itnj} + \sum_k \alpha_{kj} z_{itk})}}. \end{aligned} \tag{5.52}$$

While the mentioned models assume homogeneous preferences among decision makers, the latent class model (Swait, 1994; Boxall and Adamowicz, 2002; Greene and Hensher, 2003) allows preference heterogeneity. First, the set of voters is divided into $Q$ groups which we label as classes in the following. Note that the membership in class $q$ is not deterministic, but - as the choice model - probabilistic and depends on a $l \times 1$ vector **s** of decisions maker's $l$ characteristics. Accordingly, one can write the

[1] Please note that parameters $\alpha$ vary among alternatives.

corresponding membership likelihood function as

$$M_{iq} = \theta_0 + \sum_l \theta_q s_{il}, \tag{5.53}$$

with the class membership constant $\gamma_0$. Hence,

$$P_{iq} = \frac{e^{M_{iq}}}{e^{\sum_{q=1}^{Q} M_{iq}}}. \tag{5.54}$$

Moreover,

$$\begin{aligned} P_{itjq} &= \frac{e^{V_{itjq}}}{\sum_j e^{V_{itjq}}} \\ &= \frac{e^{(\beta_{0q} + \sum_g \beta_{gq} x_{itgj} + \sum_k \alpha_{kjq} x_{itk})}}{\sum_j e^{(\beta_{0q} + \sum_n \beta_{nq} x_{itnj} + \sum_k \alpha_{kjq} z_{itk})}} \end{aligned} \tag{5.55}$$

and the overall probability to chose $j$ corresponds

$$P_{ij} = \sum_{q=1}^{Q} P_{iq} P_{itjq}. \tag{5.56}$$

Moreover, Greene and Hensher (2003) suggest to use Bayes theorem in order to calculate posteriori class probability:

$$\hat{P}_{iq} = \frac{P_{ijq} P_{iq}}{\sum_{q=1}^{Q} P_{ijq} P_{iq}} \mid y = j. \tag{5.57}$$

We can use posteriori probability to calculate individual WTP:

$$WTP_q = -\frac{\beta_k}{\beta_{costs}} \tag{5.58}$$

$$WTP_i = \sum_{q=1}^{Q} \hat{P}_{iq} WTP_q \tag{5.59}$$

### 5.3.3 Data

We use a sample of 1002 respondents from an online survey on the topic sustainability which was carried out in November 2018. The online survey consisted of questions regarding voting behaviour and three discrete choice experiments as well as several socio-economic questions. Policy

issues covered were, among others, the topics animal welfare, climate and water protection. These three ecological issues were part of the first discrete choice experiment which we use to calculate the willingness to pay (WTP) for each issue. Original attributes as well as attribute levels are given in appendix 5.11.

The dependent variable for the voting behaviour model is participants' answer to the question which party they would vote for if a election would be held on the next Sunday. Moreover, they had to state their own position regarding amount of greenhouse gas emissions in $CO_2$ equivalent, financing animal welfare and kilograms (kg) nitrogen (N) per hectare (ha) farm land as well as other issues. Participants were also asked to state the perceived position of the parties that are part of the German parliament in order to calculate corresponding distances[2]. Distance variables are presented in table 5.1.

[2]For alternative of not voting we set distance to 0.

Table 5.1: Distances for policy issues

| **Dimension** | **Issue** | **Variable** |
|---|---|---|
| Ecology | Farm Animal Welfare | ANIMALWELFARE.percentage3 |
| | CO2 Emissions | CLIMATE.percentage3 |
| | Water protection (reduce nitrogen surplus) | WATER3 |
| Economy | Economic growth | GLOBALJUSTICE.percentage3 |

Source: Own presentation.

The variable *ANIMALWELFARE.percentage3* deals with the question how much money the government should spend in order to promote farm animal welfare. Absolute values range from zero (current) to 4.5 billion euro governmental spending and thus correspond to scientific suggestions (see WBA, 2015). With *CLIMATE.percentage3* we address the reduction of greenhouse gas emissions where 909 million tons $CO_2$ equivalent in 2016 (BMU, 2019) serve as reference value. Our third issue of interest is reduction of nitrogen surplus in order to protect water. The corresponding variable is *WATER3*. Please note that our variables have different scales as well as different units. Hence, we transformed animal welfare positions into percentage of maximum value (4.5 billion euro). Moreover, we have set mentioned amount of $CO_2$ emissions (climate position) in relation to the status quo. So the distance attributes are expressed in percentage points. To control for party loyalty we included the variable *PI* which comes also as an attribute of the parties. If a voter $i$ identifies with party $j$, it holds $PI_{ij} = 1$ and $PI_{ij'} = 0$.

For retrospective voting we use results from a PCA: The survey contained a set of ten retrospective variables which are presented in table 5.2.

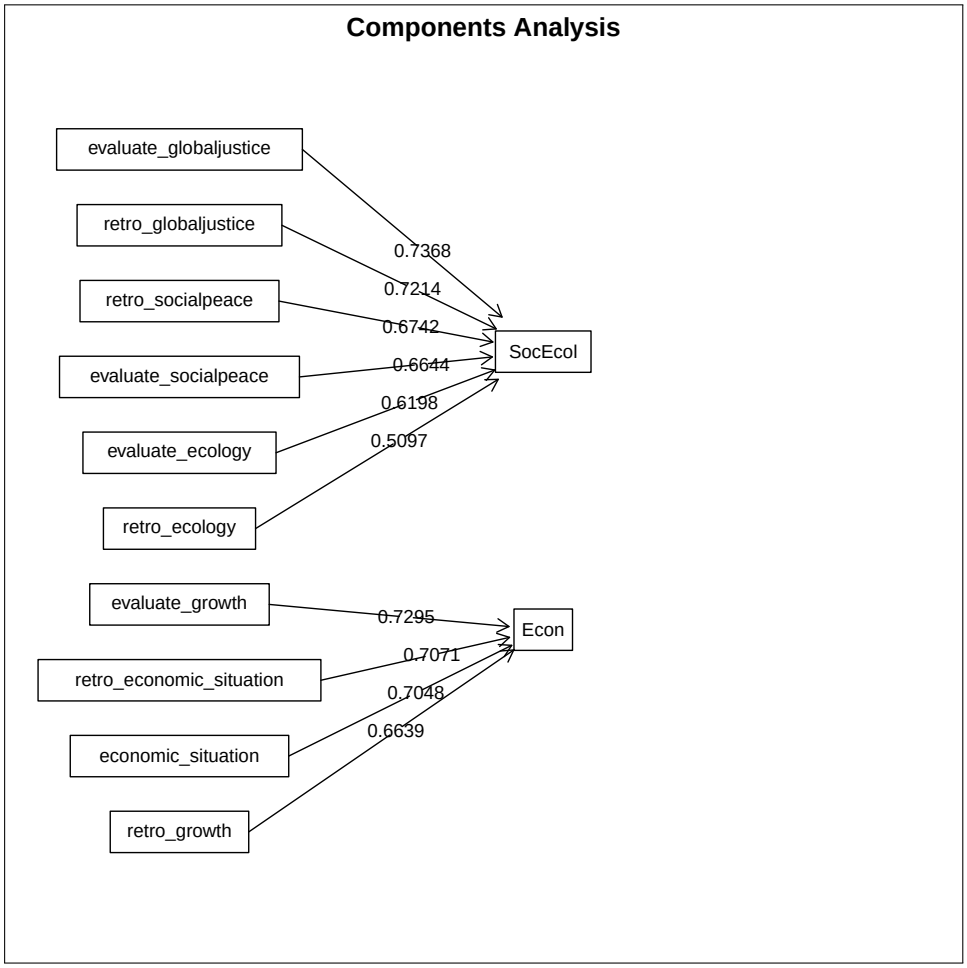
Table 5.2: Retrospective variables

| | **Values** | **Economic** | **Ecology** | **Social** |
|---|---|---|---|---|
| *Current status* | | | | |
| Very Good | 1 | economic_situation | evaluate_ecology | evaluate_socialpeace |
| Very Bad | 5 | evaluate_growth | | evaluate_globaljustice |
| *Compare to 5 years ago* | | | | |
| Much better | 1 | retro_economic_situation | retro_ecology | retro_socialpeace |
| Much worse | 5 | retro_growth | | retro_globaljustice |

Source: Own presentation.

Voters evaluated four issues from a current perspective as well as in comparison to the situation five years ago. Values range from 1 (“very good” or “much better”) to 5 (“very bad” or “much worse”, see table 5.2). With a PCA we reduced these dimensions to a suggested two component solution.

Figure 5.1: PCA Loadings




Source: Own presentation.

The economic variables load on one component (figure 5.1). Hence, we label the corresponding variable *Econ*. The social and environmental judgements load on the second component which is denoted as *SocEcol*.

Table 5.3: Variables for covariates or predictors

| Variable | Content | Values | Value meaning |
|---|---|---|---|
| *age* | Age in years | 18 | Youngest |
| | | 93 | Oldest |
| *educational_level* | Level of education | 1 | Leaved schhol without graduation |
| | | 7 | University |
| *political_interest* | Political interest | 1 | Very strong |
| | | 5 | No interest at all |
| *importance_ecology* | Importance: Ecology | 0 | Unimportant |
| | | 100 | Very important |
| *sustainability_market* | Regulating sustainability via market | 1 | Full agreement |
| | | 5 | Full disagreement |
| *subjectiveincome* | Subjective perceiption own income | 1 | Living good |
| | | 5 | Hard to cope with |
| *hypotetical_info* | Hypotetical bias information | 0 | No |
| | | 1 | Yes |

Source: Own presentation.

Table 5.3 shows the set of covariates and predictors used in the econometric models. We present the results of the analysis in the next section.

## 5.4 Results

We start with a brief presentation of the econometric results from the empirical specification before we show the belief parameter results.

### 5.4.1 Econometric Modelling

Using BIC measure we identified a three class model as the best fitting model for DCE choices. The corresponding parameters for the choice model are given in table 5.4. Moreover, the class membership coefficients are presented in table 5.5.

Table 5.4: WTP Estimation results for choices

| 1-3 | **Class1** | **Class2** | **Class3** |
|---|---|---|---|
| *ASC* | | | |
| 1 | -0.074 | 0.568 | -1.049* |
| 2 | -0.070 | 1.889 | 0.191 |
| 3 | 0.144 | -2.456 | 0.859 |
| *Attributes* | | | |
| ANIMAL | 0.264*** | 0.155** | -0.091 |
| CLIMATEPROTrelred.year | 0.177*** | -0.026 | -0.130 |
| WATERPROTrelred.year | 0.018*** | -0.010 | 0.111* |
| COSTS.euro | -0.002*** | -0.007*** | -0.013*** |
| *Predictors* | | | |
| importance_ecology | | | |
| 1 | 1.366*** | 1.082*** | 1.581** |
| 2 | 1.099*** | 1.598*** | -0.125 |
| 3 | -2.465*** | -2.680*** | -1.456*** |
| hypotetical_info | | | |
| 1 | -0.042 | -1.375 | -2.330 |
| 2 | 0.190* | -2.922*** | 7.051* |
| 3 | -0.148 | 4.297* | -4.721 |

Source: Own presentation.

The animal welfare attribute has a positive and significant impact on choice probability in classes 1 and 2 and a (not significant) negative esti-

mate in class 3. Hence, in the two largest classes (see table 5.5) animal welfare increases utility. Interestingly, climate protection is only positive (and significant) in classes 1 and 2. Water protection, i.e. reduction of kg N per ha is utility increasing in two classes (table 5.5). The sign of our cost attribute is negative in all classes and corresponds to theoretical assumptions. For the controlling predictors our results show that perceived importance of issue "ecology" decreases the choice probability of the status quo alternative in all classes and for alternative 2 in class 3. Table 5.5 also shows that providing information about hypothetical bias has only three significant coefficients for alternative 2 (positive in 1 and 3 as well as negative in class 2).

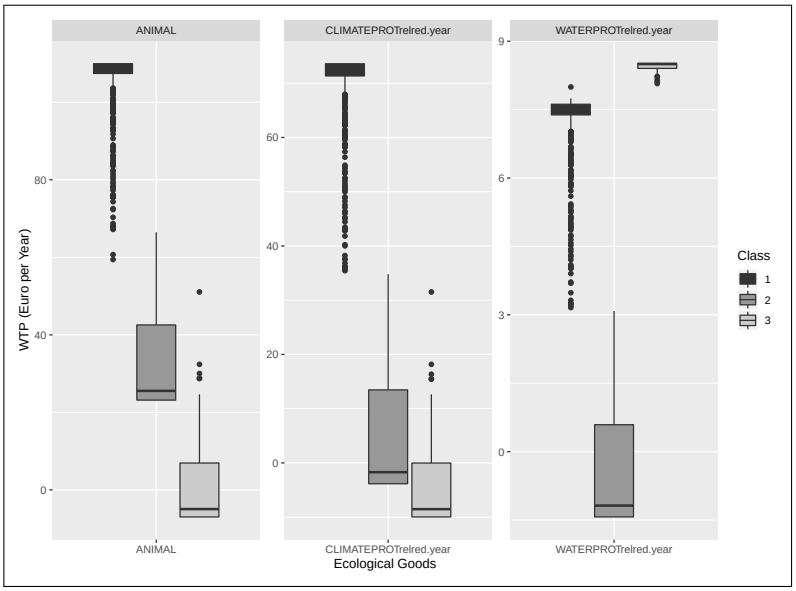
Table 5.5: WTP Estimation results for class membership

| | **Class1** | **Class2** | **Class3** |
|---|---|---|---|
| Intercept | 0.374 | -0.722* | 0.347 |
| age | -0.000 | 0.007 | -0.007 |
| education_level | 0.074* | 0.063 | -0.136** |
| sustainability_market | 0.231*** | -0.034 | -0.197** |
| *Share* | 0.79 | 0.14 | 0.07 |

Source: Own presentation.

With regard to the class membership, we see a non significant impact of *age* over all classes. Note that membership likelihood for largest class 1 (see again table 5.5) increases with higher education as well as disagreement to the statement that markets should regulate sustainability 5.5. We calculated the individual willingness to pay for each ecological attribute (see equations 5.58-5.59) from estimation results. Distributions of individual WTP by class membership are given in figure 5.2 and show that willingness to pay in class 1 is the highest for all of the ecological issues. As one can easily see from the scale, people are willing to spend up to 110 Euro in order to finance animal welfare (figure 5.2). This exceeds maximum values for climate (73.7) or water (8.52) protection. Note that our results also show some negative WTPs, i.e. indicating willingness to accept for ecological issues.

Figure 5.2: Distribution of WTP by Class




Source: Own presentation.

For voting behaviour, we decided for a 2 class model. All distances behave like we expect from theory: they have a negative coefficient (table 5.6), implying that increasing distance leads to decreased utility and hence, probability. In contrast, party identification increases voting probability.

Table 5.6: Voting behaviour estimation results for choices

| | **Class1** | **Class2** |
|---|---|---|
| **ASC** | | |
| UNION | 1.358* | 3.012*** |
| SPD | 0.402 | 2.945*** |
| AfD | 2.232*** | -4.554** |
| FDP | 1.401* | 1.134 |
| LEFT | 1.244 | -6.127** |
| GREEN | 2.255*** | 1.216 |
| NOTVOTE | -8.891** | 2.373*** |
| **Distances** | | |
| ANIMALWELFARE.percentage3 | -0.016*** | -0.002 |
| CLIMATE.percentage3 | -0.026*** | -0.006 |
| WATER3 | -0.007** | -0.010 |
| GROWTH.percentage3 | -0.013*** | -0.005 |
| PI | 3.504*** | 5.702*** |
| **Predictors** | | |
| *SocEcol* | | |
| UNION | 0.109 | -0.341 |
| SPD | -0.077 | 0.205 |
| AfD | 0.602** | -4.617*** |
| FDP | 0.598** | 0.572 |
| LEFT | 0.863*** | 4.500*** |
| GREEN | 0.547** | -1.127 |
| NOTVOTE | -2.642* | 0.808* |
| *Econ* | | |
| UNION | -0.009 | -1.219** |
| SPD | -0.249 | 0.205 |
| AfD | 0.432* | -0.916 |
| FDP | -0.016 | -0.184 |
| LEFT | 0.373 | 3.293*** |
| GREEN | -0.090 | -1.664** |
| NOTVOTE | -0.441 | 0.486 |

Source: Own presentation.

In class 1, higher values for *SocEcol* increase probability to vote for AfD while coefficient in class 2 has a negative sign. This also applies for the green party, but here the parameter in class 2 is not significant.

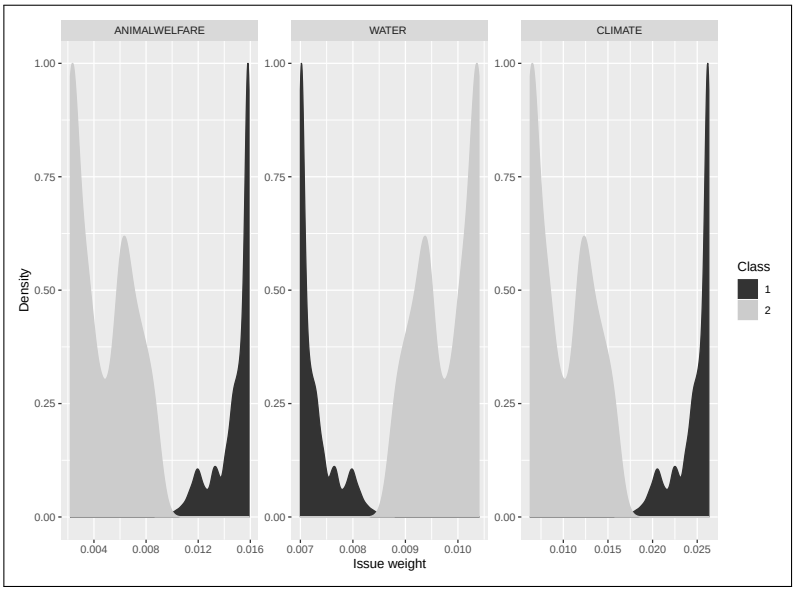
Table 5.7: Voting behaviour estimation results for class membership

| | **Class1** | **Class2** |
|---|---|---|
| Intercept | 1.320 | -1.320 |
| age | 0.009 | -0.009 |
| political_interest | -0.694*** | 0.694*** |
| education_level | 0.204** | -0.204** |
| sustainability_market | 0.089 | -0.089 |
| *Share* | 0.89 | 0.11 |

Source: Own presentation.

Class 1 is characterized by older (non significant), better educated people who disagree to market driven regulation of sustainability, while people with less political interest rather belong to class 2 (table 5.7). Note that 0.89 of respondents belong to class 1 (table 5.7).

Figure 5.3: Distribution of individual policy weights by class




Source: Own presentation.

From these estimation results we calculated policy weights at the individual level. Figure 5.3 shows that for class 1 the weights of animal welfare and climate protection are higher. In contrast, members of this class put less emphasis on water protection compared to class 2.

### 5.4.2 Belief Parameter

With the results for WTP[3] as well as policy weights we were able to calculate the belief parameters. Please note that all parameters presented in the following are the beliefs of voters. From equation 5.45 it follows that cost elasticities for ecological goods depend on those of another good. So we calculated cost elasticities given fixed cost and production elasticities for animal welfare. Hence, we show conditional cost elasticities for a set of fixed animal welfare cost elasticities in the following. Table 5.8 presents variable names and sets of fixed parameters.

[3]Note that cases with neagtive WTP measure have been removed.

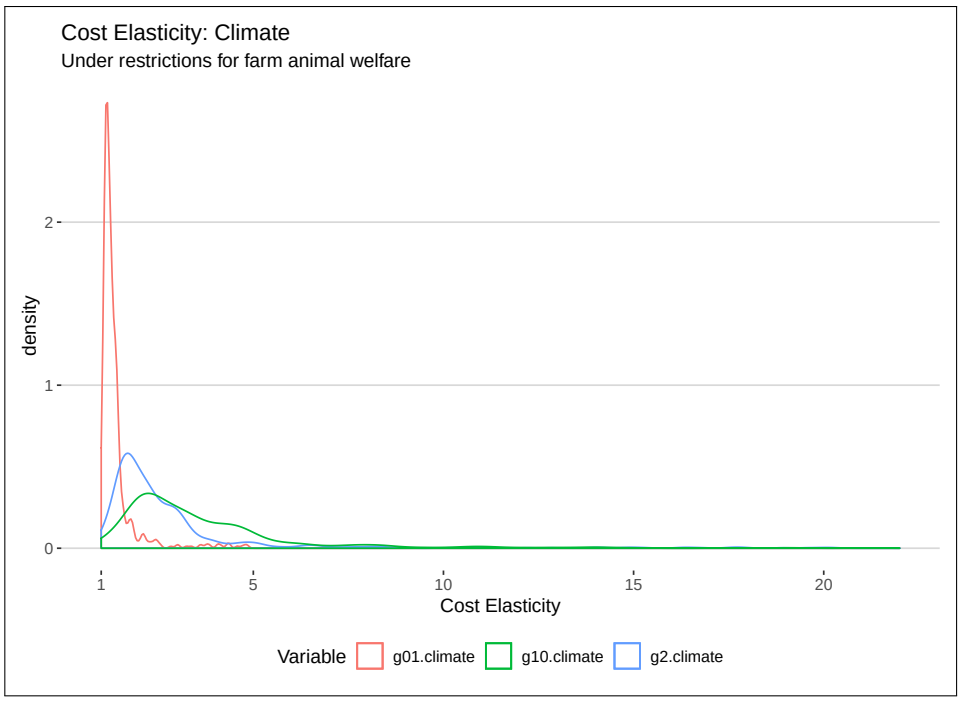
Table 5.8: Cost elasticities for climate and water given animal welfare fixation

| | **Animal welfare fixation** | |
|---|---|---|
| **Variable** | *Production elasticity* | *Cost elasticity* |
| *g01.climate* | 10 | 0.1 |
| *g2.climate* | 0.5 | 2 |
| *g10.climate* | 0.1 | 10 |
| *g01.water* | 10 | 0.1 |
| *g2.water* | 0.5 | 2 |
| *g10.water* | 0.1 | 10 |

Source: Own presentation.

Figure 5.4 shows that climate protection cost elasticities' distribution varies depending on fixed animal welfare cost elasticity: In particular, the mean for *g01.climate* cost elasticity corresponds 1.37.

Figure 5.4: Distribution of $\frac{1}{\gamma}$ for climate under animal welfare restrictions

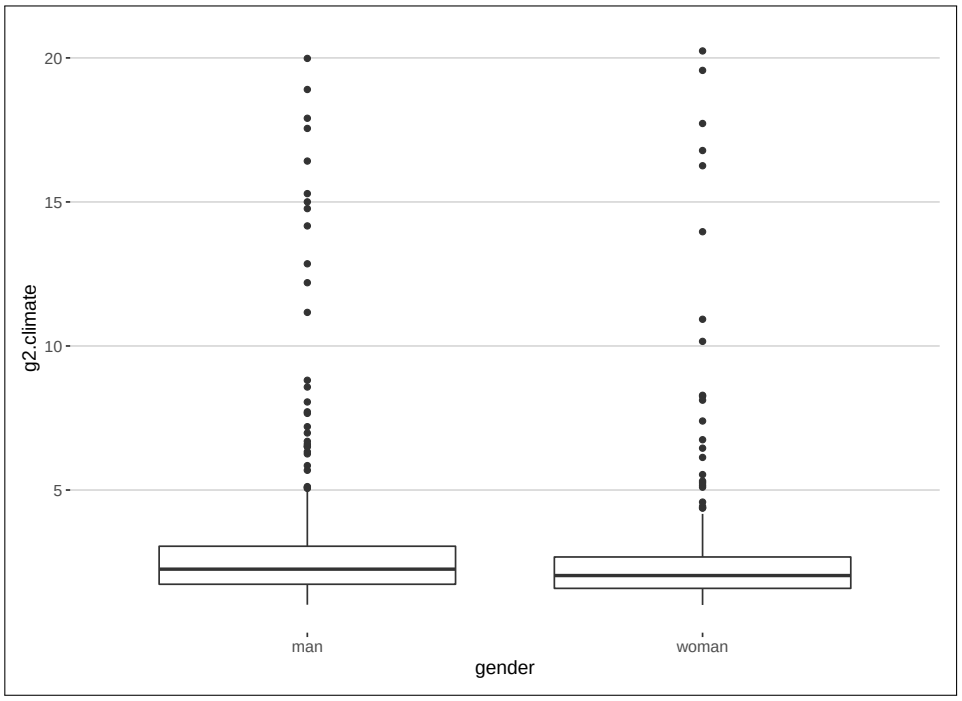



Source: Own presentation.

If we fix $\gamma' = \frac{1}{\gamma} = 2$ for animal welfare, average cost elasticity for climate corresponds 2.83 (figure 5.4). Thus, on average people assume that

1% more reduction of $CO_2$ pollution changes costs by 2.83 percent. This is twice as high as for the 0.1 fixation. Changing the fixation to 10, we see that this also doubles climate's cost elasticity: on average, people's belief correspond an elasticity of 4.3 (figure 5.4). Hence, as expected from theory, cost elasticity beliefs regarding animal welfare technically also influence climate beliefs.

Figure 5.5: Distribution of $\frac{1}{\gamma}$ for climate by gender




Source: Own presentation.

If looking at *g2.climate*'s distributions for men and women separately, one can see that we measured slightly higher cost elasticities for the former: Men have a mean cost elasticity of 3.070 while women's parameters on average correspond 2.597 (figure 5.5). We tested this difference regarding significance using a t-test. The test results imply that the difference between men and women is statistically significant (table 5.9). Please note that this pattern holds also for the two other specifications. i.e. *g01.climate* and *g10.climate*.

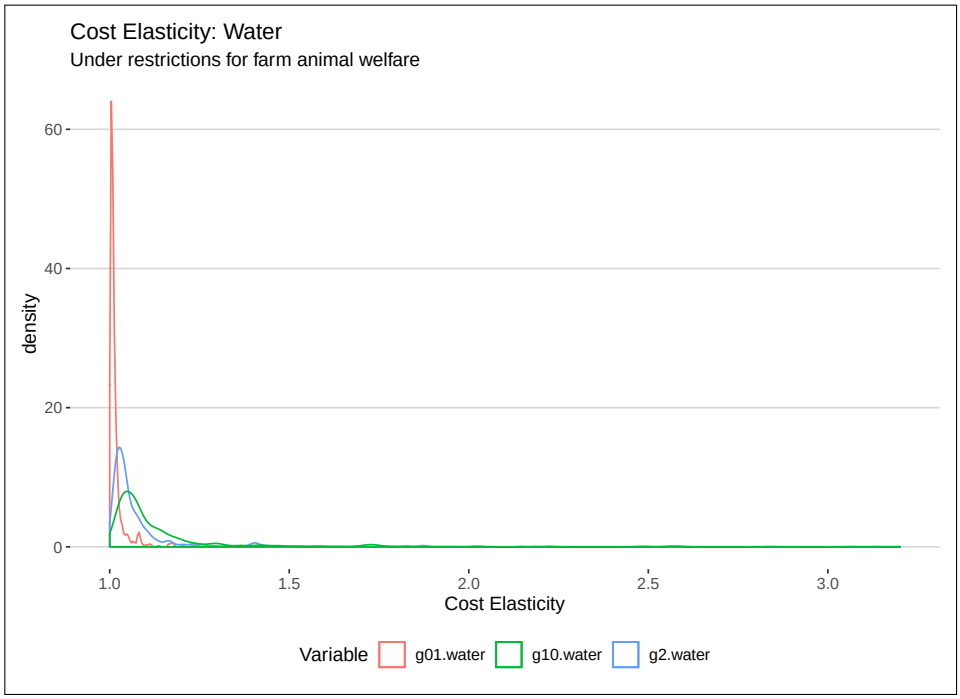
Table 5.9: Results from t-test regarding gender group means

| Variable | man | woman | p-Value |
|---|---|---|---|
| *g01.climate* | 1.414 | 1.320 | |
| *g2.climate* | 3.070 | 2.597 | 0.024 |
| *g10.climate* | 4.725 | 3.875 | |
| *g01.water* | 1.018 | 1.016 | |
| *g2.water* | 1.089 | 1.080 | 0.414 |
| *g10.water* | 1.161 | 1.144 | |

Source: Own presentation.

For water protection, we see that in general the cost elasticities are smaller. Mean value for *g01.water* is 1.02 while *g2.water*'s mean corresponds 1.08. If assuming animal welfare's cost elasticity equals 10, the mean for water *g10.water* is 1.15 (figure 5.6). Hence, cost beliefs of animal welfare do not affect water protection cost beliefs that much. Also, there is not much difference in *g2.water* regarding gender. This is confirmed by the t-test, where results clearly reject statistical significance between the small differences in group means (table 5.9).

Figure 5.6: Distribution of $\frac{1}{\gamma}$ for water under animal welfare restrictions




Source: Own presentation.

To identify whether higher beliefs regarding cost elasticities depend on voter groups, we run a binary logit model. The dependent variable is a dummy measuring whether measured belief parameter of an individual exceeds the median of all measured cost elasticities. Note that we set the AfD as the reference party, hence party coefficients have to be interpreted in comparison to AfD voters. We also controlled for gender effects, considering results from t-test presented above. Moreover, we added controls for evaluating change in ecology's state (*retro_ecology*) and attitude towards sustainability regulation (*sustainability_market*). We applied this to both, climate protection and water protection.

Table 5.10: Estimation results for binary logit models regarding climate and water

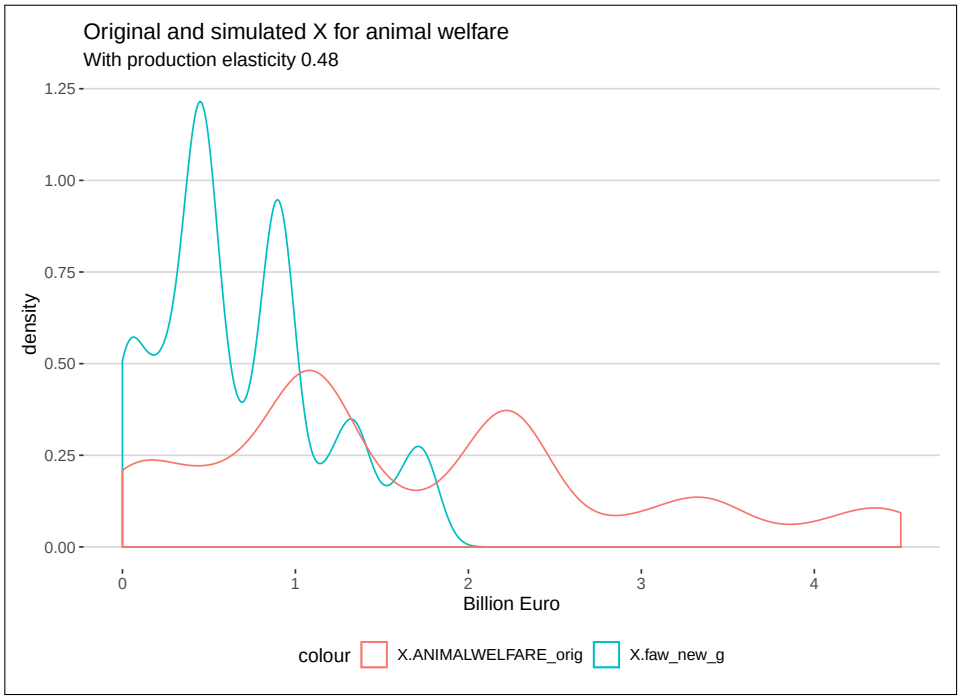
| | **Climate** | **Water** |
|---|---|---|
| *Intercept* | -1.140* | -0.927 |
| *woman* | -0.433** | -0.222 |
| *retro_ecology* | 0.062 | -0.006 |
| *sustainability_market* | 0.154 | 0.036 |
| *FDP* | 0.778* | 0.944* |
| *GREEN* | 0.480 | 0.640* |
| *LEFT* | 0.354 | 0.207 |
| *NOTVOTE* | 1.056 | 3.639*** |
| *SPD* | 0.713* | 1.176*** |
| *UNION* | 0.981** | 1.376*** |
| AIC | 883.53 | 845.08 |

Source: Own presentation.

Estimation results show that if people vote for the FDP, the likelihood for a higher $\gamma'$ increases significantly for both public goods. This also applies for people voting for SPD and UNION. Regarding water protection, voters of the GREEN party or non voters also seem to have higher cost beliefs.

So far, $\gamma'$ for animal welfare was fixed at 2 and hence, $\gamma$ corresponded 0.5. We used $\gamma = 0.5$ to calculate efficiency parameter $\Gamma$ accordingly, using *X.ANIMALWELFARE_orig*. Subsequently, we calculated a new variable *X.faw_new_g* with $\Gamma$ and $\gamma_{new} = 0.48$ to see how they affect the X position.

Figure 5.7: Distributions of X for animal welfare



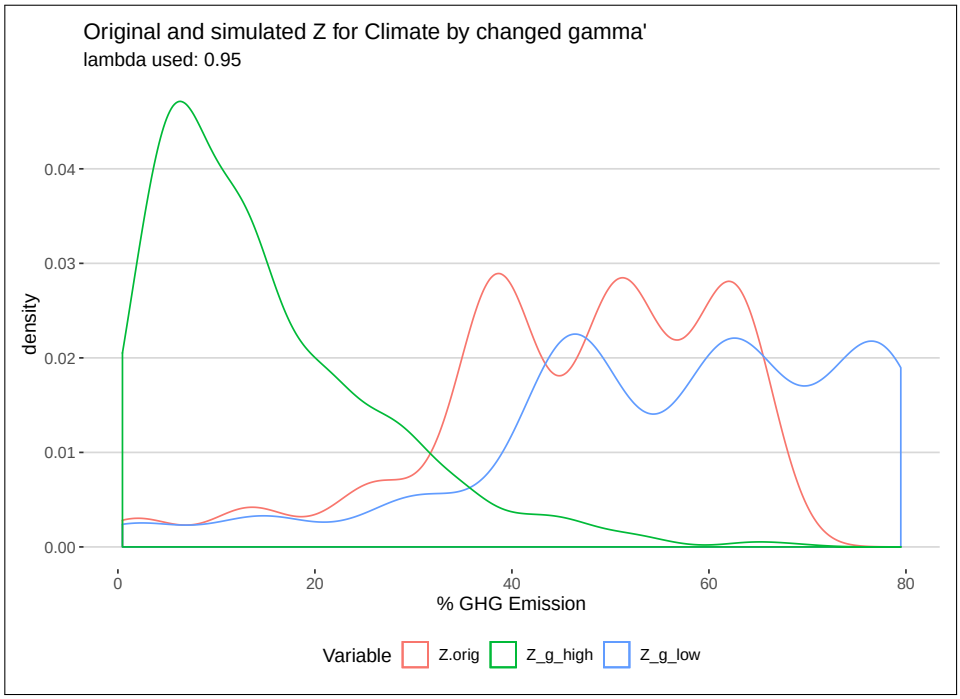

Source: Own presentation.

As becomes clear from figure 5.7, changing production elasticity by only -0.02 moves the whole distribution towards a lower level: Mean position for *X.ANIMALWELFARE_orig* equals 1.714 billion Euro while for *X.faw_new_g* the mean now is 0.692 billion Euro. Thus, preferred policy position regarding animal welfare depends on underlying beliefs regarding efficiency.

Finally, we also changed the belief parameters of *g2.climate*, i.e. cost elasticity, in order to simulate new values for $Z$. In particular, we first took the quantile values for the lower and the upper 5% quantile which we denote as $\hat{g}_l$ and $\hat{g}_u$. With weighting factor $\lambda = 0.95$ we then calculated two new variables where we shifted original *g2.climate* in a lower (*g2.climate_new_low*) or higher (*g2.climate_new_low*) direction[4]. Results for the new *Z*-variables as well the original $Z$ are given in figures 5.8 and 5.9.

[4] $g2.climater\_new\_low = \lambda g2.climate + (1-\lambda)\hat{g}_l$ and $g2.climater\_new\_high = \lambda g2.climate + (1-\lambda)\hat{g}_h$

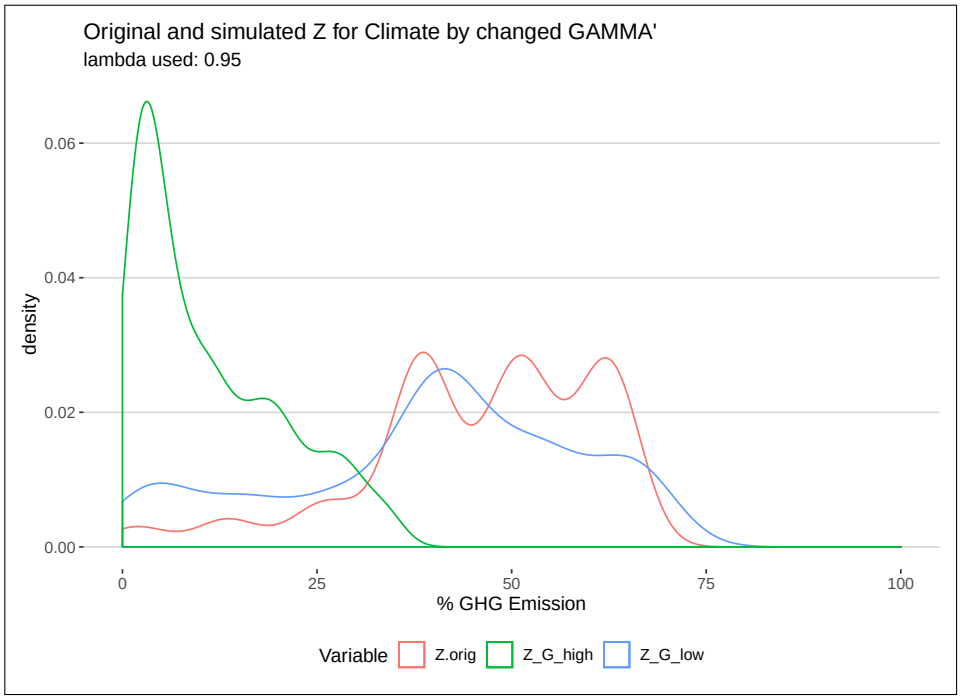
Figure 5.8: Distribution of $Z$ for changend $\gamma'$




Source: Own presentation.

If changing $\gamma'$ to a lower level, we see that average $Z^*$ increases and if increasing the cost elasticity it decreases (figure 5.8). Hence, one could conclude that rising cost beliefs lower the amount of greenhouse gas emission that people want.

Figure 5.9: Distribution of $Z$ for changed $\Gamma'$




Source: Own presentation.

This also applies for $\Gamma'$, i.e. the costs for the first percentage of reduction: If we increase this parameter, it lowers $Z$ and if we set a low value, preferred $Z$ increases (figure 5.8). From that we conclude that the preferred amount of greenhouse gas emission depends on the cost beliefs that people have in mind.

## 5.5 Conclusion

Sustainability is a field of complex political technologies. Nowadays question of ecological sustainability covers the topics climate and water protection as well as animal welfare. Voters are uncertain about the true political technology that translates a policy into outcome. Since these kind of relation is rather complex, laymen apply policy beliefs, i.e. simple mental models regarding the true political technology. These beliefs might be biased, so they can cause inefficient and non-optimal policy decisions if political agents put most emphasis on voters' position. Hence, it would be interesting to measure beliefs so that voter beliefs can be compared to interest groups beliefs and true political technologies.

Combining theoretical approaches of economics and analysis of voting behaviour, we developed an approach to measure voters' underlying belief parameters for climate and water protection as well as animal welfare. In particular, we assume that the provision of public goods corresponds to a Cobb-Douglas production function of governmental spending. Furthermore, we combined the theory of policy oriented voting with the concept of WTP for public goods, i.e. calculating individual WTP as well as policy weights for each issue. Hence, we were able to derive the measurement of the production functions' parameters which we assume to correspond to the beliefs. Based on survey data we subsequently calculated belief parameters for the issues animal welfare, climate and water protection.

First, we could show that climate protection beliefs vary depending on fixed animal welfare cost elasticity. Depending on the chosen $\gamma'$ for animal welfare, climate protection cost elasticities on average correspond 1.37, 2.83 or 4.3. Here higher cost elasticities for animal welfare increase climate's cost elasticities. In general, this pattern holds for water protection. But here the values are near 1 for all fixations. Hence, water protection costs are perceived as nearly proportional elastic.

Second, we found heterogeneity. For example, there is a significant difference between men and women for climate protection. For women, we measured slightly lower belief parameters. Moreover, results show evidence that voters of FDP, SPD and UNION in general seem to have increased belief parameters.

Third, simulating new policy positions changing parameters gave interesting results. Setting the fixed $\gamma$ for animal welfare from 0.5 to 0.48 decreased policy positions of voters regarding governmental spending. We also changed the belief parameters for climate to simulate new values for $Z$. Here we could show that changing $\gamma'$ to a lower level increased the $Z$-position. If $\gamma'$ is increased, $Z$ is lower. This also applies for the costs of the first percentage of greenhouse gas reduction. Thus, we conclude that policy positions of voters seem to strongly depend on cost elasticities and costs for the first unit of a good. More precisely, positions depend *on the beliefs* regarding the costs. If people's beliefs correspond to smaller cost elasticities, i.e. in the direction of proportional costs, the amount of relative greenhouse gas emissions they want increases. But if reducing greenhouse gas emissions is perceived with higher costs (or is initially expensive), they want less reduction.

All in all, these findings underline the important role of beliefs. With our approach we were able to demonstrate how they drive voters' policy positions. From a theoretical perspective, it allows to evaluate biases regarding sustainability goods and their politically provision. If a benchmark is given,

one can asses the beliefs among voters and subsequently compare them to the true political technology.

Unfortunately, we don't have such an adequate benchmark, yet. This especially applies for animal welfare's political technology, but also for climate or water protection. Thus, the empirical application of our approach is restricted to the pure measurement of voters' beliefs. We clearly see this as a first step to evaluate political processes regarding the possibility of basis democratic policy failure.

Regarding belief formation, we see need for more research of the causal mechanisms. The beliefs measured depend on the individual characteristics that influence voting and economic behaviour, i.e. policy weights and WTP. Nevertheless, this is not a causal mechanism that leads directly to the beliefs. Rather, beliefs are the result of learning. As argued by Acemoglu and Ozdaglar (2010), learning can be an observational and/or communicational mechanism. The latter can take place in social networks (Friedkin and Johnsen, 1990). It corresponds to the mechanism of *informational lobbying* (Henning et al., 2019) among policy stakeholders. Considering for example important role of media in animal welfare discourse (Brümmer et al., 2019; Grossarth, 2014), one should also take into account the influence of mass media. This also applies for social media where both, interest groups and voters, can communicate to each other and can influence opinions (Buddle et al., 2018). Hence we suggest future research to investigate the causal mechanism of belief building among voters considering mass and social media as well as personal communication in networks. Nevertheless, from a theoretical perspective we think that our paper contributes to the political economy of sustainability, since it allows to identify voters' policy beliefs empirically.

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# 5.A Appendix

Table 5.11: Attributes and attributes' levels of iscrete choice experiment. Italic levels are status quo.

| **Attribute Name** | **Attribute** | **Attribute level** | **Level label** |
|---|---|---|---|
| CLIMATEPROT | Climate protection | | |
| | | 1 | *909 Milion tons* |
| | | 2 | 735 Milion tons |
| | | 3 | 535 Milion tons |
| | | 4 | 388 Milion tons |
| ANIMAL | Animal Welfare | | |
| | | 1 | *No improvements* |
| | | 2 | Husbandry |
| | | 3 | Husbandry + Management |
| | | 4 | Husbandry + Management + Breeding |
| WATERPROT | Water protection | | |
| | | 1 | *100kg N/ha* |
| | | 2 | 60kg N/ha |
| | | 3 | 40 kg N/ha |
| | | 4 | 0kg N/ha |
| COSTS | Kosten | | |
| | | 1 | *No further costs* |
| | | 2 | 0,3% |
| | | 3 | 0,6% |
| | | 4 | 0,8% |

Source: Own presentation.

# Part II

# Stakeholder

# Chapter 6

# Belief Formation in German Farm Animal Politics: An Illustrative Example From A Stakeholder Network Survey

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# Abstract

Based on a framework of political participation, this study quantifies communication effects within German farm animal politics. Social network data as well as stakeholders' evaluation of a standardized testing and approval procedure for mass-produced livestock facilities are used to demonstrate these effects. The results show that the network of expert communication is comparatively strong connected. Additionally, we see that agriculture and animal production as well as animal protection groups are drivers of expert knowledge and that the meat industry is the most open to external expertise. Finally, structural effects lead to a slight convergence of positions.



**Keywords:** Farm animal politics, political processes, participation, belief, farm animal welfare


## 6.1 Introduction

Livestock farming in Germany faces increasing criticism in recent years. This is especially true for pig production, which citizens evaluate negatively and associate with terms like "factory farming" (Kayser et al., 2012; Rovers et al., 2018, 2019; Salamon et al., 2014). Due to a lack of farm animal welfare, acceptance of the current husbandry systems decreases (WBA, 2015). To solve acceptance problems and to fulfil the stated demand (BMEL, 2018, 2017a) for animal welfare, appropriate political processes are necessary.

Whenever it comes to politics, *policy beliefs* play a key role. Animal welfare is a complex concept that includes several aspects of health and physically functioning, natural living as well as affective states (Fraser, 2008). Thus, the relation between certain livestock policies and the outcomes are also complex. To cope with this complexity, non-professionals as well as politicians and agents of interest groups apply naive mental models. These usually simple heuristics map the translation of policies into the outcome and are named as policy beliefs. These beliefs influence the policy positions of voters as well as interest groups and political agents. Thus, they affect the final policies that result from political processes. Empirical work shows evidence for differences in policy beliefs between experts of economy and voters (see Caplan, 2002). The problem of those biased beliefs is that they may lead to political failure (Caplan, 2001). Policy decisions need political support. If supported policy positions base upon biased beliefs, inefficient policies result. Therefore, policy beliefs are a critical part

of politics.

How stakeholders of German livestock politics form these beliefs is unknown, yet. Literature investigating stakeholders in the area of animal welfare focuses on the empirical comparison between different stakeholder groups regarding their assessment of animal welfare programs. For example, Heise and Theuvsen (2017) compared evaluation of 13 animal welfare activities by different stakeholders. The authors not only asked for the assessment with respect towards importance, but also with regard of practical feasibility of the activities. Stakeholder groups asked are conventional and ecological famers, veterinarians as well as consumers. While many activities are evaluated as important and feasible, some differences remain. For example, conventional farmers evaluate space allowance as slightly important and judge it "partly / partly" in terms of practicability (Heise and Theuvsen, 2017, pp: 257-258). All in all, Heise (2017) concludes that judgments of different German stakeholder groups vary. Other empirical work (see for example Verbeke, 2009; Ventura et al., 2015) mostly focusses on comparison of stakeholder views along the supply chain. Unfortunately, these studies restrict themselves on pure comparison, leaving a gap with regard to the political process. Recent work in comparative political science provides a stronger contribution to the understanding of political processes. In particular, there is evidence that the green party drives change in farm animal welfare policies in the German states (Vogeler, 2017b). On the national level, party difference as well as economic integration may explain different policies (Vogeler, 2017a). Social concerns influence the emphasis of parties on farm animal issues (Vogeler, 2019). While investigating (parts of) the process leading to policies, these studies do not consider beliefs or belief formation. Moreover, they focus on the policy outputs. Overall, despite the noteworthy work in the field of stakeholder analysis, there is a gap in the understanding of how farm animal politics work and how stakeholders form their beliefs.

We investigate the formation of beliefs within German farm animal politics empirically in order to contribute to a better understanding of political processes. Since communication is a key determinant of belief formation (Henning and Hedtrich, 2018), we quantify the effect of expert communication between the most important farm animal policy stakeholders. To illustrate this effect, we use the issue of standardized testing and approval procedure for mass-produced livestock facilities. This refers to the idea that public agencies only allow mass produced facilities, which pass standardized tests before. Such facilities include, for example, feeding systems, watering facilities, flooring and grids (Gauly et al., 2006). Approval standards are the requirements of the German animal protection regula-

tions in connection with the current scientific and technological knowledge (BMEL, 2017b). Such a procedure is planned for husbandry of hens. The experience gained there should then be used for the implementation of other species. This procedure should ensure that mass-produced livestock systems correspond to legal and animal welfare requirements. It is part of the coalition agreement between the parties CDU, CSU and SPD (CDU et al., 2018) as well as of the strategy for farm animal husbandry provided by the ministry for food and agriculture (BMEL, 2017b). The scientific advisory board not only recommends the consideration of all kind of farm animals, but also a procedure for anaesthesia facilities used in the process of slaughter (WBA, 2015). The next section will briefly describe a framework of political participation and belief updating.

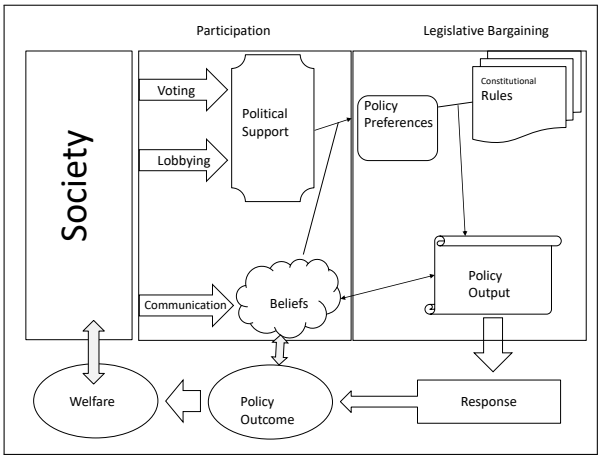
## 6.2 Framework

We consider a simple framework of political participation, including voting, lobbying and communication (see figure 6.1). Within the framework, members of the society can participate in two roles: voters and interest groups. First, citizens of a society vote for their representatives or – in direct democratic systems – a policy proposal. Thus, *voting* corresponds to the basic democratic part of the political support. Please note that citizens here appear as voters. Second, citizens form special interest groups in order to influence the policy positions of political agents directly. They swap the support of their members (e.g. farmers) for influence on the policy position of political agents (see Grossman and Helpman, 1996; Henning, 2000, 2009). This mechanism is known as *lobbying*. Voting and lobbying are both part of the political support function for a policy position (Fig. 6.1). Note that the policy preferences within legislative area depend on this support. The third way of participation affects policy positions indirectly: the aim of *communication* is influencing the policy beliefs determining the policy preferences of actors. We define policy beliefs as (naive) mental models regarding the relation between policy output $x$ and the outcome $z$. This relation is denoted as political technology $T(z, x)$. While the real political technology is rather complex, laymen as well as interest group and political agents apply their beliefs $\tilde{A}$ to reduce complexity. $\tilde{A}$ is the result of communication learning process and the initial belief $\tilde{A}^0$:

$$\tilde{A} = \Upsilon(\tilde{A}^0) \tag{6.1}$$

with $\Upsilon$ denoting the communication mechanism (Henning and Hedtrich, 2018). As argued by Acemoglu and Ozdaglar (2010), the social structure

Figure 6.1: Political Process Framework




Source: Own presentation based on Henning (2000); Henning and Grunenberg (2018)

in which an actor is embedded in plays a role in belief formation. In particular, this structure appears as a social network over a set $N$ of $n$ actors. Formally, the $n \times n$ matrix $C$ describes the structure of this network. If $C_{ij} \neq 0$ , there is a communication tie between agents $i$ and $j$. Let $M$ denote the stochastic matrix where the sum of the total weights equals 1. The element $m_{ij} > 0$ indicates that $i$ pays attention to $j$. In order to update their own beliefs, agents take the weighted averages of their neighbours' beliefs. Within this process, $m_{ij}$ denotes the trust agent $i$ places on current belief of actor $j$ and $r = 1, \ldots, R$ denotes the communication round (Henning and Hedtrich, 2018). Thus,

$$\tilde{A}_i^{r+1} = m_{ii}\, \tilde{A}_i^0 + \sum_{j \neq i} m_{ij} \tilde{A}_j^r \tag{6.2}$$

Please note that $m_{ii}$ denotes the weight that actor $i$ puts on his own belief (his *own control*).

We can rewrite equation 6.2 to

$$\tilde{A}_i^{r+1} = m_{ii} \tilde{A}_i^0 + (1 - m_{ii}) \sum_j \bar{m}_{ij}\, \tilde{A}_j^r \tag{6.3}$$

with

$$\bar{m}_{ij} = \frac{m_{ij}}{(1 - m_{ii})}. \tag{6.4}$$

$A_i^r$ denotes the political belief of agent $i$ after communication round $r$ and $(1 - m_{ii})$ corresponds to the aggregated weight for all neighbours. If 6.3 is

rewritten in Matrix notation,

$$\tilde{A} = [I - (1 - m_{diag})\bar{M}]^{-1} * m_{diag} * \tilde{A}^0 \tag{6.5}$$

where

$$\hat{M} = [I - (1 - m_{diag})\bar{M}]^{-1} * m_{diag} \tag{6.6}$$

corresponds to the network multiplier of communication. The element $\hat{m}_{ij}$ corresponds to the multiplier, i.e. direct and indirect effects of $j's$ initial belief on $i's$ final belief (Henning and Hedtrich, 2018). This update procedure corresponds to the model of Friedkin and Johnsen (1990). We apply this framework on data presented in the next section.

## 6.3 Data

Both, network and belief data, are part of an elite network survey within the research project AniFair. From September 2017 until October 2018 we conducted 37 interviews with representatives of stakeholder organizations. Based on a desk research we interviewed not only parliamentary groups and state offices, but especially interest groups involved in German livestock politics. We emphasized that we asked not for the interview partners' personal opinion, but for the position of their organization. A standardized questionnaire was used that contains four parts:

I. *Political Profile*: areas of activity, preference space

II. *Assessment and Evaluation of Farm Animal Welfare*: level of farm animal welfare, need for action, evaluation of indicators

III. *Livestock Policies*: designing a fattening policy according own preferences

IV. *Social Networks*: reputation, communication, political support and informal social relations.

Please note that we used the intermediate results of the reputation network complementary to our desk research before the starting round of interviews to filter out the most important actors. The average interview duration was 1.5 hours. Since one organization did not completed the interview, the data set consist of 36 actors.

### 6.3.1 Network

To calculate the network multiplier, we use the confirmed communication network. The communication ties were asked from two perspectives. First, we asked the interview partners, to whom they send expert information, i.e. being the supplier of expert knowledge. The perspective changed in the second question: here the interviewed representatives should name the organizations from whom they receive information, i.e. being demander of expert knowledge. This approach is useful to ensure that the real connections are measured: Using both perspectives allows constructing the confirmed network (Pappi et al., 1995). An additional question addressed the value of information. Representatives had to name organizations which knowledge is especially valuable. For each of these questions a binary $n \times n$ matrix is constructed, where "1" indicates connection tie and "0" indicates no tie. $S$ denotes the matrix showing which actors in the rows send information to the actors in the columns. $R$ is the demand matrix, showing which row actors receive information from which column actors. $V$ is the matrix where row actors mark the especially valuable suppliers of information. So, at a first stage we construct a weighted receiving matrix

$$W = R + V\,, \tag{6.7}$$

which's transpose is elementwise multiplied in order to get the confirmed network:

$$C = S \otimes W^T. \tag{6.8}$$

$C$ is the confirmed network matrix where "0" corresponds to no connection, "1" to a normal tie and "2" to an especially valuable knowledge exchange from row actors to column actors.
We used the reputation network to specify the network boundaries. Within the reputation network, actors marked the organizations they perceive as influential with regard to livestock politics. Consider the socio matrix $G$ representing the directed reputation network, where $g_{ij}$ corresponds to the naming of $j$ as an influential actor by $i$. It is straightforward to use indegree centrality to calculate reputation:

$$d_j = \sum_j g_{ij} \forall i \neq j \tag{6.9}$$

If $d_A$ for stakeholder organization A equals zero, it is not part of the network.

### 6.3.2 Belief Data

We use a variable of questionnaire part III to illustrate a belief change within the network. Within this part, stakeholders had to evaluate some institutional and structural adjustments, i.e. regulation issues. This includes the evaluation of a bylaw intended to regulate a standardized testing and approval procedure for mass-produced livestock facilities. The interviewed stakeholder representatives had to evaluate a possible corresponding bylaw for pig husbandry facilities on a five-point-scale. This scale ranges from one ("Not useful") to five ("Very useful"). The corresponding variable *TestAppMPLS*[1] contains the answers. Please note, that we use the answers as the initial beliefs of the stakeholders[2]. We present our results in the next section.

## 6.4 Results

### 6.4.1 Network Structure and Multiplier Effects

One of the 36 actors has a reputational indegree of zero. Thus, our network contains only 35 actors. Table 6.1 lists stakeholder categories, groups and number of organizations within the network as well as the reputation. The values of the column "Reputation" correspond to the mean of the measurement presented in equation 6.9. Environment protection groups and the parliamentary groups receive the highest reputation, i.e. nomination as influential actors. Note that on average the reputation of stakeholder organizations assigned to agriculture and animal production have the lowest reputation.

[1] Acronym for "Standardized testing and approval procedure for mass-produced livestock systems".

[2] This is of course an ad hoc assumption, ignoring that stakeholders might have communicated about this issue before the interviews. Thus, we do not claim to calculate the true beliefs. Moreover, the variable serves illustrational purposes.

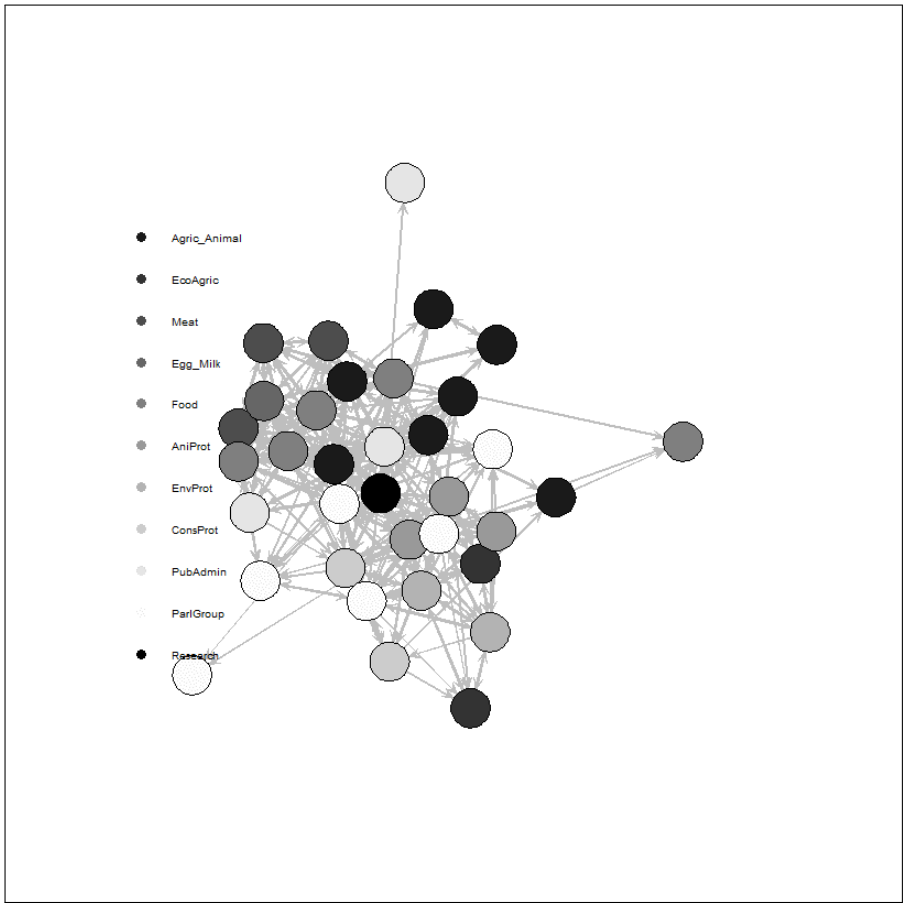
Table 6.1: Actors and Reputation

| **Category** | **Group** | **Description** | **n** | **Reputation (Indegrees)** |
|---|---|---|---|---|
| Interest Groups | Agric_Animal | Agriculture and Animal Production | 7 | 12.14 |
| | AniProt | Animal Protection | 3 | 20.00 |
| | ConsProt | Consumer Protection | 2 | 24.00 |
| | EcoAgric | Ecological Agriculture | 2 | 19.00 |
| | EggMilk | Egg and Milk Industry | 1 | 19.00 |
| | EnvProt | Environment Protection | 2 | 26.50 |
| | Food | Food Retail | 5 | 18.00 |
| | Meat | Meat Industry | 3 | 14.33 |
| | Research | Research Institutes and Organizations | 1 | 14.50 |
| Political Agents | PubAdmin | Public Administration | 3 | 18.00 |
| | ParlGroup | Parliamentary Groups | 6 | 26.00 |

Source: Own presentation.

Figure 6.2 presents the graph of the confirmed weighted communication network. The overall density of the network is 0.266, which is a comparatively high value (see Henning and Krampe, 2018; Henning, 2009). In other words, the actors within this network realise more than 26 percent of the possible connections. As one can easily see in figure 6.2, three actors within the network do not serve as knowledge supplier, but only as demander: One parliamentary group, one public agency and one food retail organization are placed at the outer region of the graph. Note that these organizations are not directly connected to each other. Actors from food retail, producer organizations as well as one public administration actor form the core of the network.

Figure 6.2: Communication Network

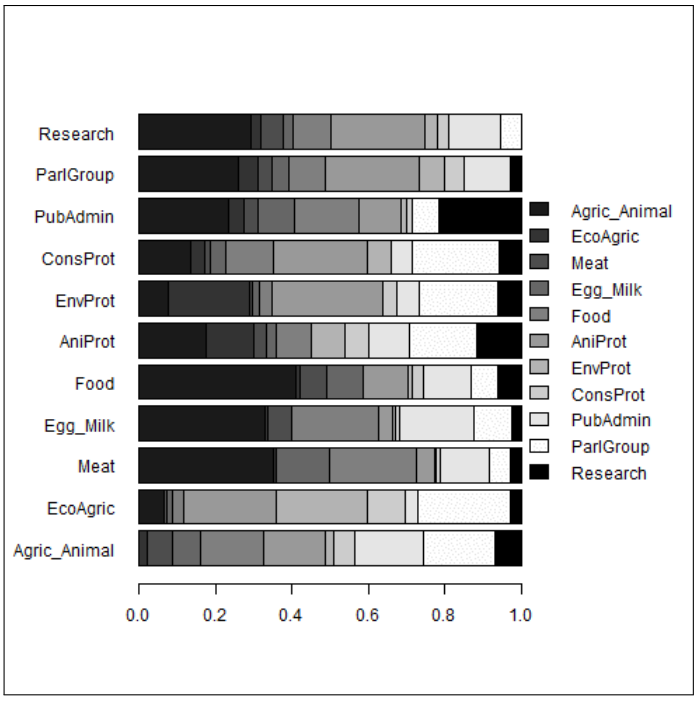



Source: Own presentation.

Based on this dense network we calculated the multiplier as described in equation 6.6. We aggregated mean values of the results on group level.

In order to show the relative weight we normalized the values as share of external knowledge while cancelling out own control. The corresponding figure 6.3 shows, how groups (coloured bars) influence other groups (rows).

Figure 6.3: Aggregated Communication Multiplier




Source: Own presentation.

Agriculture and animal production organizations drive 40.09 percent of food retailers' and 35.20 percent of meat sector's external knowledge. Moreover, these organizations also have the highest influence on actors of the political agents' category. Interestingly, they also have the highest influence on the belief updating of research. Another key player is the group of animal protection. They influence environmental protection groups' beliefs by a share of 0.2912. Moreover, they also are second important for belief updating of parliamentary groups, i.e. having a share of 0.2454 of their influence. Note that the latter not only are receiver of information, but also influential knowledge provider for ecological agriculture (0.239), consumer protection (0.228) and environmental protection (0.206) organizations. Environmental protection groups (0.016) and consumer protection (0.013) cover small shares of public administration's external knowledge. Moreover, the meat sector has small influence (0.036) on the parliamentary groups belief updating. Interestingly, research has the lowest share

(0.027), i.e. playing a subordinate role in the formation of policy beliefs in the parliament. As presented in table 6.2, the sector of agriculture and

Table 6.2: Average Own Control (Group Level)

| Group | Own control |
|---|---|
| Agric_Animal | 0.8528 |
| AniProt | 0.7494 |
| ConsProt | 0.3927 |
| EcoAgric | 0.7709 |
| EggMilk | 0.7182 |
| EnvProt | 0.3972 |
| Food | 0.5476 |
| Meat | 0.3626 |
| Research | 0.7103 |
| PubAdmin | 0.638 |
| ParlGroup | 0.5559 |
| Sample | 0.566 |

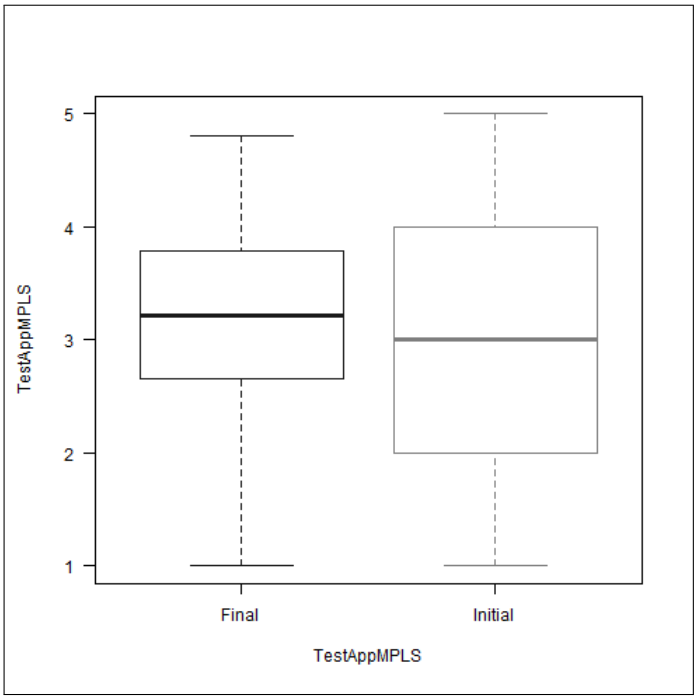
Source: Own presentation.

animal production has the highest own control. On average, actors of this group rely to 85.3 percent on their own knowledge. Organizations of the meat industry, however, have only an own-control of 0.365. Compared to other groups, they are the most open to external knowledge. The mean own control of all organizations in the network is 0.566.

### 6.4.2 Belief Change for Standardized Testing and Approval Procedure

To illustrate the results of influence patterns, we present the application results for the variable *TestAppMPLS*. As one can see in figure 6.4, the application of the communication multiplier leads to a change in the distribution of values. Note that the median of initial belief (grey) equals 3 while the interquartile range is 2. After communication occurs, the final belief distribution (black) has an interquartile range of 1.33 and a median of 3.210. This corresponds to a shift towards a higher average evaluation as “useful” policy. At the same time, the middle 50 percent of values are distributed closer to each other. This indicates a consensus about the evaluation of standardized testing and approval procedure for mass-produced livestock systems.

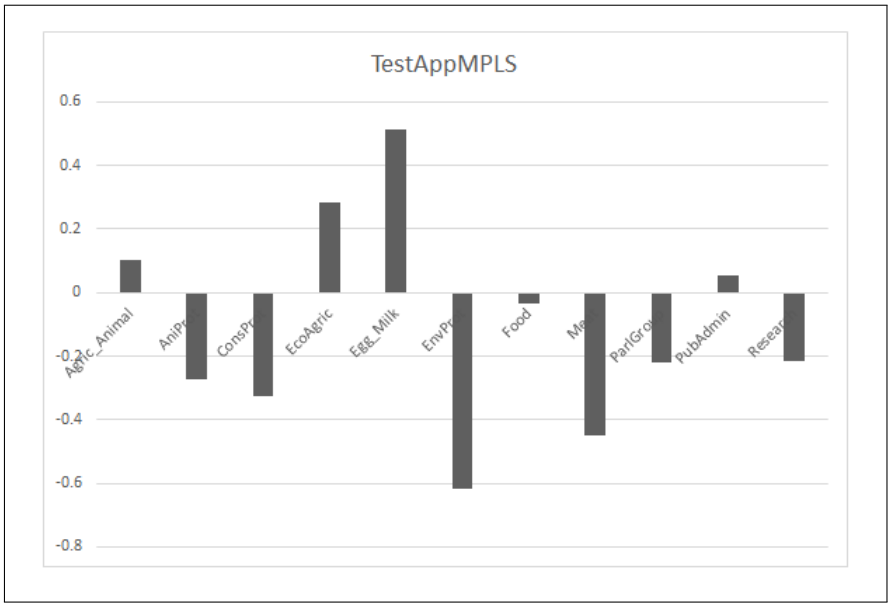
Figure 6.4: Distribution of TestAppMPLS




Source: Own presentation.

More interesting than the changes for the whole sample are the changes among the stakeholder groups. Therefore, we calculated the delta of final and initial beliefs and aggregated the mean on group level. The highest positive change appears for the group of egg and milk production: on average, the group delta is 0.513 (figure 6.5). Stakeholders assigned to ecological agriculture have the second highest change (0.283). The smallest positive change is observed for the public administration (0.056).

Figure 6.5: Deltas within Groups




Source: Own presentation.

Within environment protection there is an average negative belief change of -0.617 (figure 6.5). In addition, we observe a negative belief change of the meat sector by -0.451. This is not a surprise if thinking of the strongest influence on this group: the sector of agriculture and animal production determines 22 percent of meat sector's beliefs while initially evaluating a testing and approval procedure as rather not useful (see table 6.3). Figure 6.5 and table 6.3 show a negative change for animal protection groups after communication. Nevertheless, these stakeholders still judge a bylaw for testing and approval procedures as rather useful. The opinion within the parliamentary space also changes in a negative direction; parliamentary groups have a mean of 3.447 after communication (table 6.3). Thus, they use to evaluate testing and approval procedure as (weak) rather useful.

Table 6.3: Group Means for Beliefs

| Group | TestAppMPLS | |
|---|---|---|
| | Inital | Final |
| Agric_Animal | 2.357 | 2.460 |
| AniProt | 4.667 | 4.392 |
| ConsProt | 4.000 | 3.675 |
| EcoAgric | 3.500 | 3.783 |
| Egg_Milk | 1.000 | 1.513 |
| EnvProt | 5.000 | 4.383 |
| Food | 3.000 | 2.966 |
| Meat | 2.667 | 2.216 |
| ParlGroup | 3.667 | 3.447 |
| PubAdmin | 3.000 | 3.056 |
| Research | 4.000 | 3.785 |

Source: Own presentation.

## 6.5 Conclusion

Our empirical findings confirm that communication plays a key role in farm animal politics. Based on a network study we quantified the effect of expert knowledge communication on stakeholders' beliefs. Our study shows a comparatively dense network: The relevant stakeholder organizations realise more than 26 percent of the possible communication relations. Interestingly, we only identified three actors (from three different branches) who do not supply expert knowledge. Rather, they only receive information from other organizations. The network multiplier derived from the network show three things above all. First, the producer sector relies to more than 85 percent on his own knowledge, i.e. other groups only influence producers' opinions to a small amount. At the same time, actors within this group have the highest influence on meat industry and food retailers, i.e. their downstream sectors, as well as on the legislative. Second, animal protection groups notably also influence parliamentary actors. Thus, they represent a "counterpart" to the producers. Additionally, we observed high influence on environmental and consumer protection when it comes to farm animal politics. Overall, expert communication of farm animal politics seems to be characterized by solidified structures: Economic interest groups tend to be influenced by each other in particular. However, this also applies to (civil society) organizations in the fields of animal welfare, the environment and consumers. Third, legislative actors, i.e. parliamentary

groups, are not only demander of information. Rather, they have strong influence on the belief formation of consumer and environment protection. Additionally, we could demonstrate the result of the corresponding influence patterns. Results for the rating of standardized testing and approval procedure for mass-produced livestock facilities seem to reflect this structure. The measured evaluation by producers – which we consider the initial belief – corresponds as rather not useful. This also applies for the final beliefs and is due to the large own control of the sector. After communication, especially stakeholder from the meat industry change their beliefs into negative direction. Environmental protection organizations also tend to evaluate standardized testing and approval procedures less useful than before communication. This is because ecological agriculture strongly influences belief formation of environmentalist while evaluating the policy only with an initial value of 3.5. Nevertheless, distribution of final belief values indicates a small chance for consensus among the stakeholders.

Given these results, we conclude that appropriate political processes implementing animal welfare policies benefit from communication, since consensus building seems possible. Nevertheless, the above average strong own control of some organizations remains as a possible pitfall: In particular, stakeholders assigned to producer group are hard to convince. They tend to move to a very small extend in another direction. This is especially a problem if their beliefs are biased, i.e. not corresponding to the real political technology. Since this group has a large influence on the knowledge of others, these stakeholders may pass on biased beliefs to other organizations, e.g. the legislative and executive power. This also applies for animal protection groups.

Finally, we do not want to conceal some limitations of the study. Taking the answers of stakeholder representatives regarding standardized testing and approval procedure as initial belief is clearly an ad hoc assumption. It sheds light on a not negligible problem in the collection of belief data: How can we know, whether we are measuring the initial or the final belief? Or do we capture something in between? Additionally, one could question whether the nomination of information sources as especially valuable justifies a double high as normal weighting in the adjacency matrix. The weighting "particularly valuable" is a subjective rating that might have different meanings for representatives of stakeholder organizations. To overcome this problem, future research should use formulation of questions that clarify the quantitative (e.g. “double as high as. . . ”) judgment of knowledge sources’ value. Another limitation results from the sample composition. While the sample size is in line with other policy elite network survey samples (examples: Pappi and Henning, 1999; Leifeld and

Schneider, 2012; Henning and Krampe, 2018), it misses an important actor group: the media, who not only report more and more about issues of husbandry but also tend to frame the debate (Kayser et al., 2011). We were not able to include influential media actors, because they did not react to an interview request. Thus, it might be possible that we used a biased sample to some extent. Despite these limitations, we see our study as a promising approach to understand German farm animal politics better. Moreover, social network tools and the multiplier model may serve as a tool for the assessment of consensus ability of political landscapes.

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# Chapter 7

# Communicational Lobbying and German Animal Welfare Regulation: A Network Approach

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*Paper prepared for submission to "European Review of Agricultural Economics"*

# Abstract

Animal welfare becomes more and more important in Germany's agriculture. Beside legislative actors, other stakeholders of livestock policy nowadays are key players of policy making. How do they form their beliefs which reason their policy positions?

We use a communicational lobbying framework to investigate belief updating regarding four selected issues of animal welfare regulation in Germany. Backbone of our study is a confirmed communication network of the 35 most influential actors in livestock politics. Our results imply that agricultural producers as well as animal protection groups are the main drivers of expert knowledge in German livestock politics.


## 7.1 Introduction

Germany's livestock sector is facing decreasing public acceptance in the recent years (see for example WBA, 2015; Kayser et al., 2012; Rovers et al., 2018, 2019; Salamon et al., 2014). This is strengthened by negative media coverage of the productivity-oriented agricultural sector (Kayser et al., 2012; Grossarth, 2014). Main driver is a perceived lack of farm animal welfare regarding animal husbandry (WBA, 2015).

At an economic level, animal welfare can be considered as a public good (Bennett, 1995; Fawaz, 1997; Lusk and Norwood, 2011) plagued by market failure due to consumption externalities (Harvey and Hubbard, 2013). Thus, public legislation is a main instrument for farm animal welfare issues (Grethe, 2017). Indeed, empirical evidence shows that consumers shift responsibility for animal welfare to state and retailers (Te Velde et al., 2002). Furthermore, citizens (Schulze et al., 2006; Rovers et al., 2017) and non-governmental organizations (NGO) like Greenpeace (2017) criticize the current legal framework as not sufficient. Law studies also deal with several aspects of regulating animal welfare (see for example Peters, 2016a,b; Kloepfer, 2016; Rossi, 2016; Schürmeier, 2017). This sheds light to the area of legislation. In particular, the question regarding the legislation drivers occurs. This refers to the according political processes. Recent political science work shows evidence that especially the green party drives change in farm animal welfare policies in the German states (Vogeler, 2017b). On the national level, party difference as well as economic integration may explain different policies (Vogeler, 2017a). Vogeler (2019) shows that especially social concerns influence the emphasis of parties on farm animal issues. But the mentioned studies don't present

the underlying process of establishing the position. Previous work identified substantial influence patterns of interest groups in European Common Agricultural Policy (CAP) (Pappi and Henning, 1999; Henning, 2000; Krause, 2005; Henning, 2009) or stakeholder influence in development policy (Stark, 2017; Henning et al., 2017, 2019). In general, there is a tendency to include stakeholder organizations in the policy implementation process via political advisory committees (Hustedt et al., 2010).

What we know so far is that stakeholder of animal welfare policy have heterogeneous views on animal welfare programs (see Heise, 2017; Verbeke, 2009; Ventura et al., 2015). A comparison of conventional and ecological famers, veterinarians as well as consumers' views shows that many activities are evaluated as important and feasible (Heise and Theuvsen, 2017). Nevertheless, some differences remain for example in the question of space allowance (Heise and Theuvsen, 2017). This heterogeneity sheds light to a key driver of politics: *policy beliefs*. In fact, animal welfare is a complex concept including various issues assigned to health and physically functioning, natural living as well as affective states (Fraser, 2008). Thus, the relation between certain livestock policies and the outcomes are also complex. To cope with this complexity, non-professionals as well as politicians and agents of interest groups apply naive mental models, i.e. policy beliefs. Especially beliefs of voters and experts tend to differ (Caplan, 2002). In a worst case, biased beliefs (Akerlof, 1989) may cause political failure (Caplan, 2001). If a policy position is based on biased beliefs, the policy will be ineffective and the outcome will be biased. Therefore, policy beliefs are a critical part of politics, opening the door for informational lobbying (Henning et al., 2019). How this mechanism works in German livestock politics is unknown, yet. Hence, it would be interesting to investigate the communicational influence patterns within livestock policy.

Regarding the legal framework of animal husbandry, several issues are in the focus of debate. Beside improving some detailed husbandry specifications, e.g. space per animal or playing material in the stable, new legislative and regulatory projects are on the political agenda.

One of them is the collective right of action for animal protection groups. In general, the German law system requires that plaintiffs' subjective rights are violated. Therefore, it does not consider such a popular action (Schürmeier, 2017). Nevertheless, in the area of environmental law a right of collective action exists at federal level. For animal protection, the federal legislator as well as the states have the right to implement a corresponding law (Kloepfer, 2016). Indeed, 7 of 16 states implemented such a regulatory framework, which leads to heterogeneity and therefore could challenge

legal certainty (Rossi, 2016).

The second issue is a standardized testing and approval procedure for mass-produced livestock facilities. This refers to the idea that public agencies only allow mass produced facilities which pass standardized tests before. Among these facilities are for example feeding systems, watering facilities or flooring (Gauly et al., 2006). Approval standards are defined by animal protection regulations and current scientific and technological knowledge (BMEL, 2017). A corresponding bylaw is part of the recent coalition agreement (CDU et al., 2018) as well as farm animal husbandry strategy provided by the ministry for food and agriculture (BMEL, 2017).

Third, there is the question of a validation of competence regarding animal husbandry. The scientific council of agricultural policy recommends the introduction for all areas[1] of husbandry (WBA, 2015). In particular, this certificate might serve as an instrument for employees in agriculture without formal training. Accordingly, the German farm animal husbandry strategy includes such a validation (BMEL, 2017).

Another topic affects the transport of living animals. Back in the beginning of 2019, two German states (Schleswig-Holstein and Hesse) restricted and/or (temporarily) banned the transport of living animals in countries outside the European Union (EU). This bans were discussed not only in agricultural (see for example agrarheute.com, 2019; topagrar.com, 2019), but also mass media (see for example FAZ, 2019; ndr.de, 2019). Indeed, animal protection groups call for a ban of transport of living animals in non-EU member states (Bündnis für Tierschutzpolitik, 2017). One reason, among others, is that the duration of transports is very high. Hence, it would be interesting to see how communication patterns affect the policy positions of stakeholders in these four selected issues.

Our paper contributes to the literature in two ways. First, we quantify the structures of belief formation in livestock policy empirically. This promotes a better understanding of political processes in farm animal policy. Therefore we use an established social network approach (Stark, 2017; Henning and Hedtrich, 2018; Henning et al., 2019). We show the effect of these structures by applying the network model on the evaluation of the four mentioned policies. The latter are taken as the initial beliefs of selected influential stakeholder organizations. Second, we test the robustness of the model's results. Therefore we use a Bayesian approach of exponential random graph models (ERGM). We use the estimation results to simulate 10,000 networks and apply the model of informational lobbying for each of the network configurations.

[1] So far, this instrument has only been used for the husbandry of broiler chickens.

This paper is structured as follows. The next section will briefly describe a model of belief updating within a political participation framework. Subsequently, we give an overview about the data used for application. Main results are then shown in section 7.4. We end with a conclusion.

## 7.2 Theoretical Framework

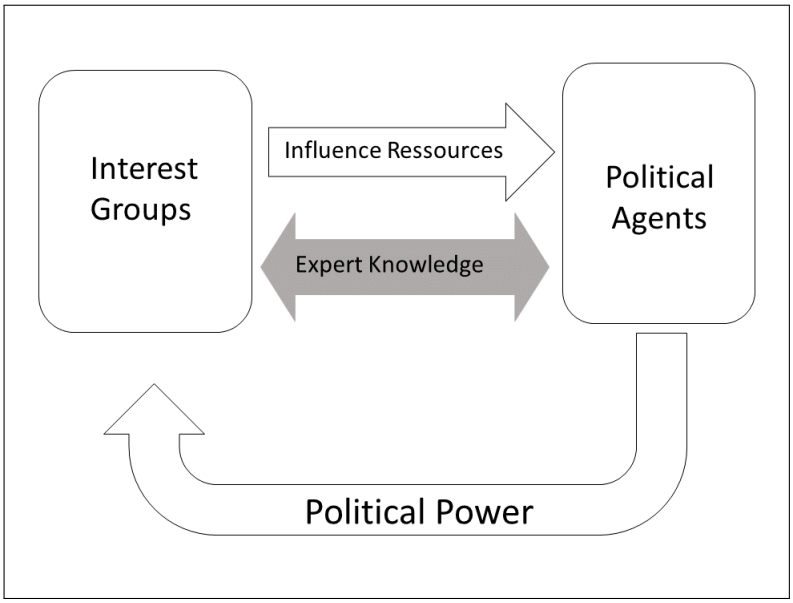
The theoretical backbone of our analysis is the framework of informational lobbying as suggested by Henning et al. (2019). In particular, interest groups use two influence mechanisms: classical (i.e. vote buying) and communicational lobbying. The former refers to traditional interest group theory "where politicians seeking reelection grant political favors to particular interest groups in exchange for political support" (Henning et al., 2019, p. 79).

Interest groups are associations of citizens from certain socio-economic groups. They seek for power in order to influence political agents (Olson, 1965; Henning, 2000). Hence, there is an exchange of influence resources and votes between interest groups and political agents (Grossman, 1994). This exchange leads to a power outflow from political agents to interest groups as illustrated in figure 7.1. Accordingly, political agents have to weight up between voters' and special interest groups' support before announcing a policy position (Brock and Magee, 1978; Grossman and Helpman, 1996). This corresponds to the formal (network based) model of Pappi and Henning (1998, 1999) as well as Henning (2009).

Communicational (or informational) lobbying serves as a complement to the approach sketched above. It refers to the idea that political actors as well as laymen apply simple mental models to reduce real world complexity. In particular, these *policy beliefs* map the relation between a policy $\gamma$ and the intended outcome $z$, i.e. the political technology. A mechanism that is also embedded in a network structure is communication learning (Acemoglu and Ozdaglar, 2010). Since agents are only imperfectly informed about the political technology, they are interested in a collective communication process in order to update their beliefs. As the two-headed arrow in figure 7.1 indicates, exchange of expert knowledge takes place from interest groups to political agents and vice versa. Moreover, political agents may provide knowledge for other political agents. The same applies for interest groups.

To formalize this framework of belief updating, consider a set N of $i = 1, 2, ..., n$ stakeholders. Moreover, let $a_i$ denote actor $i$'s belief regarding $T(\gamma, z)$. The communication takes place in a social network which is

Figure 7.1: Political Process Framework




Source: Own simplified illustration based on Henning et al. (2019)

represented in the adjacency matrix **M** where element $m_{ij} > 0$ implies a communication tie between agents $i$ and $j$. Normalizing this network matrix leads to the stochastic matrix $\bar{\mathbf{M}}$ where $\sum_j \hat{m}_{ij} = 1$. Accordingly, $\hat{m}_{ij}$ gives the trust actor $i$ places on the current belief of agent $j$. Furthermore, actors' own-control is needed. Own control refers to the extend that actors put on their own knowledge, i.e. the initial beliefs. Let $\Omega$ denote the according diagonal matrix, where the corresponding element $\omega_i$ gives the own control value of actor $i$. Hence,

$$\hat{M} = [\mathbf{I} - (\mathbf{I} - \Omega)\bar{\mathbf{M}}]^{-1}\mathbf{\Omega} \tag{7.1}$$

corresponds the multiplier matrix. Its element $\hat{m}_{ij}$ describes the multiplier effect, i.e. the effect of $j's$ initial belief on $i's$ final belief. Finally, we can apply the multiplier on the $n \times k$ matrix[2] $\mathbf{A^0}$:

$$\tilde{A} = \hat{M}\tilde{A}^0. \tag{7.2}$$

The resulting Matrix $\tilde{\mathbf{A}}$ is the $n \times k$ matrix of the stationary points of the final beliefs. This procedure of belief updating in general corresponds the work of Friedkin and Johnsen (1990, 1997). Our model is applied to the data described in the next section.

[2]Here $k$ refers to the $k = 1, 2, ...K$ beliefs

## 7.3 Empirical Specification

Data are part of an elite network survey conducted from September 2017 until October 2018. In total, 37 interviews with representatives of stakeholder organizations were conducted. Among them are parliamentary groups, federal agencies as well as various interest groups involved in German livestock politics. Before starting an interview, the interviewers emphasized that the position of the organization and not the own position were of interest. A standardized questionnaire was used consisting of questions regarding

- the political profile,
- animal welfare assessment and evaluation,
- several livestock policy positions and
- social networks.

The desk research before the starting round of interviews was complemented by the intermediate results of the reputation network question. This snowball sampling was applied in order to filter out the most important actors. On average, interview duration was 1.5 hours. Note that one organization did not complete the interview. Hence, we end up with a data base of 36 actors. After describing network data in particular, we outline the general econometric model of the network generating process and possible determinants of tie creation.

### 7.3.1 Network Data

Backbone of this study is a confirmed communication network. We followed previous studies (Pappi et al., 1995; Henning et al., 2019) in order to ensure that the real connections are measured. In particular, communication ties were asked from a *sender* as well as a *receiver* perspective. The former refers to the question to whom an actor sends informations, while the latter refers to the question from whom an actor gets expert information. Overall, the result is a confirmed network with the corresponding matrix **M**. Hence,

$$m_{ij} = \left\{ \begin{array}{l} 1 \text{ if tie from i to j} \\ 0 \text{ if no tie from i to j} \end{array} \right\}. \tag{7.3}$$

Self ties are not allowed. Therefore, the diagonal of **M** is set to zero.

Network boundaries were specified by using a reputation network: Actors marked the organizations which they perceive as influential actor in politics. Given the corresponding socio matrix G, $g_{ij}$ corresponds to the answer of $i$ that actor $j$ is an influential organization. Indegree centrality is used as reputation measurement:

$$d_j = \sum_j g_{ij} \forall i \neq j \tag{7.4}$$

An actor $j$ is not part of the network if $d_j = 0$. Since one of the interviewed actors was not marked as influential, the final dataset consists of 35 actors, each assigned to one of eleven groups (table 7.1).

Table 7.1: Actor groups

| **Group** | **No.** | **Description** | **Frequency** |
|---|---|---|---|
| Agric_Animal | 1 | Agriculture and Animal Production | 7 |
| AniProt | 2 | Animal Protection | 3 |
| ConsProt | 3 | Consumer Protection | 2 |
| EcoAgric | 4 | Ecological Agriculture | 2 |
| EggMilk | 5 | Egg and Milk Industry | 1 |
| EnvProt | 6 | Environment Protection | 2 |
| Food | 7 | Food Retail | 5 |
| Meat | 8 | Meat Industry | 3 |
| ParlGroup | 9 | Parliamentary Groups | 6 |
| PubAdmin | 10 | Public Administration | 3 |
| Research | 11 | Research Institutes and Organizations | 1 |

Source: Own presentation.

The policy positions are measured using the following variables:

- *CollectiveAction*: the right for collective action regarding legal affairs of animal protection/welfare
- *TestAppMPLS*: standardized testing and approval procedure for mass-produced livestock facilities in the area of pig husbandry
- *CertificateHusbandry*: a certificate about knowledge in the area of husbandry
- *BanThirdCountries*: a ban of living animal transports in countries not being part of the EU

All of these four policies had to be evaluated with a scale from 1 ("not useful at all") to 5 ("very useful"). Please note that we emphasised for every corresponding question that we were asking for the ideal position. Possible factors influencing tie creation are presented in the following.

### 7.3.2 Econometric Model

In particular, our econometric model follows Henning et al. (2019). Hence, we make use of an ERGM (Wasserman and Pattison, 1996; Snijders et al., 2006) in a Bayesian framework. Using a priori defined network statistics, ERGMs are able to represent the structure of networks and the according drivers. Beyond endogenous variables, they allow to consider exogenous variables.

Given a $n \times n$ adjacency matrix $\mathbf{y}$ on a set of $n$ actors, $y_{ij} = 1$ indicates that there is a directed tie from $i$ to $j$. If $y_{ij} = 0$ there is no tie. Note that self ties are not allowed, hence $y_{ii} = 0$. Moreover, $s(y, X)$ describes a vector of network statistics containing endogenous as well as exogenous covariates. The latter are denoted by $X$ and consist of attributes at edge and node level. They enter the model either as $\sum_j (\sum_i y_{ij}) X_j$, $\sum_j (\sum_i y_{ji}) X_j$ for edge attributes or $\sum_i \sum_j y_{ij} X_{ij}$ for nodal attributes. Hence,

$$\Pr(y|X) = \frac{\exp\{\theta s(y, X)\}}{\sum_{\tilde{y} \in \mathcal{Y}} \exp\{\theta s(\tilde{y}, X)\}}, \tag{7.5}$$

corresponds ERGM's probability density function with $\theta = (\theta_1, \ldots, \theta_Q)$. Moreover, $\sum_{\tilde{y} \in \mathcal{Y}} \exp\{\theta s(\tilde{y}, X)\}$ corresponds the normalizing constant summing over all possible network configurations denoted as $\mathcal{Y}$. Hence, we ensure 7.5 being a probability distribution. However, parameter estimation in ERGM framework comes as a challenge, since the normalizing constant is intractable even for networks of moderate size. This is due to the fact that there is an enormous number of possible realizations in $\mathcal{Y}$. Following the literature (see Snijders, 2002; Hunter and Handcock, 2006), Henning et al. (2019) suggest Bayesian estimation using Markov Chain Monte Carlo (MCMC) techniques, to handle this problem. Accordingly, estimated parameters appear as sample moments for a sample which is drawn from the posterior distribution. Using this approach, we are able to provide statistical inference on the derived measures of communicational lobbying sketched in section 7.2. In particular, we draw a sample of 10,000 networks and then recalculate 7.1 as well as 7.2 for each of these networks.

Regarding the parameter interpretation, we also make use of marginal effects (see Henning et al., 2019, 83-84) by first rewriting equation (7.5) as a conditional logit (see Goodreau et al., 2009; Cranmer and Desmarais, 2011):

$$\ln\left[\frac{\mathsf{Pr}(y_{ij}=1,Y_{ij}^{C}|X)}{\mathsf{Pr}(y_{ij}=0,Y_{ij}^{C}|X)}\right]=\theta\delta(y_{ij},Y_{ij}^{C},X). \tag{7.6}$$

Note that $Y_{ij}^{C}$ denotes all dyads other than $y_{ij}$. Moreover, $\delta(y_{ij},Y_{ij}^{C},X)$ denotes the vector of changes in the sufficient statistics when $y_{ij}$ changes from 0 to 1. Hence,

$$\begin{aligned}\mathsf{Pr}(y_{ij}=1|Y_{ij}^{C},X) &= \frac{\mathsf{Pr}(y_{ij}=1,Y_{ij}^{C}|X)}{\mathsf{Pr}(y_{ij}=0,Y_{ij}^{C}|X)+\mathsf{Pr}(y_{ij}=1,Y_{ij}^{C}|X)}\\ &= \frac{\exp\{\theta\delta(y_{ij},Y_{ij}^{C},X)\}}{1+\exp\{\theta\delta(y_{ij},Y_{ij}^{C},X)\}}.\end{aligned} \tag{7.7}$$

Since we are also interested in relative importance of different endogenous and exogenous variables, we then quantify the effects on the probability given in 7.7 resulting from changes in $\delta(y_{ij},Y_{ij}^{C},X)$. Corresponding marginal effects are calculated by

$$\frac{\partial\mathsf{Pr}(y_{ij}=1|Y_{ij}^{C},X)}{\partial\delta(y_{ij},Y_{ij}^{C},X)}=\mathsf{Pr}(y_{ij}=1|Y_{ij}^{C},X)(1-\mathsf{Pr}(y_{ij}=1|Y_{ij}^{C},X))\theta. \tag{7.8}$$

The individual marginal effects are locally defined. Hence, they depend on all network statistics, as they are derived as partial derivatives at a specific point (Henning et al., 2019).

### 7.3.3 Endogenous and exogenous variables for the econometric model

As sketched up above, endogenous as well as exogenous variables might influence tie formation, i.e. the network generating process. The first endogenous variable that we use is *edges*. It equals the number of edges in the network and represents general propensity of tie formation:

$$E(y)=\sum_{i<j}y_{ij}. \tag{7.9}$$

We also add a statistic for mutuality (*mutual*), which corresponds to the number of actor pairs where actor $i$ sends and receive ties to and from $j$, hence $y_{ij}=y_{ji}=1$.

$$H(y)=\sum_{i<j}y_{ij}y_{ji} \tag{7.10}$$

With *twopath* we take into account directed paths from actor $i$ to $j$ via $k$ ($i > k > j$). Two additional statistics used are the geometrically weighted dyadwise shared partner distribution (*gwdsp*) and the geometrically weighted edgewise shared partner distribution (*gwesp*) (Goodreau, 2007; Hunter, 2007; Morris et al., 2008). The *gwdsp* measure captures the propensity of any linked or not linked dyad to have multiple transitive shared partners (Leifeld and Schneider, 2012). Moreover, *gwesp* counts the triangles in the network as well as considering the ties being part of multiple triangles. Positive parameters for *gwesp* indicate triadic closure in the network. If both, *gwesp* as well as *gwdsp* are included in a model, the latter corresponds to the base effect isolating the effect for not tied dyads only (Henning et al., 2019). The former then isolates the effect for those dyads which are directly linked.

Additionally, we added several exogenous attributes at edge and node level which are presented in table 7.2.

Table 7.2: Exogenous variables for ERGM

| Level | Attribute | | Meaning |
|---|---|---|---|
| Node | Group | | Actor group |
| | | 1 | Agric_Animal |
| | | 2 | AniProt |
| | | 9 | ParlGroup |
| | | 10 | PubAdmin |
| | Reputation | | Reputation of an actor |
| | ExternalKnowledge | | 1 - own-control |
| Edge | Z_CONSUMER | | Euclidean distance: Importance consumer welfare |
| | Z_FAW | | Euclidean distance: Importance animal welfare |
| | Z_PRODUCER | | Euclidean distance: Importance producer welfare |
| | soc.nw | | Informal relation network tie |

Source: Own presentation.

Using actor group assignments (see again table 7.1), we check whether a tie is more likely to be created when both, actor $i$ and $j$ are part of the same group. Furthermore, we expect parliamentary groups as well as public administration to be demander of knowledge. Hence, we add additional parameters for main effects of factor attribute *Group* for legislative as well as executive actors, i.e. groups 9 and 10 (see table 7.1). Moreovoer, we control for group assingment to groups 1 and 2 at the sender and the receiver stage of a tie. *Reputation* is a node's attribute that corresponds to the indegree-measurement presented in equation 7.4. In particular, we add two statistics: one for the reputation of the sender and one for the reputation of the receiver of information. With *ExternalKnowledge* we take into account the openness for external knowledge of an actor. This term is added for receiver side of a tie and equals $1 - \omega_i$ (see again equation 7.1 from theoretical framework). At the edge level, we take into account political preference homophily. Since farm animal welfare affects consumers' welfare[3] the term *Z_CONSUMER* corresponds to the euclidean distance between the actors regarding the importance of consumers' welfare. We add a corresponding statistic which equals the sum of edges' distance values. Additionally, *Z_FAW* is the distance regarding importance of farm animal welfare. Furthermore, we also add a statistic for the importance of producers' welfare (Z_PRODUCER) since animal welfare improvements have consequences for producers[4]. The last attribute added is *soc.nw* which corresponds to a network of informal social relations. Hence, the term describes whether there is an edge in the social relation network as well as the communication network.

All steps of analysis were performed using *R* with packages *Bergm* (Caimo and Friel, 2014) and *ergm* (Hunter et al., 2008) for estimation as well as *tidyverse* (Wickham et al., 2019) and *ggthemes* (Arnold, 2019) for post-estimation analysis.

## 7.4 Results

This section provides the results of our study. We first show the most important properties of the realised network according the expert interviews as well as the corresponding multiplier results. Subsequently, we present

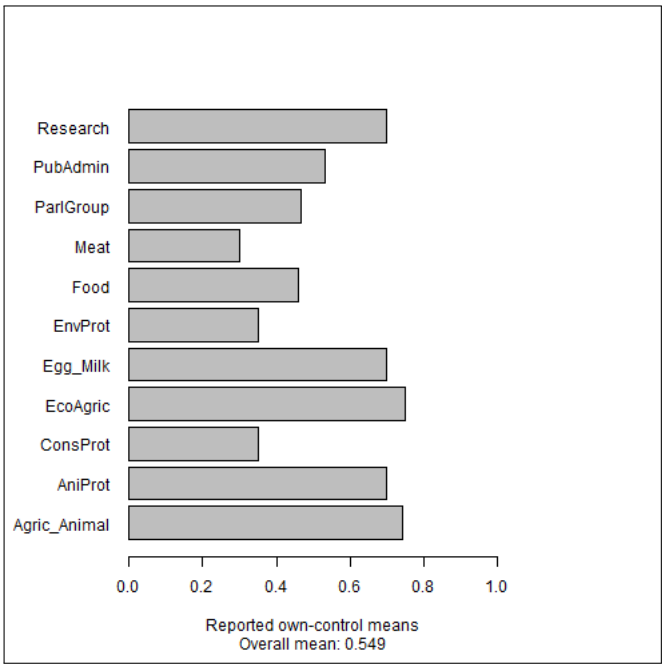
[3] For example higher prices for animal based products due to higher costs of production or well-being from the fact that animals are held under better conditions.

[4] For example, Henningsen et al. (2018) show a weak positive relation between economic performance and animal welfare which might stem from good farm management.

the outcomes of our econometric model as well as the belief changes, i.e. we compare realised network based with simulation based results.

The confirmed expert communication network has a density of 0.266 (figure 7.11). Hence, more than 26 percent of possible ties are established. One parliamentary group, one public agency and one food retail organization in the network do not send expert information, but only receive knowledge. This network serves as the basis for our multiplier model. Since the own-control is a key element of multiplier calculation, figure 7.2 presents corresponding mean values at the group level. As one can easily see, *Agric_Animal* on average has the highest own-control value (0.743), followed by ecological agriculture (figure 7.2). Other group means above the full sample average (i.e. 0.549) are observed for *AniProt*, *Egg_Milk* and *Research*. All other groups reported own-control values lower than overall mean. Please note that the meat sector is the most open to external expertise (average own-control: 0.3, figure 7.2).

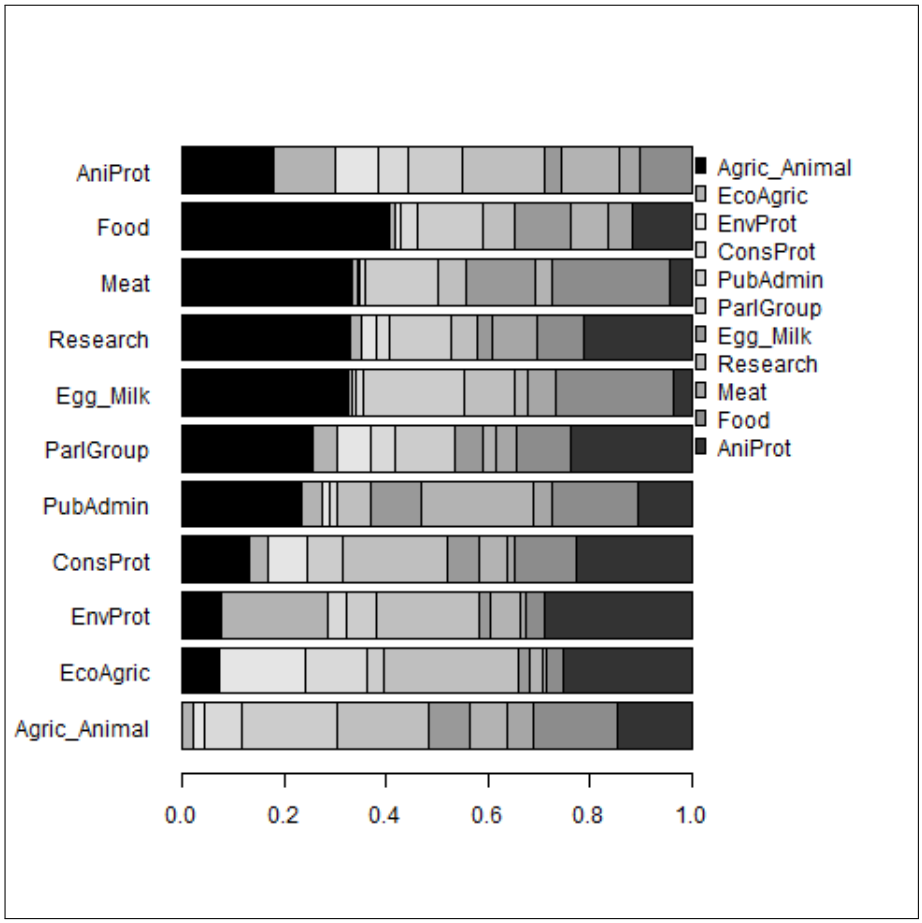
Figure 7.2: Reported own control mean at group level




Source: Own presentation.

Results of the multiplier model have been aggregated at the group level and were subsequently normalized to the share of external knowledge. Hence, own control is cancelled out.

Figure 7.3: Aggregated communication multiplier




Source: Own presentation.

As figure 7.1 shows, *Agric_Animal* is a very dominant group when it comes to belief formation. In particular, members of this group tend to influence 0.407 of food retailers' external knowledge. Note also that shares on *Meats*'s, *Researchs*'s and *Egg_Milk*'s external knowledge are roughly the same. However, civic society organizations are mainly influenced by animal protection organizations. Animal protectors drive 28.7 percent of external knowledge influencing environmental groups, the value for consumer protection corresponds to 22.7 percent (figure 7.3). With regard to the political agents, we see that parliamentary groups are mainly influenced by *Agric_Animal* (0.257) and *AniProt* (0.236, figure 7.3). Interestingly, these legislative actors not only serve as knowledge demander, but also provide information. Furthermore, they have the highest share on external knowledge influencing ecological agriculture (see again figure 7.3).

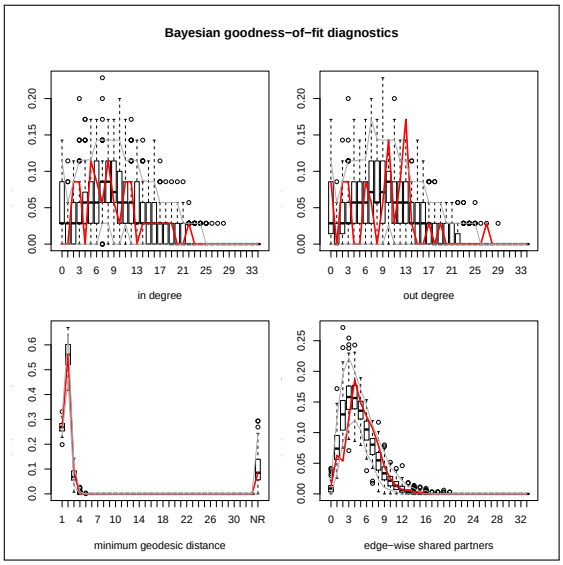
In the following we describe the results of our econometric model that drives this influence patterns. All in all, we specified and estimated ten different models. While Model 1 is a purely endogenous one, the Models 2-6 are exogenous specifications. Among the latter, Model 5 is a "preference only" model that only includes actors' preferences. Models 7-10 combine both, endogenous as well as exogenous variables, where Model 7 is the "full model" including all endogenous and exogenous variables. We report model fit criteria in table 7.3 which are based on likelihood. As one can easily see, Model 9 delivers the lowest AIC as well as the lowest BIC. Hence, this model seem to fit best our data. This is also suggested by

Table 7.3: Model fit criteria

| | **Log. Likelihood** | **AIC** | **BIC** |
|---|---|---|---|
| *Model 1* | -654.69 | 1319.38 | 1344.789 |
| *Model 2* | -699.382 | 1414.763 | 1455.417 |
| *Model 3* | -669.625 | 1359.25 | 1410.067 |
| *Model 4* | -637.019 | 1296.039 | 1351.938 |
| *Model 5* | -691.193 | 1388.385 | 1403.631 |
| *Model 6* | -545.019 | 1118.038 | 1189.182 |
| *Model 7* | -440.314 | 918.627 | 1015.18 |
| *Model 8* | -428.587 | 889.175 | 970.482 |
| *Model 9* | -429.398 | 886.796 | 957.94 |
| *Model 10* | -434.163 | 892.326 | 953.307 |

Bayesian goodness of fit measures (Caimo and Friel, 2014) presented in figure 7.4

Figure 7.4: Goodness of Fit for Model 9




Source: Own presentation.

The corresponding estimation results are given in table 7.4. While *edges* has a significant negative impact, mutuality has a positive parameter (table 7.4). Please note that *twopath* is also positive, but in contrast not significant. Parameter for *gwesp* is significant and *gwdsp* is negative (both are significant). This can be interpreted in the sense that stakeholder organizations rely on others. The aim is to reduce transaction costs through finding trustworthy sources of knowledge. With regard to nodal attributes one can easily see that tie creation is more likely if the sender is an actor of *Agric_Animal* or *AniProt* (table 7.4). Moreover, ties are more likely to be created if the target is a political actor, i.e. parliamentary group or public administration. This fits the theoretical assumption that especially political agents seek for knowledge. Part of the exogenous nodal attributes is the homophily measurement of group assignment. Looking at the estimation results, it becomes clear that tie creation probability increases if two actors belong to the same group (table 7.4). Related to that we see a positive effect of edge attribute *soc.nw*: If actors know each other and have an informal relation, it increases probability of knowledge exchange. Furthermore, *Reputation* has a significant positive parameter for both, senders and receivers. Additionally, the amount a possible receiver relies on external knowledge positively influences creation of ties (table 7.4).

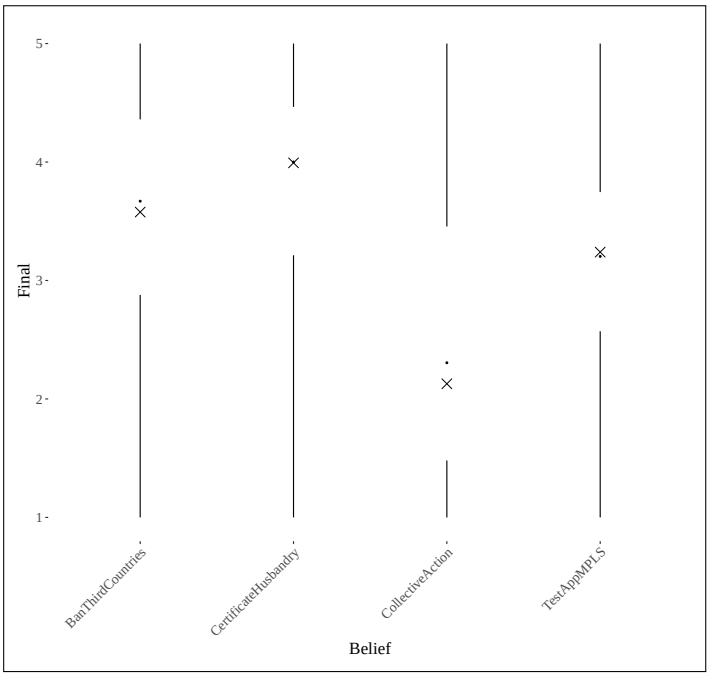
Based on these econometric results we simulated 10,000 network configurations. For each of these simulations we applied the model presented

Table 7.4: Estimation results for best fit model. Source: Own presentation.

| | **Communication Network** |
|---|---|
| *edges* | -6.327 *** |
| | (0.477) |
| *mutual* | 3.113 *** |
| | (0.21) |
| *twopath* | 0.015 |
| | (0.019) |
| *gwesp* | 1.291 *** |
| | (0.342) |
| *gwdsp* | -0.064 * |
| | (0.029) |
| *Factor (out): Agric_Animal* | 0.326 * |
| | (0.196) |
| *Factor (out): AniProt* | 0.678 *** |
| | (0.276) |
| *Factor (in): ParlGroup* | 0.873 *** |
| | (0.213) |
| *Factor (in): PubAdmin* | 0.509 ** |
| | (0.298) |
| *Homophily: Group* | 0.32 * |
| | (0.228) |
| *edgecov.soc.nw* | 1.478 *** |
| | (0.178) |
| *node (out) Reputation* | 0.043 *** |
| | (0.012) |
| *node (in) Reputation* | 0.037 *** |
| | (0.012) |
| *node (in) ExternalKnowledge* | 0.622 * |
| | (0.348) |

in equation 7.2. Table 7.5 presents descriptive statistics of the initial belief variables. They enter the matrix $A^0$ according equation 7.2. First, we take a look at the overall sample values for all belief variables. As figure 7.5 shows, the average final belief is always lower than initial beliefs reported in table 7.5.

Figure 7.5: Final belief values based on simulation and realised network (cross)

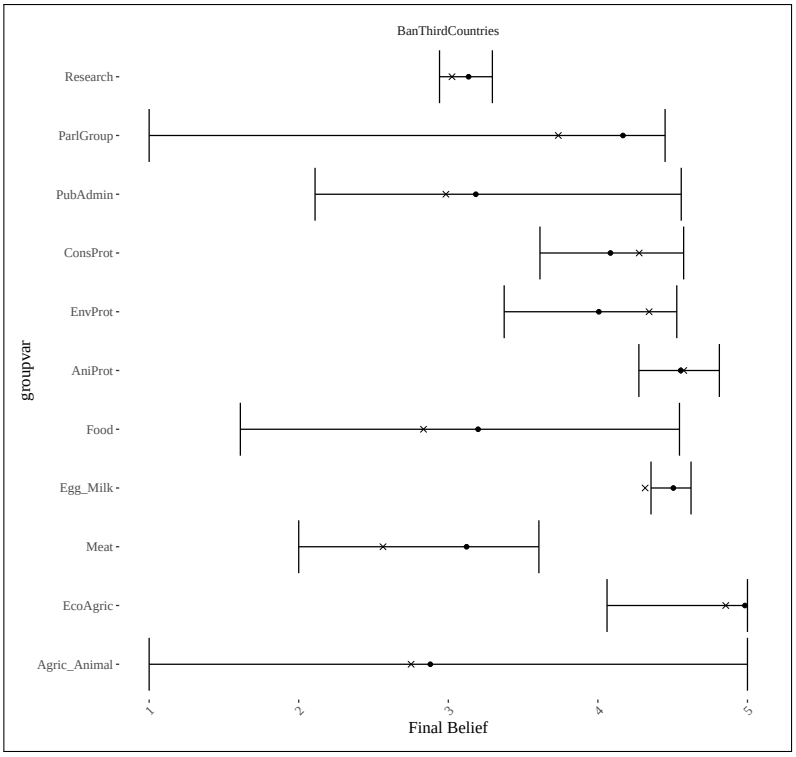



Source: Own presentation.

Please note that the sample median for *CertificateHusbandry* based on the interview data perfectly matches the median of the simulated final beliefs. Additionally, also medians for *TestAppMPLS* match nearly perfectly. As the cross indicates in figure 7.5, the realised network based value is only slightly higher than simulations' median. For *BanThirdCountries* and *CollectiveAction* we see that simulations' median is always higher than the median of the interview based belief values (figure 7.5).

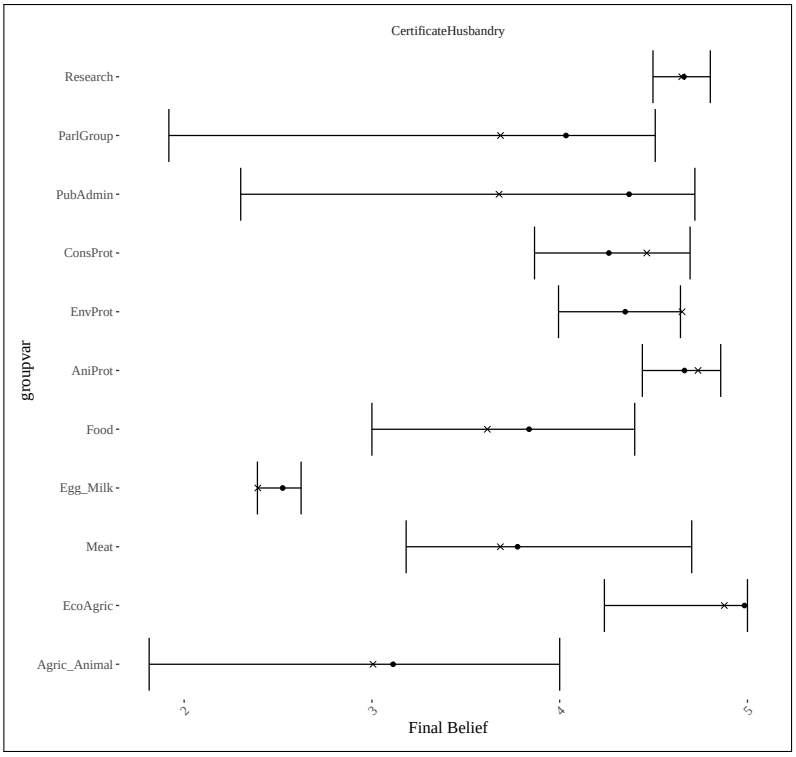
Figures 7.6-7.9 show the group means for all four belief variables. In particular, they show the means of simulated beliefs with the 0.95 confidence intervals as well as the mean from the realised data. They allow us to test significance of the latter.

Figure 7.6: Group means for *BanThirdCountries* due to simulation (point) and interview based network (cross) with 0.95 confidence intervals



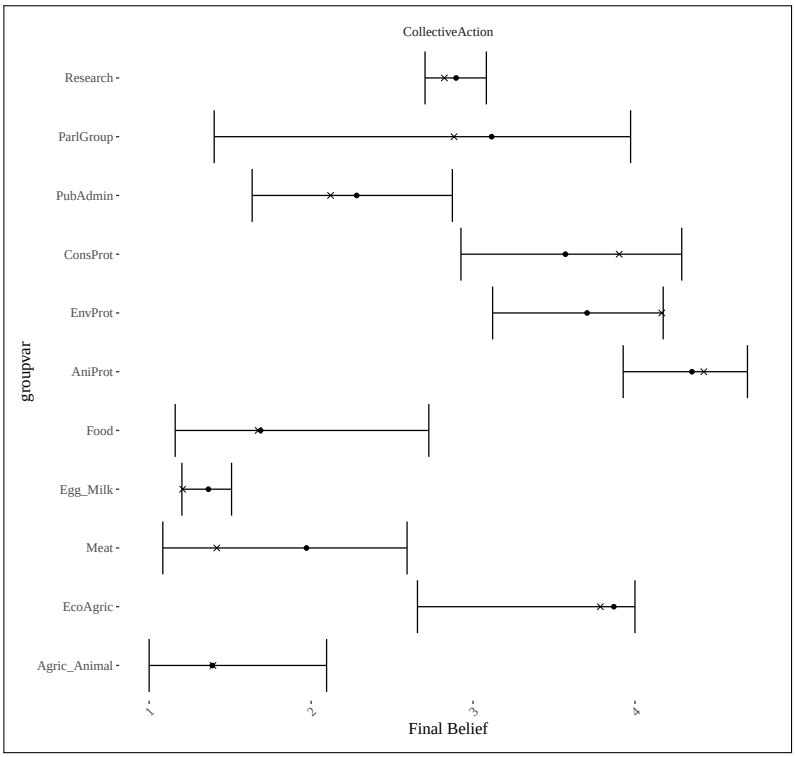

Source: Own presentation.

Figure 7.7: Group means for *CertificateHusbandry* due to simulation (point) and interview based network (cross) with 0.95 confidence intervals



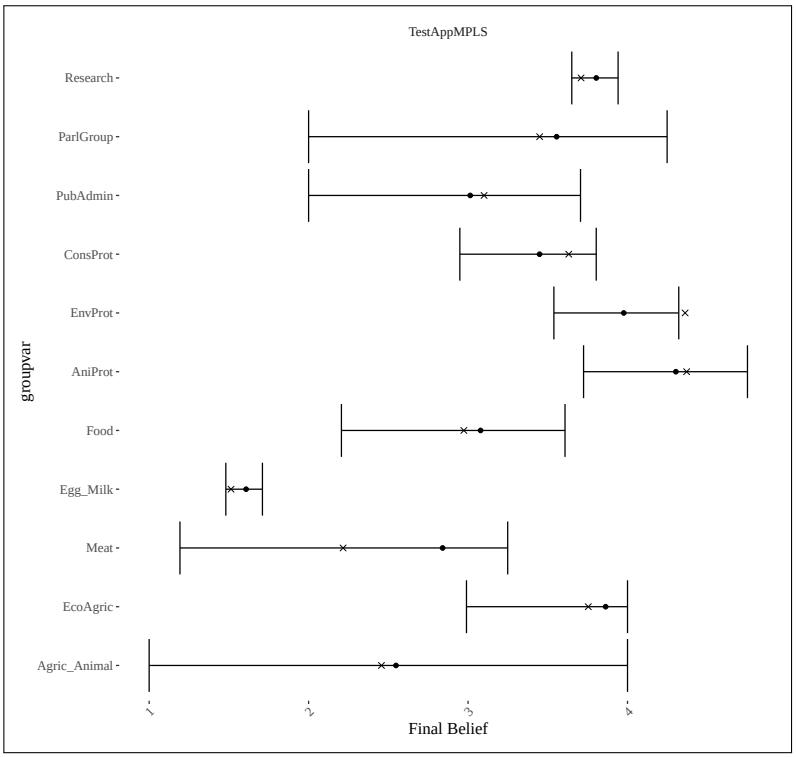

Source: Own presentation.

Figure 7.8: Group means for *CollectiveAction* due to simulation (point) and interview based network (cross) with 0.95 confidence intervals




Source: Own presentation.

Figure 7.9: Group means for *TestAppMPLS* due to simulation (point) and interview based network (cross) with 0.95 confidence intervals

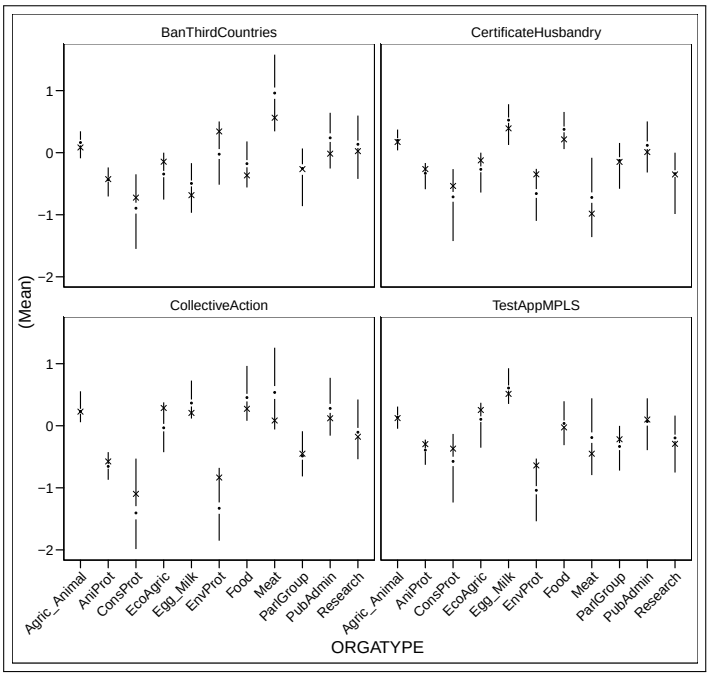



Source: Own presentation.

Note that the realised network based final belief mean of *CollectiveAction* perfectly matches the simulation based mean in Group *Agric_Animal* (figure 7.8). Only few measures lay out of the 0.95 confidence interval, i.e. indicating that the mean of calculated values based on interview data are not significant. This applies for the average evaluation of *BanThirdCountries* after communication proecess(es): The group mean of *Egg_Milk* is placed outside the lower confidence interval border (figure 7.6). Moreover, environment protectors' group mean for *CertificateHusbandry* is located outside the upper 0.95 interval (figure 7.7). Regarding *TestAppMPLS*, the mean in group *EnvProt* is higher than the upper border of the confidence interval, i.e. indicating non significant measure.

Additionally, we calculated the delta group means for each of the 10,000 simulations. Delta corresponds $\tilde{A}_k - A_k^0$ where $k$ denotes the simulated network with its multipliers. It allows us to demonstrate which groups react sensitive to communication networks. Figure 7.10 shows distribution of the delta group means.

Figure 7.10: Delta of group means for 10,000 simulations and realised network based (cross) belief change




Source: Own presentation.

As one can see, distributions for groups with higher own control (see again figure 7.2) are wider than those for groups with a lower own control. Moreover, we see that the direction of group deltas is not the same for all simulated networks. For each belief the distributions of some group means cross the threshold of 0 in both directions. There is one group, where this applies for each belief: the public administration. It is also striking that most of all the mean distributions that exceed zero in both directions concern the beliefs that groups initially rated with values close to three, i.e. seem to be indifferent.

## 7.5 Conclusion

Farm animal welfare is a very important issue in Germany. This is especially true for the legal and regulatory framework. Discussions revolve not only around the right for collective action or testing procedures of mass produced facilities, but also around questions of training and transport. Due to the important role of stakeholders, we quantified their impact on

knowledge formation regarding four policy beliefs. The theoretical framework of our study is the network based theory of informational lobbying (Henning et al., 2019). In order to check robustness of our empirical basis, we used Bayesian ERGM to identify drivers of the network generating process and subsequently simulated 10,000 networks based on estimated results.

Our results imply that in the realised network agricultural producers are the main drivers of expert knowledge in German livestock politics. Animal protection organizations seem to be their counterparts when it comes to knowledge communication: Especially consumer and environment protectors, ecological agriculture as well as (part of) the parliamentary floor seem to be strongly influenced by animal protection. This is mirrored by estimation results which show significant positive impact if a sender of a tie belongs to *Agric_Animal* or *AniProt*. Moreover, coefficients for political agent groups as knowledge demander are also positive, confirming that legislative actors as well as executive branch seek for expert information.

Regarding policy beliefs, we could show that in general the belief changes based on realised network data correspond simulated values. This is especially true for the certificate of animal husbandry as well as the standardized testing and approval procedure: Here the means are nearly perfectly matched. Hence, empirical data capture the simulated values. At a group level, only few means of the final beliefs are not significant. Hence, we assume the interview based results to be robust.

Note that we could show that all of public administration's deltas per simulation vary in their direction. It seems that depending on the network configuration this group is easy to move. Considering the role of public administration in German livestock policy, this finding is of particular interest: Much regulations in the sector appear as by-laws, issued by the federal ministry for agriculture[5]. Hence, worthwhile targets of influence are the public agencies. In general, delta results showed that groups that evaluate a policy with a neutral 3 are groups that can be moved in both directions. Comparing the range of delta means per group per simulation with the reported own control, i.e. the weight that organizations put on their own knowledge, we showed that range is wider for low own-control groups. This clearly follows from the model itself, but emphasizes a general problem: How to convince actors that don't want to be convinced? For example, conventional as well as ecological producer organizations heavily rely on own knowledge. Positions contrary to their own, even if

[5]For example, the minimum amount of space per animal in a stable is defined by the German farm animal husbandry decree.

they would lead to a more efficient policy, would cause their resistance. If we now look again on the group of public administration, we see that their own-control is slightly higher than 50 percent. Hence, they are more open to external knowledge. Clearly, as indicated by the findings mentioned above, the pitfall here is the network configuration. As already described, it determines the direction of position change in *PubAdmin*. If we now look at the influence patterns provided by multiplier results, we see that besides *Agric_Animal* (which is hard to convince and thus might provide biased policy knowledge), research has high influence. This comes as a "hope" for optimal policy decisions.

Regarding real world policy impact, we also found that at a stationary point only the right for collective action is negatively evaluated. Hence, we can conclude that stakeholder participation does not increase likelihood for this policy to be implemented soon. In contrast, a ban of living animal transport in third party countries, farmers' certificate of husbandry knowledge and a standardized testing and approval procedure for mass produced husbandry components are positive evaluated in the stationary point. But of course we do not predict that all policies are implemented since our study did not include classical lobbying. Here it would be interesting to see how the final policy position would look like if integrating political support (see Henning, 2009; Pappi and Henning, 1998) structures. This is a proposal to supplement this study. The application of a complete decision-making model (see Henning and Hedtrich, 2018) could show the outcome of the total participation of the stakeholders.

Finally, we want to point out limitations of our study, where the first one is due to the missing media actors. During the interviews, all participants stated communicational relations to media actors. But against all attempts, no media actors were willing to participate at the interviews. Hence, despite the important role of media coverage in the field of animal husbandry (Kayser et al., 2012; Grossarth, 2014), they could not be considered. This might lead to slight bias regarding the communicational structure. Second, there is only one research organization included. Of course, expert communication includes scientific knowledge and hence, all corresponding actors should be included in a corresponding survey. Indeed, we were able to conduct two interviews with research organizations. But since one of them did not answer the network questions, it could not be included in the social structure and therefore not considered for empirical investigation. Both limitations, missing media actors as well as small research group, therefore reflect a problem of social science in general: Conducting elite studies requires the full participation of relevant stakeholders. Nevertheless, our study contributes to a better understanding of German an-

imal welfare policy by providing a framework that allows us to measure influence beyond classical lobbying as well as showing that results of the approach are robust from a statistical point of view.

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# 7.A Appendix

Figure 7.11: Communication Network. Source: own presentation

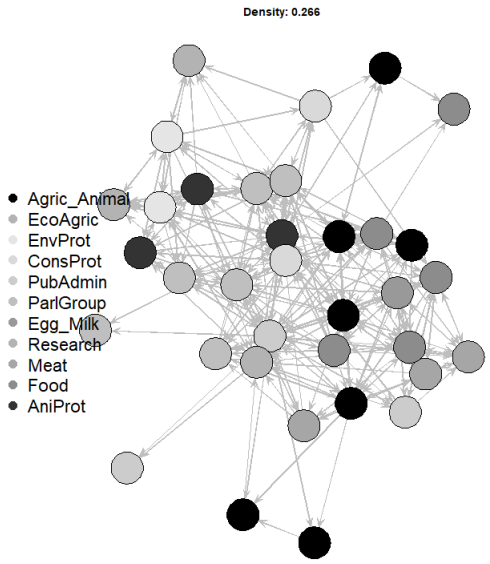

Table 7.5: Descriptive statistics for initial beliefs. Source: Own presentation.

| ORGATYPE | Belief | Min | Mean | Max | SD |
|---|---|---|---|---|---|
| *Agric_Animal* | *BanThirdCountries* | 1 | 2.667 | 5 | 1.380 |
| | *CertificateHusbandry* | 1 | 2.833 | 4 | 0.988 |
| | *CollectiveAction* | 1 | 1.167 | 2 | 0.345 |
| | *TestAppMPLS* | 1 | 2.333 | 4 | 1.024 |
| *AniProt* | *BanThirdCountries* | 5 | 5.000 | 5 | 0.000 |
| | *CertificateHusbandry* | 5 | 5.000 | 5 | 0.000 |
| | *CollectiveAction* | 5 | 5.000 | 5 | 0.000 |
| | *TestAppMPLS* | 4 | 4.667 | 5 | 0.471 |
| *ConsProt* | *BanThirdCountries* | 5 | 5.000 | 5 | 0.000 |
| | *CertificateHusbandry* | 5 | 5.000 | 5 | 0.000 |
| | *CollectiveAction* | 5 | 5.000 | 5 | 0.000 |
| | *TestAppMPLS* | 3 | 4.000 | 5 | 1.000 |
| *EcoAgric* | *BanThirdCountries* | 5 | 5.000 | 5 | 0.000 |
| | *CertificateHusbandry* | 5 | 5.000 | 5 | 0.000 |
| | *CollectiveAction* | 3 | 3.500 | 4 | 0.500 |
| | *TestAppMPLS* | 3 | 3.500 | 4 | 0.500 |
| *Egg_Milk* | *BanThirdCountries* | 5 | 5.000 | 5 | 0.000 |
| | *CertificateHusbandry* | 2 | 2.000 | 2 | 0.000 |
| | *CollectiveAction* | 1 | 1.000 | 1 | 0.000 |
| | *TestAppMPLS* | 1 | 1.000 | 1 | 0.000 |
| *EnvProt* | *BanThirdCountries* | 3 | 4.000 | 5 | 1.000 |
| | *CertificateHusbandry* | 5 | 5.000 | 5 | 0.000 |
| | *CollectiveAction* | 5 | 5.000 | 5 | 0.000 |
| | *TestAppMPLS* | 5 | 5.000 | 5 | 0.000 |
| *Food* | *BanThirdCountries* | 1 | 3.200 | 5 | 1.833 |
| | *CertificateHusbandry* | 1 | 3.400 | 5 | 1.356 |
| | *CollectiveAction* | 1 | 1.400 | 3 | 0.800 |
| | *TestAppMPLS* | 2 | 3.000 | 4 | 0.894 |
| *Meat* | *BanThirdCountries* | 1 | 2.000 | 3 | 0.817 |
| | *CertificateHusbandry* | 4 | 4.667 | 5 | 0.471 |
| | *CollectiveAction* | 1 | 1.333 | 2 | 0.471 |
| | *TestAppMPLS* | 1 | 2.667 | 4 | 1.247 |
| *ParlGroup* | *BanThirdCountries* | 1 | 4.000 | 5 | 1.528 |
| | *CertificateHusbandry* | 1 | 3.833 | 5 | 1.463 |
| | *CollectiveAction* | 1 | 3.333 | 5 | 1.795 |
| | *TestAppMPLS* | 2 | 3.667 | 5 | 1.247 |
| *PubAdmin* | *BanThirdCountries* | 1 | 3.000 | 5 | 1.633 |
| | *CertificateHusbandry* | 1 | 3.667 | 5 | 1.886 |
| | *CollectiveAction* | 1 | 2.000 | 3 | 0.817 |
| | *TestAppMPLS* | 2 | 3.000 | 4 | 0.817 |
| *Research* | *BanThirdCountries* | 3 | 3.000 | 3 | 0.000 |
| | *CertificateHusbandry* | 5 | 5.000 | 5 | 0.000 |
| | *CollectiveAction* | 3 | 3.000 | 3 | 0.000 |
| | *TestAppMPLS* | 4 | 4.000 | 4 | 0.000 |
| **Overall** | *BanThirdCountries* | 1 | 3.562 | 5 | 1.595 |
| | *CertificateHusbandry* | 1 | 3.910 | 5 | 1.384 |
| | *CollectiveAction* | 1 | 2.605 | 5 | 1.706 |
| | *TestAppMPLS* | 1 | 3.267 | 5 | 1.287 |

# Part III

# Concluding Remarks

# Chapter 8

# Conclusion

The aim of this work was to contribute to the research on the political economy of farm animal welfare. It addressed questions regarding animal welfare policy, considering voters' and stakeholders' beliefs. With regard to the voters, one has to state that animal welfare is not as important as climate protection or social policy when measured at the ballot box (chapter 2). But it clearly offsets issues like water protection or economic growth. Moreover, studies on the voters' WTP showed that the value of animal welfare is low when compared to education or security (chapter 3 and chapter 4). A second result of chapter 3 is that participants perceive climate regulation in the stable as well as space per animal as important animal welfare aspects. Hence, the corresponding WTP measurements are the highest. Moreover, there is a gap between people's private and collective WTP. The chapter 5 theoretically links voting behaviour with economic analysis. Here the aim was to quantify voters' beliefs regarding political technology of the three issues already discussed in chapter 2. The empirical part then tests for heterogeneity among voters. For climate protection significant differences were found due to gender. Additionally, voters of certain parties show a tendency to differ from others. Moreover, simulations could show that beliefs indeed move voters' policy positions.

Part II examined a stakeholder network structure where agriculture and animal production as well as animal protection groups are the key drivers of belief formation. This structure implies that stakeholders evaluate a standardized testing and approval procedure for mass-produced livestock facilities as rather useful (chapter 6). On the other hand, chapter 7 shows that the right for collective action is still evaluated as rather useless. Communication lowers the evaluations of animal husbandry knowledge certificate and banning living animal transports. But both policy beliefs remain still positive. In general, the measured empirical data capture the simulated values based on an ERGM. At group level, only few means of the final beliefs are not significant. Hence, the interview based results seem to be robust.

All in all, one can conclude that the role of policy beliefs matters for both, voters as well as stakeholder organizations. The latter are able to use politicians' uncertainty to influence the direction of political decisions. On the other hand, voters are strongly influenced by beliefs. Hence, if they apply biased beliefs and vote strongly policy oriented, basis democratic policy failure could occur if politicians put heavy weight on voters' support. In the following section I will critically discuss the single contributions before I give a general outlook.

## 8.1 Chapters

### 8.1.1 Ecological Voting in Germany? Animal Welfare, Climate and Water Protection as Drivers of Voting Behaviour

Ecological issues gained importance in the last decades. Hence, this essay contrasted animal welfare with climate protection as well as water protection. In order to quantify corresponding marginal effects, a probabilistic model of voting behaviour was used. The econometric backbone of the study is a nested multinomial logit model. We followed the suggestion of Thurner and Eymann (2000) since “non voting” has to be treated different to the parties. The derived marginal effects show that farm animal welfare is an important driver of voting behaviour, but also that climate protection and social policy are more important. Furthermore, we show that party loyalty still has the most important effect.

A possible limitation of the study occurs from the econometric model. In general, multinomial logit models assume that preferences are homogeneous regarding attributes and predictors. But since weights of policy issues might be heterogeneous among electorate, one should take this into account. Hence, maybe a latent class approach would be more appropriate. These kind of choice models allow to partition the electorate into subgroups (classes). Applications of these models in voting behaviour research can be found in Petri (2015) or Henning et al. (2018). The reason for not using this kind of models was that modelling of nested decision structures is not implemented, yet. Another issue to discuss is the comparability of the policy dimensions used. Climate protection is measured in $CO_2$ equivalent and water protection in N kg/ha. In contrast, farm animal welfare is expressed in governmental spending. Hence, money is compared to natural measurements.

### 8.1.2 The Price for Happy Pigs: Private and Collective Willingness to Pay for Animal Welfare in Germany & About Bus Drivers and Happy Pigs: Collective and Private Willingness to Pay for Animal Welfare

These chapters dealt with financing increased animal husbandry standards. We suggested a framework of modelling the public provision of

animal welfare at the theoretical level. In particular, we distinguished between *private WTP* and *collective WTP*. The former refers to the financing of particular husbandry factors and is the trade-off between animal welfare related husbandry systems and private consumption. The latter addresses the question of budget reallocation and therefore corresponds to the trade-off between public expenditure for animal welfare and other public goods.

A critical point of the study is the database used. Since the survey was just carried out via mailing list of Kiel University, we don't have a representative sample. Hence, we can not draw general conclusions for the German population from the results. I strongly encourage further research to apply the framework on a representative data basis. Regarding the design of the experiments, two points have to be mentioned. The public goods taken as the references (here: security, education and public transport) may should be related to agriculture more strongly. In particular, the chosen reference goods are more on a level like the "agriculture budget". If undertaking the study again, I would suggest to contrast animal welfare spending with spending for environment protection or spending within agricultural sector. Such a scenario would be even more realistic and helpful to understand preferences of agricultural policy among citizens. Moreover, it would contribute to the ongoing debate of financing only public goods provided by agriculture (see WBAE, 2018; Henning et al., 2019a) and help to see where the emphasis of European CAP should be located. Additionally, this would fix a problem of the study's empirical setting: Public transport is not a pure public good, but "only" a field where governmental spending occurs.

### 8.1.3 Possible Democratic Policy Failure in Sustainability? Measuring German Voters' Policy Beliefs

In this paper a theoretical framework was established that allows to evaluate the role of policy beliefs. The framework integrates analysis of voting behaviour as well as WTP measurement. Motivated by the aim to assess basic democratic policy failure, the approach should enable the assessment of belief biases regarding sustainability goods and their politically provision. Hence, the paper contributes to the political economy of sustainability: it allows to identify voters' policy beliefs empirically. With this approach we were able to demonstrate how they drive voters' policy positions. In particular, the empirical findings underline the important role of policy beliefs.

If a benchmark is given, one can asses the beliefs among voters. Furthermore, they can be compared to the true political technology. Unfortunately, we don't have such an adequate benchmark for animal welfare's political technology, i.e. how governmental spending contributes to animal welfare. Hence, due to missing benchmarks, belief measurements could not be evaluated. More research is needed here to investigate the relation between plausible animal welfare indicators and governmental spending. If true parameters are known, they can be compared to the results reported by the paper. This would allow to judge whether putting emphasis on voters' policy position leads to optimal or non-optimal decisions. This also applies for climate and water protection.

Regarding belief formation, I suggest more research of the causal mechanisms. Clearly, measured beliefs depend on the individual characteristics that influence voting and economic behaviour, i.e. policy weights and WTP. Nevertheless, this is not a causal mechanism that leads directly to the beliefs. For example, beliefs can be the result of learning, which can be an observational and/or communicational mechanism (Acemoglu and Ozdaglar, 2010), where the latter takes place in social networks (Friedkin and Johnsen, 1990). This corresponds to the mechanism of *informational lobbying* (Henning et al., 2019b) among policy stakeholders that was applied in chapters 6 and 7. One should also consider mass media, due to their important role in the animal welfare discourse (Brümmer et al., 2019; Grossarth, 2014). This also applies for social media (Buddle et al., 2018). Thus, I suggest future research to investigate the causal mechanism of belief building among voters considering mass and social media as well as personal communication in networks. Furthermore, the voter model used comes as a limitation. It does not treat voting for a party different than non-voting. Here I propose latent class models following the logic of nested multinomial logit models (which were used in chapter 2).

### 8.1.4 Belief Formation in German Farm Animal Politics: An Illustrative Example From A Stakeholder Network Survey

The study assessed communication influence on livestock stakeholders belief formation. A relatively dense communication network sets up the basis for a network multiplier model quantifying organizations' influence. Additionally, we simulated the evaluation of a standardized testing and approval procedure for mass-produced livestock facilities.

The studies illustrate two general problems. First, assessing beliefs is

not that simple. We took the answers from a stakeholder survey as the initial beliefs. But we do not know, to what extend the answers of the representatives are driven by communication that took place before. Even though we framed the corresponding questions by emphasising that we want to know organizations ideal positions, we can't be sure that external influence is eliminated. Second, weighting "particularly valuable" information suppliers is crucial. Within the study we weighted the stated important providers by value 2 while value of 1 represents normal communication ties. Here the question occurs whether a double high weighting is appropriate. Not least because the term "particularly valuable" is a subjective interpretation. If undertaking following studies using the same approach, one should make use of a quantitative frame like "Which information do you value as double high" or similar. Beyond these methodological questions I want to point out a problem of the data used. When investigating communicational patterns, one can not ignore the role of the media. This is due to the important role of mass media in public's debate on livestock production (Kayser et al., 2012). Unfortunately, the data used do not include media actors. This is due to the fact that media actors did not response to the interview inquiry. While methodological problems discussed before may be solved by future research, this data problem is somehow typical for social science investigations.

### 8.1.5 Communicational Lobbying and German Animal Welfare Regulation: A Network Approach

This chapter complements chapter 6 by not only examining three other policies, but also checking the results regarding their robustness. For this purpose, a Bayesian Exponential Random Graph Model is used to examine drivers of the network generating process. Subsequently, 10,000 network configurations are simulated to calculate the confidence intervals of beliefs' stationary points.

The study shares the same problem of the previous chapter: it includes no media actors. Hence, a possible important communication channel is missing. Moreover, the sample only includes one research organization. Of course, expert communication includes scientific knowledge. Thus, all corresponding actors should be included in a corresponding survey. This reflects the problem of willingness to participate in social science research. Here I see also a problem at the econometric level. Including media actors and more research organizations could change the estimation results.

This would also cause different simulation results for the 10,000 network simulations. Therefore, even the robustness test for the belief changes is challenged by the non-complete data sample.

## 8.2 A General Outlook

All in all, this thesis investigates some crucial aspects of German animal welfare policy. Beside studies on voting behaviour, willingness to finance FAW policies and a theoretical framework of belief measurement, it also consists of essays on stakeholder influence. Hence, it contributes to the understanding of the political economy of animal welfare policy under consideration of policy beliefs. Nevertheless, I want to highlight three implications for future research.

First, there is need for further representative empirical research on voters behaviour and WTP. Due to a lack of sufficient data, it was not possible to investigate the effect of certain animal welfare policy program aspects, i.e. the comparison of husbandry and management factors, on the voting behaviour. This would be a step in the domain of sub policies which could help to understand in which aspects polity should put emphasis. In general, research should compare animal welfare with other agriculture related issues like biodiversity or structural change. Such a comparison would contribute to the design of sustainable agricultural policy that fulfils social, economic and ecological demands. In a further step, one could combine this to the willingness to pay sphere. The concept of collective WTP should thereby be applied using issues that are linked to agriculture and rural areas as well as being at the same administrative level (district, state or national). Here I clearly see need for further research, for what the chapters in part I form a solid foundation.

Second, one has to investigate voters' belief building considering the digital sphere. The formation of voter beliefs is not taken into account in the corresponding chapters. Therefore, we do not know what drives voters' beliefs about important aspects of husbandry. With regard to the chapters 3 and 4, we know *which* participants want to pay more money for climate and space than for play. Additionally, a theoretical approach of belief measurement based on WTP and voting behaviour was suggested in chapter 5. So, we also know which people have which belief parameters. But we do not know *why* they have these beliefs or, more precise, *how they formed* these beliefs. An in-depth occupation with it could help to better understand voters' behaviour and willingness to pay motivation in animal welfare policy. Apart from personal networks (for example friendship),

mass and social media could play an important role for voters' belief formation. There is empirical evidence that both, social networks and mass media, affect voting behaviour (see for example Schmitt-Beck and Mackenrodt, 2010; Petri and Henning, 2015a,b). With regard to animal welfare, these influence tools may contribute to the belief updating process of society. This is especially true for mass media, which use to frame their coverage about livestock in Germany (see Brümmer et al., 2019; Grossarth, 2014; Kayser et al., 2011). Beside traditional mass media like newspaper or broadcast, especially social media might serve as belief driver. Political discussions more and more take place in the digital sphere. Social media link voters' discourse space to the sphere of politicians and other stakeholders. Platforms like Twitter allow politicians and stakeholders to directly communicate with citizens who are concerned about animal welfare. Especially animal protection organizations use media like Twitter as influence tool (see Buddle et al., 2018). Hence, belief updating might also occur via social media channels. Investigating economic and voting behaviour in animal welfare policy while considering belief updating through media influence is clearly an interdisciplinary work. It links agricultural economy with political as well as communicational science. Therefore, I see this issue as a promising research area for future methodological and empirical work and as an extension of the results provided in this thesis.

Third, comparative research at the European level could be necessary. Agricultural policy is mainly driven by the CAP, i.e. European policy making and the corresponding legal framework. With the end of the current period of payments new mechanisms will be implemented. Hence, scientists recommend that payments should be oriented at public goods provided by agriculture (WBAE, 2018). This also includes animal welfare. While the CAP sets a framework in which national strategies have room to move, there is the question of how much spendings should be provided for animal welfare. How much emphasis should be put on animal welfare (spending) and how important are other issues? Moreover, there are recommendations to implement a European animal protection law (Broom, 2017). Beyond the questions of regulating the standards, European trade of animal products is affected by higher standards. Since we know about the influential role in general (see Pappi and Henning, 1999; Henning, 2009), it would be interesting to investigate the corresponding livestock policy networks at the European level. Also, comparative studies on national influence of different stakeholder groups could be of interest since nationals' regulations within European framework are still heterogeneous despite social concerns (Vogeler, 2019). Therefore, I recommend corresponding empirical work of agricultural economists and political scientists.

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# Chapter 9

# Zusammenfassung

## 9.1 Ecological Voting in Germany? Animal Welfare, Climate and Water Protection as Drivers of Voting Behaviour

Wahlverhalten wird nicht nur von einem Thema beeinflusst, sondern durch mehrere Politikfelder. Somit ist die sinnvolle Messung des Tierwohleinflusses auf die Wahlentscheidung nur durch den Vergleich mit anderen *policy issues* möglich. Daher quantifiziert dieser Beitrag den Tierwohleinfluss und stellt ihn den ökologischen Themen Klima- und Gewässerschutz gegenüber. Insbesondere der Stickstoffüberschuss belastet das Grundwasser: Eine hohe Konzentration an reaktiven Stickstoffverbindungen kann nicht nur die biologische Vielfalt verringern, sondern auch die menschliche Gesundheit schädigen (Sachverständigenrat für Umweltfragen , 2015, S. 33). Laut Umweltbundesamt stammt der größte Teil der Stickstoffemissionen aus dem Agrarsektor (UBA, 2018). Über Branchen- und Landesgrenzen hinweg steht zudem der Klimawandel heutzutage im Fokus der Öffentlichkeit. Treiber des Klimawandels sind die Treibhausgasemissionen. Aus diesem Grund will die deutsche Regierung diese Emissionen bis 2030 um 55% senken, also auf 562 Millionen Tonnen $CO_2$-Äquivalente (BMU, 2019).

Ein probabilistisches Wählermodell (Thurner, 1998; Thurner and Eymann, 2000; Adams et al., 2005) wird geschätzt, dessen Datenbasis aus einer repräsentativen Befragung zum Thema Nachhaltigkeit in Deutschland stammt. Dabei handelt es sich um ein *nested multinomial logit model*. Dies ist dem Umstand geschuldet, dass die Entscheidung zur Nichtteilnahme an einer Wahl Ergebnis eines anderen Abwägungsprozesses ist, als die Entscheidung zur Wahl einer Partei (vgl. Thurner and Eymann, 2000). Auf Grundlage der geschätzten Parameter werden die marginalen Effekte berechnet. Sie geben an, in welchem Umfang sich die Wahlwahrscheinlichkeit für eine Partei ändert, wenn sich eine erklärende Variable um eine Einheit ändert. Das Modell enthält außerdem zahlreiche Kontrollvariablen zur ökonomischen Wohlfahrt und zu Fragen des Sozialen. Darüber hinaus wird auch auf retrospektives Wählen und nicht-politische Faktoren (Parteienidentifikation, Alter und Geschlecht) kontrolliert.

Im Ergebnis zeigt sich, dass Klimaschutz etwa 1,09 mal wichtiger ist als Tierwohl. Überraschenderweise erweist sich der Koeffizient für Gewässerschutz als nicht signifikant. Darüberhinaus zeigt die Studie, dass ökologische Wahlmotive wesentlich wichtiger sind als das ökonomische Wachstum. Auch hier erweist sich der Schätzer zudem als nicht signifikant.

Zu beachten ist allerdings, dass kein einziges Politik-Motiv so stark ist, wie die Identifikation mit einer Partei. Da dies jedoch nur für die wenigen Personen gilt, die sich mit einer Partei identifizieren, sind die Parteien auf zusätzliche Stimmen angewiesen. Dazu müssen sie sich entlang des poltischen Raumes bewegen. Besonders Tierwohl und Klimaschutz sind dabei Felder von hoher Sensibilität.

## 9.2 The Price for Happy Pigs: Private and Collective Willingness to Pay for Animal Welfare in Germany & About Bus Drivers and Happy Pigs: Collective and Private Willingness to Pay for Animal Welfare

Die den beiden Kapiteln zugrunde liegende Studie befasst sich mit der Finanzierung höherer Tierwohlstandards. Ausgangspunkt ist der Befund, dass existierende Studien (Liljenstolpe, 2008, 2011; Lagerkvist and Hess, 2011; Clark et al., 2017) von der Annahme ausgehen, Tierwohl sei ein privates Gut bzw. Attribut eines privaten Gutes. Dabei ist unklar, wie Trittbrettfahrerprobleme behandelt werden. Daher lautet das Kernargument dieser Studien, dass der Markt bei der Bereitstellung von Tierwohl versagt. Aus diesem Grund schlagen wir einen theoretischen Rahmen zur Finanzierung von Tierwohl (und anderen öffentlichen Gütern) vor. Dabei folgen wir der Studie von Uehleke and Hüttel (2016) und berücksichtigen neben dem Trittbrettfahrerproblem auch die Umverteilung von staatlichen Budgets zugunsten eines öffentlichen Gutes. Der empirische Teil besteht dementsprechend aus zwei Discrete Choice Experimenten. Zunächst wird nach der privaten Zahlungsbereitschaft für drei Haltungssystemkomponenten (Platz pro Tier, Beschäftigungsmöglichkeiten und Stallklimatisierung) in der Schweinemast gefragt. Daran schließt dann ein zweites Experiment an, in dessen Rahmen die Befragten entscheiden sollen, welche staatlichen Ausgaben aus den Bereichen Sicherheit, Bildung oder öffentlicher Personennahverkehr zugunsten der Tierwohlfinanzierung gekürzt werden sollen. Dies ist die kollektive Zahlungsbereitschaft.

Unsere Ergebnisse zeigen zunächst, dass die Zahlungsbereitschaften heterogen sind. Sie variieren nicht nur anhand sozioökonomischer Merkmale, sondern auch hinsichtlich der Einstellungen zum Thema Tier-

wohl. Zudem zeigen sich klare Muster bezüglich der Haltungsstandards und der Quelle ihrer Finanzierung: Am wichtigsten ist dabei die Klimatisierung von Ställen. Hier zeigt sich im Durchschnitt eine Zahlungsbereitschaft von 3,03 Euro pro Kilogramm Schlachtgewicht. Am zweitwichtigsten ist der Platz pro Tier, für den die Zahlungsbereitschaft im Durchschnitt 2,25 Euro beträgt. Vergleichsweise weniger wichtig sind die Möglichkeiten zur Beschäftigung. Für diese wurde eine Zahlungsbereitschaft von durchschnittlich 1,50 Euro gemessen. Darüber hinaus konnte eine Diskrepanz zwischen der privaten und der kollektiven Zahlungsbereitschaft herausgearbeitet werden. Letztere entspricht dabei lediglich einem Bruchteil der privaten Bereitschaft für bestimmte Haltungsstandards mehr zu zahlen. Im Allgemeinen existiert allerdings ein positiver Zusammenhang zwischen beiden Zahlungsbereitschaften.

## 9.3 Possible Democratic Policy Failure in Sustainability? Measuring German Voters' Policy Beliefs

Ausgangspunkt dieses Kapitels ist die Rolle der sogenannten *policy beliefs* (Akerlof, 1989; Caplan, 2001, 2002, 2007): Das Verhältnis zwischen Politik und den beabsichtigten Ergebnissen ist komplex. Um diese Komplexität zu verringern, wenden Laien naive mentale Modelle an. Diese Überzeugungen können aufgrund psychologischer Faktoren verzerrt sein und unterscheiden sich daher von Expertenwissen (den echten politischen Technologien). Wie Caplan (2001) argumentiert, können verzerrte Beliefs dazu führen, dass ineffiziente Politiken umgesetzt werden und somit ein basisdemokratisches Politikversagen auslösen. Mit dieser Studie werden die Konzepte der vorhergegangenen Kapitel zusammengeführt, um einen Ansatz zur Messung von Wählerbeliefs zu entwickeln. Basierend auf einer Cobb-Douglas Produktionsfunktion werden die Kostenelasitizitäten für Tierwohl sowie Klima- und Gewässerschutz abgeleitet. Die empirischen Bestandteile des Ansatzes sind Discrete Choice Experimente und ein probabilistisches Wählermodell.

Die Ergebnisse zeigen, dass die Beliefs der Wähler variieren. So entsprechen die Kostenelastizitäten des Klimaschutzes im Durchschnitt 1,37, 2,83 oder 4,3. Dies ist abhängig von der gewählten Kostenelastizität für das Tierwohl. Generell gilt dieses Muster auch für Gewässerschutz, allerdings bleiben die Beliefparameter hier nahe der 1. Ein zweiter Befund ist, dass eine geschlechterspezifische Heterogenität vorliegt: Für Männer

wurden im Durchschnitt signifikant höhere Kostenelastizizäten gemessen. Darüber hinaus zeigen die Ergebnisse, dass die Wähler der FDP, SPD und Unionsparteien im Allgemeinen höhere Beliefs haben. Drittens wurden neue Politikpositionen bzw. Zielvorstellungen simuliert, indem die Parameter systematisch variiert wurden. So zeigte die Erhöhung der Tierwohl-Kostenelastizität, die in dieser Studie als Referenz fixiert wurde, dass die Wähler im Durchschnitt 0,692 statt zuvor 1,174 Milliarden Euro als Regierungsausgaben für Tierwohl bevorzugen. Somit hängen die Tierschutzausgaben stark davon ab, wie die zugrunde liegenden *Beliefparameter* in Bezug auf Kosten und Effizienz ausfallen. Diese Kostensensibilität wurde auch für Klima- und Gewässerschutz gemessen.

## 9.4 Belief Formation in German Farm Animal Politics: An Illustrative Example From A Stakeholder Network Survey

Auf konzeptioneller Ebene ist Tierwohl realtiv komplex und umfasst eine Vielzahl von Aspekten der Gesundheit, physischen Funktionalität, des natürlichen Verhaltens und des psychischen Zustandes (Fraser, 2008). Daher spielen sogenannte *policy beliefs* eine Schlüsselrolle in der Tierwohlpolitik. Sie erlauben es den politischen Akteuren, komplexe Sachzusammenhänge zwischen Politik und Ergebnis zu vereinfachen. Sind diese Beliefs verzerrt, so können sie jedoch zu Politikversagen führen (Caplan, 2001). Gleichzeitig wird die Rolle von Stakeholdern in der Implementierung von Politiken immer wichtiger. Bisherige Arbeiten (vgl. etwa Heise and Theuvsen, 2017; Verbeke, 2009; Ventura et al., 2015) haben sich jedoch eher auf den Vergleich von Stakeholder-Bewertungen konzentriert. Daher tragen sie leider nicht dazu bei, den Prozess der Belief-Bildung besser zu verstehen. Somit ist nicht bekannt, wie Stakeholder - und somit auch politische Entscheider - ihre Beliefs bilden bzw. aktualisieren. Diese Lücke wird ein Stück weit geschlossen, indem diese Studie einen Analyserahmen der politischen Partizipation mit entsprechenden Netzwerkdaten verknüpft, um die Kommunikationseffekte in der deutschen Nutztier-Politik zu quantifizieren. Letztere werden anhand von Bewertungen des Stall-TÜVs veranschaulicht.

Unsere Ergebnisse zeigen, dass das Experten-Netzwerk der deutschen Nutztierpolitik relativ dicht ist: Mehr als 26 Prozent aller möglichen Verbin-

dungen werden realisiert. Darüber hinaus konnten wir die Gruppen “Landwirtschaft und Tierproduktion” sowie “Tierschutz” als die Haupttreiber des beliefbildenden Prozesses identifizieren. Gleichzeitig zeigt sich der Fleischsektor als besonders offen für externes Wissen. Demgegenüber ist es die Gruppe “Landwirtschaft und Tierproduktion”jene, die am meisten auf ihre eigene Expertise vertraut. Ihre Eigenkontrolle liegt im Durchschnitt bei 0,853. Diese strukturellen Effekte führen im Ergebnis zu einer Konvergenz der Stall-TÜV-Bewertungen. Der Median verschiebt sich von 3 (“unentschlossene” Position) zu 3,2 (Verschiebung in Richtung “eher nützlich”).

## 9.5 Communicational Lobbying and German Animal Welfare Regulation: A Network Approach

Diese Studie stellt eine Erweiterung des Kapitels 6 dar. Der theoretische Rahmen ist wiederum die netzwerkbasierte Theorie des *informational lobbying* (Henning et al., 2019). Auf empirischer Ebene befasst sich die Studie mit drei weiteren Fragen der Tierschutzregulierung. Wie im Bereich des Umweltrechts haben sowohl der Bundesgesetzgeber als auch die Bundesländer das Recht, ein Gesetz umzusetzen, das es Tierschutzgruppen ermöglicht, vor Gericht gegen Tierschutzverstöße zu klagen (Kloepfer, 2016). Darüber hinaus stellt sich die Frage nach dem Nachweis der Sachkunde zur Tierhaltung, wie er durch den WBA (2015) vorgeschlagen wird. Die nationale Strategie für die Haltung von Nutztieren beinhaltet eine solche Überprüfung (BMEL, 2017). Ein weiteres Thema ist das Verbot des Transports lebender Tiere in Ländern außerhalb der EU, wie es von Tierschutzgruppen (Bündnis für Tierschutzpolitik, 2017) gefordert wird. Als methodische Erweiterung zum vorherigen Kapitel werden die Ergebnisse auf ihre statistische Signifikanz hin überprüft. Daher wird ein bayesianisch geschätztes ERGM verwendet, um zuerst Determinanten des das Netzwerk generierenden Prozesses zu identifizieren. Basierend auf den Schätzergebnissen werden in einem weiteren Schritt 10.000 Netzwerkkonfigurationen simuliert.

Unsere Ergebnisse deuten darauf hin, dass in dem realisierten Netzwerk die landwirtschaftlichen Erzeuger die Haupttreiber des Expertenwissens in der deutschen Nutztierpolitik sind. Tierschutzorganisationen scheinen dabei ihr Gegenpol zu sein, wenn es um Wissenskommunikation geht. Die ERGM-Ergebnisse spiegeln diese Muster wider. Für po-

tentielle Sender von Informationen wurden positive Parameter identifiziert, wenn sie zu einer der beiden Gruppen gehören. Darüber hinaus sind auch die Koeffizienten für politische Agenten als Wissensnachfrager positiv, was bestätigt, dass sowohl die gesetzgebenden Akteure als auch die Exekutive Wissens-Nachfrager sind. In Bezug auf die empirischen Beliefs konnten wir zeigen, dass die empirische Daten im Allgemeinen den simulationsbasierten entsprechen. Dies gilt insbesondere für den Sachkundenachweis in der Tierhaltung sowie das standardisierte Prüf- und Zulassungsverfahren, für die die Mittelwerte nahezu perfekt übereinstimmen. Auf Gruppenebene sind nur wenige Mittelwerte nicht signifikant. Daher betrachten wir die auf Interviews basierenden Ergebnisse insgesamt als statistisch robust. Darüber hinaus zeigen die Ergebnisse, dass die Gruppe der öffentlichen Verwaltung je nach Netzwerkkonfiguration leicht in ihrer Position zu verschieben ist. Im Allgemeinen zeigt die Beliefänderung, dass Gruppen, die eine Politik mit einer neutralen 3 bewerten, Gruppen sind, die in beide Richtungen bewegt werden können. Vergleicht man den Bereich der Delta-Mittelwerte pro Gruppe und Simulation mit der angegebenen Eigenkontrolle, also dem Gewicht interner Expertise, so zeigt die Studie, dass die Wertebereiche für Gruppen mit geringer Eigenkontrolle breiter sind.

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# Appendix A

# Methods

# A.1 Discrete Choice Models

Chapters 2, 3 and 4 are based on discrete choice models. This sections describes the econometric modelling approaches.

## A.1.1 Random Utility Framework

Discrete choice models are the appropriate econometric model for decisions between alternatives. These decisions appear as data with discrete dependent variables (Greene, 2009). Thus, they are used for both, modelling economic preferences (see Hanley et al., 2001) as well as probabilistic models of voters' behaviour (see Adams et al., 2005; Enelow and Hinich, 1984b; Thurner, 1998; Thurner and Eymann, 2000).

The theoretical foundation of discrete choice models is the random utility theory. Assume a rational, i.e. utility maximizing, decision maker $i$ in situation $t$ who has to choose between a set $J$ of alternatives. The utility of alternative $j$ is denoted by $U_{itj}$. Alternative $j$ is chosen if its utility is higher than the utility gained by alternative $j'$, hence

$$U_{itj} > U_{itj'}. \tag{A.1}$$

This utility consists of two components: $V_{itj}$ refers to the deterministic part of voter $i$'s utility, which is based on observable characteristics. In contrast, $\epsilon_{itj}$ is the unobserved stochastic error component (Hensher et al., 2015). Hence,

$$U_{itj} = V_{itj} + \epsilon_{itj}. \tag{A.2}$$

Note that $V_{itj}$ is a linear combination of a $n \times 1$ vector of $n$ explanatory variables **x** and a $n \times 1$ vector of parameters $\beta$:

$$V_{itj} = \beta \mathbf{x}. \tag{A.3}$$

Observing the particular choice $j$ leads to the conclusion that its utility is the maximum of set $J$ (Greene, 2012), hence the probability to chose alternative $j$ is

$$P_{itj} = Prob(y = j|it) = Prob(U_{itj} > U_{itj'}) = Prob(U_{itj} - U_{itj'} > 0). \tag{A.4}$$

## A.1.2 (Nested) Conditional and Multinomial Logit Models

Both, conditional and multinomial logit models require the assumption that the stochastic component $\epsilon_{itj}$ is independent and identically distributed

with Gumbel (type 1 extreme value) distributions (Hensher et al., 2015). Based on this assumption, McFadden (1974) proposes the *conditional logit model* of the form

$$\begin{aligned} P_{itj} &= \frac{e^{V_{itj}}}{\sum_j e^{V_{itj}}} \\ &= \frac{e^{(\beta_0 + \sum_n \beta_n x_{itnj})}}{\sum_j e^{(\beta_0 + \sum_n \beta_n x_{itnj})}} \end{aligned} \tag{A.5}$$

where $x_{itnj}$ refers to the $n$th attribute of alternative $j$ in choice set $t$ for decision maker $i$. The attributes vary among alternatives in the choice set. Furthermore, $\beta_0$ corresponds to the alternative specific constant (ASC) and is also estimated like parameter $\beta_n$. If one wants to take individual characteristics into account, the *multinomial logit model* has to be used. In particular, a $k \times 1$ vector **z** of individual characteristics may now describe the observable part of utility:

$$\begin{aligned} P_{itj} &= \frac{e^{V_{itj}}}{\sum_j e^{V_{itj}}} \\ &= \frac{e^{(\sum_k \alpha_{kj} z_{itk})}}{\sum_j e^{(\sum_k \alpha_{kj} z_{itk})}} \end{aligned} \tag{A.6}$$

where $z_{itk}$ is the $k$th characteristic of individual $i$ in choice situation $t$. Please note that parameters $\alpha$ vary among alternatives. Using both kind of models (Greene, 2009) leads to

$$\begin{aligned} P_{itj} &= \frac{e^{V_{itj}}}{\sum_j e^{V_{itj}}} \\ &= \frac{e^{(\beta_0 + \sum_n \beta_n x_{itnj} + \sum_k \alpha_{kj} z_{itk})}}{\sum_j e^{(\beta_0 + \sum_n \beta_n x_{itnj} + \sum_k \alpha_{kj} z_{itk})}}. \end{aligned} \tag{A.7}$$

An extension of these models is the nested multinomial logit model (NMNL). It is used if the underlying independence of irrelevant alternatives (IIA) assumption only holds for subsets of all alternatives (Greene, 2009; Hensher et al., 2015). In particular, choices are partitioned into a set of $B$ branches. The probability to chose alternative $j$ now corresponds to

$$P_{itj} = P_{itj|b} \times P_{itb}, \tag{A.8}$$

with

$$P_{itj|b} = \frac{e^{V_{itj|b}}}{\sum_j e^{V_{itj|b}}} \tag{A.9}$$

$$P_{itb} = \frac{e^{(\lambda_b I V_{itb})}}{e^{(\lambda_b I V_{itb})}}. \tag{A.10}$$

Note that $b$ refers to the branch containing alternative $j$. $P_{itb}$ is the probability to chose branch $b$. The utilities of alternatives in branch $b$ are summarized in inclusive value $IV_{tb}$ (McFadden, 1984).

### A.1.3 Latent Class Models

The models mentioned above assume that preferences are homogeneous among decision makers. In contrast, the latent class model takes preference heterogeneity into account. The population of choice makers (for example voters) is divided into $Q$ unobservable segments, i.e. classes (Swait, 1994). Membership in class $q$ is not deterministic, but probabilistic. Moreover, it depends on a $l \times 1$ vector **s** of $l$ individual characteristics of the decisions maker. Following Boxall and Adamowicz (2002) and Greene and Hensher (2003), one can write the corresponding membership likelihood function as

$$M_{iq} = \gamma_0 + \sum_l \gamma_q s_{il}, \tag{A.11}$$

with the class membership constant $\gamma_0$. Hence,

$$P_{iq} = \frac{e^{M_{iq}}}{\sum_{q=1}^{Q} e^{M_{iq}}}. \tag{A.12}$$

Accordingly, choice models now depend on the classes:

$$\begin{aligned} P_{itj|q} &= \frac{e^{V_{itj|q}}}{\sum_j e^{V_{itj|q}}} \\ &= \frac{e^{(\beta_{0|q} + \sum_n \beta_{n|q} x_{itnj} + \sum_k \alpha_{kj|q} x_{itk})}}{\sum_j e^{(\beta_{0|q} + \sum_n \beta_{n|q} x_{itnj} + \sum_k \alpha_{kj|q} z_{itk})}} \end{aligned} \tag{A.13}$$

Using A.12, the probability of individual *i* to choosing alternative *j* in situation *t* finally corresponds to

$$P_{itj} = \sum_{q=1}^{Q} P_{iq} P_{itj|q}. \tag{A.14}$$

### A.1.4 Probabilistic Models of Voting Behaviour

Probabilistic models of voting behaviour consist of three components:

- policy motives ($V_{ij}^{POL}$),

- retrospective voting ($V_{ij}^{RETRO}$) and
- non-policy voting ($V_{ij}^{NONPOL}$).

The policy motive component is based on the assumption that voters are rational utility maximizing decision makers. They evaluate platforms of competing parties regarding the perceived utility (Downs, 1957). According equation A.1, they vote for the party from which they expect the highest utility. An extension of this theoretical model are the spatial models of voting behaviour based on Hotelling (1929). Voters as well as parties are assigned along one or more policy dimensions, i.e. policy issues. Let $x_{in}$ denote the voter position and $c_{ijn}$ the *perceived* position of party $j$ in policy issue $n$. Following equation A.1 a voter chooses the party next to his own position. This is the party with the smallest distance to the voter (Adams et al., 2005; Enelow and Hinich, 1984a). The deterministic policy component of utility corresponds to

$$V_{ij}^{POL} = -\sum_{n} \beta_n \sqrt{(x_{in} - c_{ijn})^2}. \tag{A.15}$$

At the econometric level, $\sqrt{(x_{in} - c_{ijn})^2}$ is modelled as a party attribute. The retrospective motive (Fiorina, 1981) refers to the evaluation of the governmental performance. Therefore, voters make use of observable indicators or state of satisfaction with situation:

$$V_{ij}^{RETRO} = \sum_{k} \beta_k z_{ik}, \tag{A.16}$$

with $z_{ik}$ as the evaluation of issue $k$ by voter $i$. Several non-policy motives are part of $V_{ij}^{NONPOL}$. For example, loyalty to a party is an influential factor of a voter's decision (Bartels, 2000). Moreover, attributes of a party like sympathy for a candidate as well as socio-structurally class membership can drive voting behaviour (Schoenfeld, 1982; Schoen, 2014). Hence,

$$V_{ij}^{NONPOL} = \sum_{m} \beta_m c_{jm} + \sum_{s} \beta_s z_{is}, \tag{A.17}$$

where variable $z_{is}$ denotes the characteristics of a voter and $w_{mj}$ party characteristics. All in all, the deterministic component corresponds to

$$V_{ij} = V_{ij}^{POL} + V_{ij}^{RETRO} + V_{ij}^{NONPOL}. \tag{A.18}$$

This corresponds to a model integrating behavioural aspects into a spatial framework (Adams et al., 2005). Thus, the overall deterministic part described in equation A.18 is usually used in the model A.7.

### A.1.5 Discrete Choice Experiments and WTP Measurements

Within the random utility framework, discrete choice experiments (DCE) are used to "assess people's preferences or decisions in hypothetical situations" (Colen et al., 2016, p. 672). Beside the random utility theory, the characteristics of value theory (Lancaster, 1966) is the theoretical foundation of this approach: The core idea is that people benefit from characteristics of the good and not from the good itself. Hence, goods are described by certain attributes. Since the 1990s, DCE have been applied for evaluation in environmental economics (see Hanley et al., 1998). Agricultural economists also use the approach in varying fields like the European CAP (for an overview see Colen et al., 2016, p. 672-674) and animal welfare (for example Liljenstolpe, 2008). Researchers have to decide about

- the number of attributes,
- number and content of their levels as well as
- their description

when applying DCE (Hanley et al., 1998). Attribute levels may be quantitative or qualitative (Hensher et al., 2015). Furthermore, the number of alternatives per choice set has to be considered. In order to avoid forcing unwanted decisions, DCE designs should also include an opt-out option (Auspurg and Liebe, 2011). This also increases proximity to reality. Another question refers to the labelling of alternatives. A DCE is a *labelled* experiment if the alternatives have different names (for example brand names of cars). In contrast, *unlabelled* experiments consist of alternatives with generic names (for example "A" and "B"). As pointed out by Hensher et al. (2015), the decision whether to apply a labelled or unlabelled experiment is not a trivial one. Rather, unlabelled experiments have two main benefits (Hensher et al., 2015, p. 205-207): First, not all alternatives within the overall set have to be used. Second, unlabelled experiments do not contain a name that might simultaneously serve as an another attribute and hence, might be correlated with other attributes and thus fail the IID assumption. For the purpose of chapters 3 and 4, unlabelled experiments are sufficient since the DCE describe legal framework as well as budget redistribution schemes. A last note on the overall design: Let $L$ be the number of Levels and $A$ the number of attributes. For unlabelled experiments the number of all possible alternatives is $L^A$ (Hensher et al., 2005). Hence, the number of total alternatives increases with the

number of attributes and levels. In most cases, such a full factorial design can not be distributed to the participants of a survey. Rather, a fractional factorial design is applied and the participants are partitioned into several blocks and certain choice sets are assigned to each block (Auspurg and Liebe, 2011).

The calculation of WTP is straightforward. In a conditional logit model, WTP corresponds the marginal rate of substitution between attribute $k$ and costs (Hensher et al., 2015). Hence, the WTP for attribute $k$ is

$$WTP_k = -\frac{\beta_k}{\beta_c}, \tag{A.19}$$

where $\beta_c$ refers to the cost attribute coefficient. Hence, this is the average WTP of the whole sample. In a latent class approach, the individual WTP for individual $i$ can be calculated. Given class membership probability $P_{iq}$ from equation A.12 as well as the average WTP in class $q$

$$WTP_{k|q} = -\frac{\beta_{k|q}}{\beta_{c|q}} \tag{A.20}$$

one can calculate the individual WTP

$$WTP_{ik} = \sum_{q=1}^{Q} P_{iq} WTP_{k|q}. \tag{A.21}$$

## A.2 Social Network Analysis

Methods and models described in section A.1 rely on attributes of alternatives and an actor's characteristics. In contrast, social network analysis (SNA) focuses on the social structure between individual actors, e.g. people or organizations. Hence, the researcher is interested in relational characteristics. This kind of network analysis has its origins in psychology and is widespread in empirical sociological work (Newman, 2010). A variety of studies makes use of SNA in order to investigate elite policy networks (Henning, 2009; Leifeld and Schneider, 2012; Pappi et al., 1995). Based on work of Golub and Jackson (2010) as well as Acemoglu and Ozdaglar (2010), Henning and Hedtrich (2018) suggest a framework of belief formation. This informational lobbying (Henning et al., 2019) in stakeholder networks complements classical political support networks. This model was applied in chapters 6 and 7.

Consider the set $S$ of $n$ actors. Actor pairs $(i, j) \in S$ might establish a certain relation $r$ from a set of possible relations $R$. Please note, that this

*dyad* is the smallest unit in SNA (Jansen, 2006). The most simple formal representation of a relational network of actors is the $n \times n$ *sociomatrix* **M**. Hence, element $m_{ij}$ indicates whether row actor $i$ and column actor $j$ have an established tie. Note that one has to distinguish between directed or undirected networks. The former refers to a network, where row actor $i$ establishes a tie towards column actor $j$, while $j$ not necessarily establishes the same tie to $i$. If $m_{ij} \neq m_{ji}$, it is an asymmetric relation. In contrast, $m_{ij} = m_{ji}$ describes a symmetric relation. Giving support is a classical example for this kind of networks. In an undirected network, $m_{ij} = m_{ji}$. Hence, if there is a tie from $i$ to $j$, there also is a tie from $j$ to $i$. A good example is a network of friendships. Furthermore, social networks may be represented as *graphs*. While the actors appear as *vertices*, their relations occur as *edges* or *lines* (Newman, 2010). If self selection in a network is allowed, possible relations corresponds $n^2$. If self selection is not allowed, one ends up with $n \times (n-1)$ possible connections.

Network data can be collected in several ways. For the studies of part II, personal interviews including corresponding network questions were conducted. In particular, the networks have been constructed by asking from two perspectives: sender and receiver. Hence, confirmed networks (Pappi et al., 1995) have been constructed. Starting point was a list of potentially relevant interest groups and political organizations (executive and legislative). Based on this list, personal interviews were conducted with representatives of the listed organizations. Target groups of the first interviews were the most important groups of agribusiness as well as animal protection. Additionally, a relational method (Jansen, 2006, p. 73) was applied: At the beginning of the interview's network part, a reputation question was asked first: Interviewees had to identify all influential organizations based on the provided list. If an organization was missing, they were allowed to add it to the list. Hence, the *indegree centrality* of this reputation network was calculated:

$$d_i = \sum_j x_{ji} \tag{A.22}$$

Network boundaries were then constructed using this reputational measure. In particular, organizations where $d_i = 0$ have not been considered.

Exponential Random Graph Models (ERGM) (Wasserman and Pattison, 1996; Snijders et al., 2006) can be used to model network generating processes. Using a priori defined network statistics, ERGMs are able to represent the structure of networks and the according drivers. Beyond endogenous variables, they allow to consider exogenous variables. Let $\mathbf{y}$

denote a $n \times n$ adjacency matrix on a set of $n$ actors. Then $y_{ij} = 1$ indicates that there is a directed tie from $i$ to $j$ and $y_{ij} = 0$ that there is no tie[1]. With $s(y, X)$ one can describe a vector of network statistics. It consists of endogenous as well as exogenous covariates. Exogenous variables are denoted with $X$ and correspond to attributes at edge and node level. They enter the model either as $\sum_j(\sum_i y_{ij})X_j$, $\sum_j(\sum_i y_{ji})X_j$ for edge attributes or $\sum_i \sum_j y_{ij}X_{ij}$ for nodal attributes. The ERGMs probability density function corresponds

$$\Pr(y|X) = \frac{\exp\{\theta s(y, X)\}}{\sum_{\tilde{y}\in\mathcal{Y}} \exp\{\theta s(\tilde{y}, X)\}}, \tag{A.23}$$

with $\theta = (\theta_1, \ldots, \theta_Q)$. Furthermore, $\sum_{\tilde{y}\in\mathcal{Y}} \exp\{\theta s(\tilde{y}, X)\}$ is the normalizing constant summing over all possible network configurations denoted as $\mathcal{Y}$ (Henning et al., 2019). This ensures that A.23 is a probability distribution.

Henning et al. (2019) argue that parameter estimation in ERGM framework comes as a challenge because of the normalizing constant being intractable. This applies even for networks of moderate size and is due to the enormous number of possible realizations in $\mathcal{Y}$. Following the literature (see Snijders, 2002; Hunter and Handcock, 2006), Bayesian estimation using Markov Chain Monte Carlo (MCMC) techniques can be used to handle this problem. Hence, estimated parameters appear as sample moments for a sample drawn from the posterior distribution. Equation (A.23) can be rewritten as a conditional logit (see Goodreau et al., 2009; Cranmer and Desmarais, 2011):

$$\ln\left[\frac{\Pr(y_{ij} = 1, Y_{ij}^C|X)}{\Pr(y_{ij} = 0, Y_{ij}^C|X)}\right] = \theta\delta(y_{ij}, Y_{ij}^C, X), \tag{A.24}$$

where $Y_{ij}^C$ denotes all dyads other than $y_{ij}$ and $\delta(y_{ij}, Y_{ij}^C, X)$ denotes the vector of changes in the sufficient statistics when $y_{ij}$ changes from 0 to 1. Hence,

$$\begin{aligned}\Pr(y_{ij} = 1|Y_{ij}^C, X) &= \frac{\Pr(y_{ij}=1, Y_{ij}^C|X)}{\Pr(y_{ij}=0, Y_{ij}^C|X)+\Pr(y_{ij}=1, Y_{ij}^C|X)} \\ &= \frac{\exp\{\theta\delta(y_{ij}, Y_{ij}^C, X)\}}{1+\exp\{\theta\delta(y_{ij}, Y_{ij}^C, X)\}}.\end{aligned} \tag{A.25}$$

Subsequently, effects on the probability given in A.25 (resulting from changes in $\delta(y_{ij}, Y_{ij}^C, X)$) can be quantified by

$$\frac{\partial\Pr(y_{ij} = 1|Y_{ij}^C, X)}{\partial\delta(y_{ij}, Y_{ij}^C, X)} = \Pr(y_{ij} = 1|Y_{ij}^C, X)(1 - \Pr(y_{ij} = 1|Y_{ij}^C, X))\theta \tag{A.26}$$

[1] Self ties are not allowed, so $y_{ii=0}$.

to get marginal effects. Since individual marginal effects are locally defined, they depend on all network statistics derived as partial derivatives at a specific point (see Henning et al., 2019, pp. 83-84).

*Informational (or communicational) lobbying* refers to the idea of influence through belief updating (Henning et al., 2019). Beliefs determine the preferences according certain policies. Updating these beliefs takes place through an updating mechanism (Henning and Hedtrich, 2018). Beside observational learning, communicational learning corresponds to such a mechanism. It takes into account that the social structure in which an actor is embedded is a key driver of learning (Acemoglu and Ozdaglar, 2010). This structure appears as a local directed network and is reflected in the $n \times n$ socio-matrix $M^C$. If $m_{ij}^C > 0$, there is an established tie where $i$ sends information to $j$. $\bar{M}^C$ denotes the row stochastic matrix of $M^{C\prime}$ with elements $\bar{m}_{ij} > 0$ indicating that $i$ pays attention to $j$ (Golub and Jackson, 2010). Moreover, $t = 1, 2, ..., T$ denotes the communication round and $\tilde{A}$ the political beliefs. In particular, $\tilde{A}_i^0$ reflects agent's initial beliefs while $\tilde{A}_i^r$ denotes beliefs in communication round $r$. Hence,

$$\tilde{A}_i^{r+1} = \bar{m}_{ii}\, \tilde{A}_i^0 + \sum_{j \neq i} \bar{m}_{ij} \tilde{A}_j^r. \tag{A.27}$$

Note that $\bar{m}_{ii}$ denotes an actor's weight that he or she puts on his/her own expertise. If calculating

$$\tilde{m}_{ij} = \frac{m_{ij}}{(1 - m_{ii})} \tag{A.28}$$

equation A.27 can be rewritten to

$$\tilde{A}_i^{r+1} = m_{ii}\, (\tilde{A}_i^0 + (1 - m_{ii}) \sum_j \tilde{m}_{ij}\, \tilde{A}_j^r. \tag{A.29}$$

Here $(1 - m_{ii})$ corresponds to the aggregated weight for all of $i$ neighbours. Following Henning and Hedtrich (2018), A.29 can be rewritten in matrix notation to identify stationary points of final beliefs:

$$\tilde{A} = [I - (1 - m_{diag})\bar{M}]^{-1} * m_{diag} * \tilde{A}^0, \tag{A.30}$$

with the network multiplier Matrix

$$\hat{M} = [I - (1 - m_{diag})\bar{M}]^{-1} * m_{diag}. \tag{A.31}$$

Element $\hat{m}_{ij}$ corresponds to the multiplier effect, taking direct and indirect effects of $j$'s initial belief on $i$'s final belief into account. The model corresponds to the Friedkin-Model (Friedkin and Johnsen, 1990, 1997).

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