Universität Bayreuth
Rechts- und Wirtschaftswissenschaftliche Fakultät
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From Public Goods to Public Choice

Dissertation
zur Erlangung des Grades eines Doktors der Wirtschaftswissenschaft
der Rechts- und Wirtschaftswissenschaftlichen Fakultät
der Universität Bayreuth

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Tag der mündlichen Prüfung:	16.12.2022

Thank you!

Firstly, to my family and friends, for having great times together and for standing by my side in bad times. Without you, I could not have written this thesis.

Secondly, to the ones supporting me with research and feedback. Special thanks to Jonathan Bothner, Moritz Kern, Theresa Rollwage, and Tim Röthel for their essential feedback and support.

Thirdly, to my co-authors Kathrin Muth, Johanna Barop, and in particular, Niklas Gogoll. Together we developed the ideas and concepts of our theses. During the four years we worked together, you became one of my best friends.

Last but not least, to my doctoral advisor Prof. Dr. Martin Leschke. During lectures, seminars, and discussions together I have learned so much from you. Your knowledge and economic insights changed the way how I understand the world.

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Chapter 1

Introduction

Institutions such as constitutions, laws, and contracts guide individuals' behavior by changing their individual cost-utility calculus. Besides the pure analysis of how institutions affect individuals' choices, institutional economics becomes interesting by implementing normative goals and trying to fulfill these goals by developing suitable institutions. The outstanding normative goal is to increase society's welfare. Regularly, decentralized decision-making leads to Pareto-efficient outcomes. However, this is only the case if a fundamental framework for interactions is given. For example, a constitution and competition regulations are necessary to prevent prisoner's dilemmas leading to processes of collective self-destruction. Such prisoner's dilemmas also occur in the case of market failure. Economic literature states the reasons for market failures as externalities, information asymmetries, natural monopolies, and public goods (and sometimes merit/demerit goods).

In this thesis, I mainly focus on the willingness to pay for public goods and their provision on the political market. For public goods, two properties are characteristic. First, one person's consumption does not impact another person's consumption (non-rivalry). Second, people cannot be excluded from consumption (non-excludability). Thus, individuals do not have an incentive to contribute to the provision of public goods as their individual impact on the provision of the good is marginal. Consuming the public good without contributing to its provision, i.e., free-riding, should be the dominant strategy.

In recent years public goods received more attention, especially the public good climate. Many people claim that there is an urgent need for regulations to reduce global warming. Besides new policy regulations, many actors also demand an individual behavior change in line with less environmental pollution. From a theoretical perspective, this change is unlikely to happen. A high preference for the environment should not result in a willingness to pay for this good, as one's contribution is only marginal. This explains

why demanding stricter environmental regulations and individual extensive environmental pollution are not contradicting.

In contrast to this explanation, a growing number of people individually contribute to the provision of public goods, e.g., by compensating for their flight emissions. At first glance, this behavior seems to contradict the standard economic theory. However, an explanation that is in line with economic theory can be found focusing on different preferences linked to public goods. Social incentives like gaining reputation and silencing one's conscience can explain the observed behavior. Thus, we can interpret the revealed willingness to pay as a willingness to pay for social incentives apart from the public good.

Based on this idea, in the first paper of this thesis (chapter 2), we try to develop a simple microeconomic calculus to distinguish the willingness to pay for public goods and social incentives. We implement a so-called Quasi-Monarch setting to measure the willingness to pay for public goods. In the second paper (chapter 3), we try to apply the idea of this model to reality. For this, we measure the willingness to pay for eggs using different scenarios. By separating different preferences from the stated willingness to pay for different varieties of eggs, we try to identify the willingness to pay for social incentives and the public good production animal welfare.

Determining the real willingness to pay for the public good is crucial for politicians to establish welfare-increasing standards. However, in the light of public choice, we consider politicians as self-interested utility maximizers. This raises the question of whether politicians provide the level of the public good that is in line with the individual's willingness to pay for the public good. The median voter model shows that politicians are forced to provide the preferred amount of public goods of the median voter to win an election. However, this standard model only shows the demand side and does not consider the supply side. In my third paper, I develop a simple microeconomic calculus that includes the demand and supply side and provides an easy way to analyze changes in preferences and budgets and different market forms in the price-quantity scheme (chapter 4).

But do politicians align their positions to the one of the median voter as theory predicts? In reality, the precise theoretical predictions of the median voter model are difficult to measure. Since the median voter is a static model, it just states an equilibrium but does not make any predictions how this equilibrium is reached. In the fourth paper of this thesis, we develop a model to measure the median voter in a framework that is

in line with economic theory. We use the 2016 U.S. presidential election to evaluate the median voter model. The key feature of this analysis is the shift of the median voter in the transition from primary elections (where each party designates its candidate) to the presidential election. We expect candidates to align their positions to the median voter of the party in the primaries and the median voter of all citizens in the presidential elections. Using this shift, we try to analyze the median voter theorem in line with theory (chapter 5).

I summarize the results and undertake a critical review of all papers in chapter 6.

Chapter 2

Why Being a Frequent Flyer and an Environmental Activist is no Contradiction

Niklas Gogoll & Felix Schlieszus[1]

2.1 Introduction

Environmental activist movements have raised the focus of media attention in recent years. Typically, these movements demand drastic changes of our present consumption patterns to improve public goods by, for example, reducing greenhouse gas emissions. One of these climate-intensive activities is flying, which is often criticized harshly. As a consequence one would expect especially those people, who are actively engaged, to reduce flights. However, the number of flights of the aforementioned group has been growing the fastest (Adv 2018). There are more examples of this kind to be found which, at first glance, seem to be contradictory behavior. A study of the German Federal Environment agency suggests that members of the "critical-creative milieu" are prone to consuming resources at a level high above the average, and this is not compensated by buying food in organic grocery stores (Umweltbundesamt 2018). This is why some accuse environmental activists of hypocrisy, i.e. to not practice what they preach (Book 2019). But is frequent flying and being an environmental activist really hypocritical? In this paper we will argue the opposite.

The effect of one person restricting herself to a sustainable consumption is negligibly small for large public goods. Hence, just changing one's own behavior will not improve the public good, e.g. the climate. Even though the environment may be important

[1]The authors contributed equally to this work.

to an environmental activist, the individual's lower strain on the environment does not compensate for the loss of an individual's utility when flying less. Instead, free-riding is the rational choice even when having a high preference for the public good.

Following this argument, we do not expect rational individuals to spend money for improving a large public good individually. However, the increasing amount of individually compensated CO_2 emissions (Donofrio et al. 2021), provides evidence against this hypothesis. How can this behavior be explained assuming that individuals know, that their impact on the public good is marginally small? Individuals might hope to motivate others to change their consumption patterns as well. But reciprocal behavior of other individuals is very uncertain – especially for large public goods (Budescu et al. 1990; Rapoport and Suleiman 1993; Hine and Gifford 1996; Jagers et al. 2020). Instead, it can be explained by the individual's preference to for instance soothe one's conscience after a long-haul flight by compensating CO_2 emissions. These payments based on social incentives (e.g. conscience, reputation or morality) are linked to the willingness to pay for improving the public good, but they have to be viewed separately, because these payments do not increase the level of the public good.

Knowing that reciprocal behavior is not feasible, the only way environmental activists can target the level of a public good is by implementing or increasing standards and rules on a societal level, for instance with the introduction of a carbon tax, which prohibits free-riding behavior. Without state intervention, these environmental activists cannot achieve any significant change of the level of the public good. Therefore, they will not change their individual consumption pattern and still fly frequently. To show why environmental activists do not act hypocritically by flying frequently it is important to separate these two forms of willingness to pay. We achieve this by devising a simple model in this paper.

2.2 Willingness to Pay for Collective Goods

The willingness to pay for public goods has engaged economists since Samuelson (1954) and Olson (1971). Early literature suggests that, when a public good is provided for privately, individuals have the incentive to free-ride and therefore not participate in its provision (see Samuelson 1954; Olson 1971; Brubaker 1975; Sandler 1992). The currently accepted view is that one cannot make general statements on the willingness to pay for

public goods, as it depends highly on the good and the framework of its provision (Dawes 1980; Fleishman 1988; Jagers et al. 2020).

Improving a public good is not the only reason why individuals would be willing to pay for it. For instance, an individual may not care about a public good at all, but for fear of social sanctions yet decides to contribute towards its provision. This individual would even cooperate in the case when her own contribution does not benefit the level of the public good, since she is motivated by social reasons only. In other words, the willingness to pay for improving a public good and the willingness to pay based on social sanctions might be linked, but they arise from different preferences. Despite this, most literature does not distinguish these two kinds of willingness to pay, even when social incentives are accounted for. In the following, we will separately discuss these two types of willingness to pay for public goods. We start with social incentives, which are the focus of our model presented later.

Social incentives

Willingness to pay based on social incentives is relatively well established in the economic literature (see e.g. Sen 1977; Udehn 1993; Moreh 1994). While there are many different kinds of social incentives, we will focus on reputation, altruism and social norms.

An individual might be willing to contribute to a public good in order to achieve some form of social benefit or avoid social sanctions – even if they are non-monetary. These reputational, external considerations potentially reduce free-riding in public goods games, as individuals would include reputational payoffs into their optimization strategy (Olson 1971; Kreps et al. 1982; Ostrom 1990; Bornstein et al. 1990; McCabe et al. 1996). This could, for instance, mean that consuming less of a good can be rational, when fearing social sanctions. This would imply in our example that environmental activists fly less.

Additionally, other social incentives, not linked to reactions of other individuals, potentially play a role. For example, an individual might act on the basis of altruism. The literature often describes altruistic persons as ones, who would participate in improving a public good, even when not directly benefiting from its improvement (see e.g. Margolis 1983; Taylor 1987; Guagnano et al. 1994). An altruist might for instance consider to consume less of an environmentally harmful good with the goal of increasing the welfare of another person, even if the altruist does not benefit directly and even if her own influence

on the public good is negligibly small. I.e. in a situation, where it would be optimal to free-ride, an altruist might still contribute. So, altruism is considered to be the perceived obligation to cooperate in a public goods game, which is sometimes called "warm glow of giving" (see Andreoni 1990; Kahneman and Knetsch 1992). This means that even if large public goods are provided privately, i.e. without any state intervention, in the presence of altruists some level of the public good would still be provided.

Other internal social incentives may be based on social norms. Social norms are defined as a catalogue of generally accepted behaviour (see Elster 1985; Coleman 1986). Elster (1985) argues that social norms influence the willingness to pay in two ways: Firstly, some social norm (e.g. morality) may drive people to participate in the provision of a public good independently of the actions of others, if only it leads to an expected increase in overall welfare. Secondly, collective action can also arise through the norm of fairness. Contrary to morality, fairness might be conditional on the choices of other players (Elster 1989). An individual is only willing to cooperate, if enough other players do so as well (conditional cooperation). Once this threshold is reached, an individual considers the game to be fair and feels obliged to participate as well (Ostrom 2000).

Willingness to pay for public goods

The willingness to pay based on social incentives is independent on whether or not it improves the public good, as our discussion on social sanctions above shows. But there are situations when it is based on the preference for the public good itself as well. This happens when the public good can be provided by one person or reciprocity is feasible (i.e. cooperation is the dominant strategy). Reciprocal behaviour can increase the contribution of other players, which leads to a higher level of the public good (Axelrod 1984; Nowak and Sigmund 2005; Ule et al. 2009; Mani et al. 2013), though economic literature does not agree on whether it is dynamically stable (Andreoni 1995; Gale et al. 1995; Roth and Erev 1995; Palfrey and Prisbrey 1997).

A few factors can influence the probability of reciprocal cooperation, the most important of which is information. This is why Boyd and Richerson (1985), Güth (1995) and Börgers and Sarin (1997) argue that observable actions may increase cooperative behaviour, as individuals see how high cooperation actually is.[2] Cooperation can also arise

[2]Conversely, more information can also decrease cooperation, if it exposes a high number of defectors (Güth 1995; Keser and van Winden 2000; Fischbacher and Gächter 2010).

in public good games where actions are hidden, but all players are allowed to communicate (Frank et al. 1993; Sally 1995; Ostrom 1998). Then assurances based on trust can lead to collective action (Sen 1967; Shaw 1984; Sabia 1988).

The smaller the public good, the more feasible reciprocity is. Larger public goods are typically more costly to provide and correlated with larger groups of individuals, who are non-excludable from consumption. This decreases the marginal effect of an individual's contribution on the public good and decreases the probability of cooperation, even if the groups are heterogeneous and some players have a high willingness to pay for this public good (Esteban and Ray 2001; Pecorino and Temimi 2008).

So only if an individual believes that her own contribution has a high influence on the public good – which is the case when either the public good is very small or her influence on other individuals' contributions is high – cooperation is a stable outcome. Otherwise free-riding becomes optimal and the willingness to pay for the public good goes to zero. Note, however, there may still be some willingness to pay based on social incentives. Thus the sum of these two, the total willingness to pay, could nevertheless be non-zero. If individuals are not interested in improving the public good or reckon that their own contribution is marginal, they may still have a positive total willingness to pay for goods or services that supposedly improve the public good just to satisfy social incentives. Therefore, we propose to separately study these two kinds of willingness to pay and to consider the total willingness to pay for a public good as the sum of the two. This may also help to solve disputes in the economic literature on whether free-riding or cooperation is the dominant form of strategic action.

2.3 Model

2.3.1 Baseline Model

To keep our model as simple as possible, let us assume that an individual – in our case an environmental activist – can choose between consuming two goods x_1 (e.g. trees) and x_2 (e.g. flights) with a given budget restriction.[3] Additionally, this environmental activist is also concerned with the level of the environment e, which increases her utility with higher levels. Assume that good x_1 increases the level of the public good e, though

[3] x_2 can also be interpreted as the sum of all other consumption choices instead of flights.

insignificantly for a single individual. When planting trees (or paying someone to plant trees) the environmental activist receives some form of utility based on social incentives (e.g. conscience, social norms, reputation). x_2 negatively influences the level of the public good e. The utility is determined by the environmental activist's preferences α, β and γ for the level of the public good e, the social satisfaction derived from consuming x_1, and the consumption of x_2, respectively.[4] Assuming a Cobb-Douglas form, the utility function can then be written as

$$u(x_1, x_2) = e^{\alpha} x_1^{\beta} x_2^{\gamma} \tag{2.1}$$

In the next step, we have to specify the relation between x_1, x_2 and the public good e. Unlike for private goods, consumption of the public good e does not decrease its level (property of non-rivalry). We assume, that the level of the public good e in period t is dependent on its level in the previous period e_0 and the impact from all individuals $i = 1, 2, \cdots, n$, which we define as Δe_n. We assume that e can be written as

$$e = e_0 + \Delta e_n \tag{2.2}$$

The consumption of x_1 increases the environmental level e. x_2 has a negative impact on e.

If you consider large public goods, a single individual's consumption has either no or only a very small influence on the level of the public good, unless reciprocity plays a large role. Since cooperation based on reciprocity is unlikely for large public goods, we assume that the effect of an individual's consumption of good x_1 and x_2 on the environment e is negligibly small. A simple algebraic relationship between the consumption levels x_{1i} and x_{2i} of individuals $i = 1, 2, \cdots, n$ and the change in the environmental level Δe_n that satisfies the above assumptions is

$$\Delta e_n = \sum_{i=1}^{n} x_{1i}\theta_1 + x_{2i}\theta_2, \tag{2.3}$$

[4] An individual could of course also gain utility by consuming x_1 besides social incentives and the consumption of x_2 could be negatively impacted by social incentives. To keep the model as simple as possible, we omit these extensions for now.

where θ_1 is the influence of one consumed unit of x_1 on e. We assume that θ_1 is positive, but so small that $x_{1i}\theta_1 \approx 0$ for each single $i = 1, 2, \cdots n$. The same is true for θ_2, which we assume to be negative. Hence within an individual's utility function we can consider Δe_n as an exogenous term, and therefore

$$u(x_1, x_2) = (e_0 + \Delta e_n)^\alpha x_1^\beta x_2^\gamma \tag{2.4}$$

We assume that each individual's budget constraint can be written as

$$m = p_1 x_1 + p_2 x_2, \tag{2.5}$$

where m is the budget and p_j the price of good x_j for $j = 1, 2$.

Deriving the optimal bundle of goods with respect to x_1 and x_2, by maximizing (2.4) with respect to (2.5) we obtain the demand functions

$$D_{x_1}(p_1) = \frac{\beta m}{p_1(\beta + \gamma)} \tag{2.6}$$

$$D_{x_2}(p_2) = \frac{\gamma m}{p_2(\beta + \gamma)} \tag{2.7}$$

The resulting demand functions are identical to the ones of the standard Cobb-Douglas utility functions. It is important to note that the willingness to pay for x_1 and x_2 is independent of the preference α for the public good. Neither does the initial level of the environment e_0 nor the consumption of others, summarized in the Δe_n term, influence the individual willingness to pay for x_1 or x_2.

Assuming that this model describes the rational calculus of individuals with respect to large public goods in reality, we can derive the following: An individual, who is not interested in improving the public good or understands that their own contribution is marginal, still exhibits a positive willingness to pay for the public good due to social incentives, even if their contribution need not actually impact the public good. Environmental activists hence contribute an optimal amount that e.g. silences their conscience. By being environmentally active they still try to increase the level of the environmental good. This is possible for instance, if the preference for social incentives β of all other

individuals increased as well. So, one strategy could be to appeal to the conscience of all other individuals, which will be less feasible with larger public goods.

Our model explains multiple seemingly irrational decisions to pay for public goods. For instance, Desvousges et al. (1992) and Kahneman and Knetsch (1992) come to the conclusion that the willingness to pay for the rescue of birds seems to be independent of the number of birds actually rescued. This appears to be hypocritical at first glance. If people really care for the birds' welfare (public good), their willingness to pay should increase with the number of birds which can be rescued. But as the above model shows, it can be utility maximizing, and therefore rational, to just spend a specific amount of money on goods that supposedly improve the public good as the amount spent is not directly linked to the improvement of the public good but to any kind of social incentives.

The sum of all consumption choices of x_1 and x_2 influences the level of the public good. Knowing that one own's contribution does not influence the public good, this does not mean, that an environmental activist acts hypocritically, if she flies frequently. Therefore, flying frequently and being environmentally active is not a contradiction. On this individual level, the resulting change of the public good is only a non-intentional consequence of fulfilling social incentives, hence a positive externality. Furthermore, this does not imply that the public good cannot be influenced through other channels (e.g. via increasing all other individuals' β).

2.3.2 Quasi-Monarch Model

In our baseline model, an environmental activist can only marginally influence the level of the public good. However, the sum of all marginal contributions can add up to have a significant impact on the level of the public good, even if the impact of the single individual is negligibly small. The only way of influencing the contributions of all individuals – since we assume that reciprocity is not feasible – is to force a change in consumption patterns.

This is where the state can step in. By collecting taxes from its citizens, it can provide the public good, solve the coordination problem and force reciprocal behaviour. This shows how demanding the intervention of a public entity, while (apart from social incentives) individually defecting to raise the level of the public good remains the dominant strategy of an environmental activist.

To include this public enforcement mechanism into our framework, we add a direct per capita state consumption x_{1S} of good x_1 to our model. As it is financed through taxes, both the utility function and budget constraint need to be adjusted. Unlike individual consumption, the state consumption has a significant positive impact on the public good. In fact, its level is of the same order of magnitude as the total consumption of all individuals in our baseline model, as it is determined by the number of people in the state n and the desired level of per capita state consumption x_{1S}. We take the impact of one unit of x_{1S} on the public good to be identical to the impact of x_1 in the baseline model, which is θ_1. For simplicity, we assume that the state collects the same amount of taxes from all individuals. Therefore the more tax-paying individuals the higher the impact, or equivalently, the lower the per capita cost. Hence, the resulting level of the environmental good e equals

$$e = e_0 + \Delta e_n + n x_{1S} \theta_1 \tag{2.8}$$

and the utility function of an individual becomes

$$u(x_1, x_2) = (e_0 + \Delta e_n + n x_{1S} \theta_1)^{\alpha} x_1^{\beta} x_2^{\gamma}. \tag{2.9}$$

In comparison to the budget constraint of the baseline model, individuals have to in addition pay for the state consumption of x_{1S} in form of a lump-sum tax. Therefore,

$$m = p_1(x_1 + x_{1S}) + p_2 x_2 \tag{2.10}$$

In reality $p_1 x_{1S}$ is exogenous and should be thought of as decreasing an individual's budget m. To uncover the willingness to pay for the improvement of the public good, one could let an individual decide the level of state consumption, and hence tax contribution, for everyone including herself. As the effect of state consumption is substantial and everyone has to pay the chosen tax, nothing stops the individual from stating their true willingness to pay. We call this hypothetical construct the *Quasi-Monarch*.

Hence, we only need to solve the constrained optimization problem (given by equations 2.9 and 2.10) for an individual in order to derive the demand functions for x_1, x_2 and x_{1S}. A straightforward computation yields

$$D_{x_1}(p_1) = \frac{\beta(mn\theta_1 + p_1(e_0 + \Delta e_n))}{np_1\theta_1(\alpha + \beta + \gamma)} \tag{2.11}$$

$$D_{x_2}(p_2) = \frac{\gamma(mn\theta_1 + p_1(e_0 + \Delta e_n))}{np_1\theta_1(\alpha + \beta + \gamma)} \tag{2.12}$$

$$D_{x_{1S}}(p_1) = \frac{\alpha mn\theta_1 - p_1(e_0 + \Delta e_n)(\beta + \gamma)}{np_1\theta_1(\alpha + \beta + \gamma)} \tag{2.13}$$

The above demand functions are in line with our intuition and consistent with previous results. It is important to note that the willingness to pay for x_1 and x_2 decreases with larger n. Note, however, that per capita state consumption x_{1S} increases with n, as $\frac{\partial D_{x_{1S}}}{\partial n} > 0$. When optimizing, one unit x_{1S} has a higher total impact on the level of the public good – as it is multiplied by n.

Without state intervention, an individual can only increase her utility by consuming x_1 and x_2. Her own consumption (e.g. frequently flying) individually has a negligible effect on the public good. But the state can control the level of the public good by demanding everyone to contribute x_{1S}. Then the environmental activist would reduce her consumption of x_2, e.g. by flying less frequently, and reduce x_1 to maximize her utility. This shows that being an environmental activist and flying frequently is by no means contradictory or even hypocritical. An environmental activist demands a higher x_{1S} and will only start reducing her flights once a public entity intervenes and ensures her impact is not marginal anymore. Hence, the same individual makes different choices depending on the "rules of the game". The environmental activist aims to change these rules such that "choices within rules" improve the public good.

Without public intervention the level of the environmental good depends on the preference β for social incentives. If β is relatively high, a high level of the environmental good will be sustained, though not due to the utility derived from the enjoyment of the environmental good itself. Instead individuals consume x_1 based on their preference for social incentives, which in sum leads to a high level of the environmental good. Vice

versa, for a low β the environmental good e remains on a relatively low level, even when the preference α for the environmental good e is high. If the state intervenes, the level of e compared to the situation with no public provision depends on the preferences α and β.

Splitting up the willingness to pay for a public good in two parts is crucial for making policy decisions. Naturally, public entities have to provide multiple public goods, but their resources are limited, as the state cannot or does not want to collect more than a certain amount of tax. Hence, the question arises in which public goods a policy maker should invest.[5] Private versus public provision leads to different levels of a public good, depending on the preferences of individuals, as we showed in our framework above. Public entities could base their resource allocation decisions on the differences between these levels. If individuals have a relatively high preference for social incentives, they, in sum, already provide a relatively high level of the public good, and less state intervention is needed.

2.3.3 Extensions

We have so far made many simplifying assumptions, as is often the case in economic modeling.[6] For example, one can include a negative effect of x_2 on social incentives. This decreases the willingness to pay for x_2, while increasing it for x_1 (and x_{1S} in the Quasi-Monarch model). Many other extensions are feasible without changing the qualitative results presented in this paper so far. There exist some exceptions though.

Social incentives and the level of the public good

One could argue that social incentives depend on the level of the public good. For instance, an increasing level of the environmental good e may reduce the social reward an individual earns for consuming x_1, which in turn shifts consumption towards x_2 and x_{1S}. Assume we extend the baseline to capture such an effect. Would the level of e at optimum be larger or lower than for the Quasi-Monarch model described in Section 2.3.2? At first one might expect the level of e to be larger as the consumption of x_{1S} increases. However, since all individuals lower their consumption of x_1, the change Δe_n is substantial, and in fact larger than the preceding increase in e. Therefore, the environmental level e is actually lower than for the Quasi-Monarch model due to the stronger crowding-out effect.

[5] There is a large literature on the optimal provision of public goods (see e.g. Samuelson 1954; Olson 1971; Varian 1993; Anomaly 2015).

[6] The mathematical proofs of the following results can be made available on request.

Impact of state consumption on social incentives

We have assumed, that only private consumption has an impact on the utility based on the preference for social incentives β. However, we can easily imagine the case that higher state consumption x_{1S} is positively linked to internal motivations – e.g. soothes an individual's conscience as well. The optimal consumption of x_1 and x_2 would then decrease, while x_{1S} increases. With an increasing marginal utility of x_{1S}, the level of the public good e increases as well.

Overestimation of own impact

We argued that individual consumption choices, when considering large public goods, have a negligibly small impact on the level of the public good. Therefore, we assumed it to be zero. However, this is not true for smaller public goods or if people overestimate their individual impact on the public good. This can be caused by information asymmetries or the hope of reciprocity. The own consumption of x_1 could influence other individuals, so that they increase their consumption of x_1 as well. As a result, the willingness to pay for x_1 increases as its marginal utility increases. Therefore, x_{1S} decreases as it will be (partly) substituted by x_1. Finally, e increases in the model without state intervention, whereas it remains constant in the Quasi-Monarch model, if we assume homogeneous individuals. However, due to the overestimation of the own impact, the utility of an individual decreases in both cases, as the impact of the individual consumption on e isn't as large as expected.

2.4 Conclusion

In this paper we argued that frequent flying environmental activists do not suffer from hypocrisy, if they only demand the state to intervene but don't change their consumption choices on an individual level in the same manner. Despite a high preference for a public environmental good, it is optimal to free-ride, as individual consumption choices do not influence its level and hence their impact is marginal. Only the sum of all individuals' behaviour can alter the level of the good, but due to the lack of reciprocity this does not factor into decision-making. Nevertheless some level of the environmental good is

sustained, but only due to social incentives linked to the public good rather than the public good itself.

Environmental activists, however, will demand the state to intervene, as they understand that collective action is needed. To squash free-riding the state can force every individual to contribute towards the public good by for instance levying a tax. We suggested the following method to determine the individual willingness to pay for the tax: Treat one individual as Quasi-Monarch, who can set a level of state consumption for everyone including themselves, which resolves the free-riding incentive.

By considering the environmental activist as an example, we argued that the total willingness to pay for a public good is based on the utility derived from the public good itself and the associated social incentives. This split is important for making policy decisions. Politicians need to understand both the social incentives and the preference for the public good of their electorate in order to determine the optimal level of state provision of the public good. Studying interactions between preferences is important to prevent over or under supplying the public good due to crowding-out or -in effects. How to empirically measure these two types of willingness to pay needs to be subject of further research.

Chapter 3

Differentiating the Willingness to Pay for Public Goods and Social Incentives based on the Example of Animal Welfare

Niklas Gogoll & Felix Schlieszus[1]

3.1 Introduction

Theoretically, individuals' autonomous and independent purchase decisions lead to utility maximization. However, this should not be the case for public goods, where individual purchase decisions only have a marginal impact on the level of the public good. The willingness to pay for public goods should be zero, as free-riding is the dominant strategy. In this case, the intervention of a (public) entity is necessary to provide the public good and maximize the overall social welfare. Even though the effect of one individual is marginal, a larger strand of literature argues that coordination without any public intervention is nevertheless (at least in some cases) possible (see Warr 1982; Roberts 1984; Montgomery and Bean 1999; Ostrom 2000). They argue that social incentives (conscience, reputation, etc.) still lead to a positive willingness to pay for public goods. For example, some people compensate their flight emissions even if their individual compensation has almost no influence on climate change. However, they might silence their conscience by doing so or brag about their compensation in front of others (reputation).

[1]The authors contributed equally to this work.

Both considerations do not contradict each other as discussed in Gogoll and Schlieszus (2021b). While the "real" willingness to pay for the public good is zero without (public) intervention, individuals might have a positive willingness to pay caused by social incentives. In this paper, we aim to identify the two different kinds of willingness to pay. We introduce two scenarios to survey participants at the example of the public good animal welfare, i.e., the husbandry of chicken and male chick killing. In the first scenario, we focus on the willingness to pay without public intervention. The stated willingness to pay is caused by different preferences (e.g., for taste, health, and social incentives). By separating them we want to find the willingness to pay for social incentives. In the second scenario, we use a Quasi-Monarch setting (Gogoll and Schlieszus 2021b) to construct a referendum. In a regular referendum, individuals are given a standard (e.g., preventing male chick killing) and vote for or against this proposal. If the referendum is accepted, all individuals are forced to contribute to the provision of the public good. In this case, free-riding is not possible anymore. We use this property of a referendum to measure the willingness to pay for animal welfare and ask individuals up to which price they would still approve (vote with "yes") the referendum. We use the stated willingness to pay and separate it from other preferences e.g., for free choice. Doing this we want to gather the willingness to pay for the public good animal welfare. In summary, we want to measure the willingness to pay in the individual and the referendum case and separate different components to get the willingness to pay for social incentives on the one hand and for the public good on the other hand.

Our paper is structured as follows. The first chapter gives a theoretical foundation of animal welfare as a public good. We focus on the setting and methods to gather stated willingness to pay in surveys. Afterwards, we present the results of our survey and separate the components of the stated willingness to pay in the individual and the referendum case. We analyze the components in both cases and identify the willingness to pay for social incentives and the public good. Finally, we discuss the results from a theoretical perspective.

3.2 Methodology

Animal welfare is receiving more and more attention in German politics and society in general. For instance, the German government prohibits killing male chicks in laying hen breeding from 2022 onwards (Bundesministerium für Ernährung und Landwirtschaft 2021). Instead, the gender has to be determined inside the egg, or male chicks must be raised.

Generally, one would consider the husbandry system to be the most relevant attribute with respect to the preference for animal welfare. But husbandry systems might also be correlated with other preferences. It is, for instance, stated that organic eggs taste better (Bray and Ankeny 2017; Güney and Giraldo 2020) and are more healthy (Pettersson et al. 2016; Bray and Ankeny 2017). Responses in our survey supported this view strongly. In contrast, the killing of male chicks is not related to other preferences that could potentially influence the willingness to pay for eggs. Thus, killing male chicks seems to be an appropriate instrument for measuring the willingness to pay for animal welfare. For our survey, we differentiated the products by two attributes: the husbandry system and the killing of male chicks.

Animal welfare seems to be an excellent example to explain the difference between the two kinds of willingness to pay introduced above. In Germany, for instance, even though organic food is increasing in popularity, its market share is still relatively low. In 2020, organic fresh eggs had the highest organic share of food products in the basket of goods of German households with "only" 15,4 percent according to Bund Ökologische Lebensmittelwirtschaft (2021). However, some studies suggest that the majority of Germans would support increasing animal welfare levels if they were enforced on a public level (Bundesministerium für Ernährung und Landwirtschaft 2019; Sorg et al. 2021). This purchasing behavior can be explained by free-riding as there are around 45 million laying hens in Germany (Bundesanstalt für Landwirtschaft und Ernährung 2021). By buying organic eggs, the conditions of these hens, on average will not change significantly. The individual impact is marginal and one's utility should not increase by buying a product linked to better husbandry conditions. Hence, animal welfare can be defined as a public good.

This gap seems to be exactly what can be explained by the two types of willingness to pay we distinguish in our model (Gogoll and Schlieszus 2021b). The total willingness to pay in the case of the private provision will only be based on individual preferences such as social incentives or taste if reciprocity does not play a role. This way, a (small) share of the public good will be provided. In the case of public provision, the willingness to pay will additionally be based on the willingness to pay for increasing animal welfare. In our model (Gogoll and Schlieszus 2021b), we introduced an approach that enables us to measure this willingness to pay: the Quasi-Monarch. As a Quasi-Monarch, an individual can determine the level of contribution of every individual, including herself. Therefore, this individual has no incentive not to state her "real" willingness to pay because her impact is not marginal anymore. Following this model, we can determine the difference in the total willingness to pay for these two scenarios: One where every individual contributes on their own and one where the individual has the possibility of forcing everyone to participate in improving the level of the public good.

We implemented a referendum setting to compare these individual results to the Quasi-Monarch ones. Respondents were asked to imagine a scenario in which the state thinks about introducing a minimum standard concerning male chick killing or/and the husbandry system. Here, we ask for the maximum price for a carton of ten eggs, up to which respondents would still approve a referendum.

Multiple methods exist for measuring the willingness to pay. The availability of these depends on whether the willingness to pay for the respective public good can be measured directly and whether there is real data of market transactions available. To use real data to determine the willingness to pay for animal welfare, one would need to fluctuate market prices on an extensive level and in a controlled environment, which is often not feasible. Therefore, economic analysis uses stated willingness to pay approaches to indirectly determine the individual willingness to pay. The main two approaches are called choice experiments and contingent valuation.

Choice experiments are said to have multiple advantages over contingent valuation studies, making them popular in economic literature (Adamowicz et al. 1998; Hanley et al. 1998; Freeman et al. 2014). For instance, it is easier to include multiple different attributes into choice sets, which is why they have been highly used in market research (Louviere and Woodworth 1983; Adamowicz et al. 1998; Hanley et al. 1998). Using

a choice experiment, we would be able to include preferences for, in our example, the amount of eggs, the husbandry level, or whether the killing of male chicks is permitted in only one study. This hypothetical multi-attribute setting is typically better suited to model real scenarios, leading to a smaller influence of biases.

However, there are also disadvantages of choice experiments compared to contingent valuation studies. Choice experiments are typically harder to process cognitively (Adamowicz et al. 1998; Perman et al. 2011). Respondents might only focus on some aspects of the question without considering all options, or they might focus on specific labels to make a choice easier. And while some biases might be weakened in choice experiments, multiple other biases – most notably the hypothetical bias – still have to be taken into account. In our pre-tests choice experiments led to inconsistent and misleading results (Gogoll and Schlieszus 2021a). For example, individuals agreed to a specific price for a product in the referendum scenario but stated a lower willingness to pay in the same scenario in the next question. Furthermore, our results had such a large variance depending on the assumptions of calculating the individual willingness to pay that no implications could be drawn.

Therefore, we changed the approach in this paper. We decided to use a contingent valuation, where participants have to either state their willingness to pay directly (open-ended question) or have to confirm binarily whether they are willing to pay a specific amount for a given product. Contingent valuation suffers from multiple biases just as any survey method. The settings are, for instance, hypothetical in nature (hypothetical bias), focus on one specific aspect that participants might not have thought of beforehand (prominence bias), or suffer from biased strategic answers, if participants anticipate the survey design. A list of potential biases can be found in Perman et al. (2011) and Freeman et al. (2014).

In our survey, we implemented the contingent valuation setting by introducing sliders for all products in question. Participants were confronted with all product combinations (husbandry system and male chick killing) at once and had to state their maximum willingness to pay (in a range of 0 € to 10 €) while being able to see the difference between their stated willingness to pay for different properties respectively. We abstained from showing market prices for the various types of boxes of eggs in the question, to reduce the influence of the survey questions on the participants. We want to find out the

willingness to pay, hence the maximum amount they are willing and able to pay for a box of ten eggs. The actual price on a competitive market would just reflect the production cost of the producers and should be independent of the individuals' willingness to pay. Using sliders also means that we turned the intuitive process of buying products into a rational thinking process. On the one hand, this avoids inconsistencies comparing the stated willingness to pay to the referendum scenario. On the other hand, this might lead to inconsistencies and an even further gap between stated and revealed willingness to pay.

We repeated this slider setting in the referendum scenario. Each individual had to set a price for all combinations of husbandry level and male chick killing. For this price, the participant would just approve the referendum. The combination of barn and male chick killing was not presented as this represented (at the time of conducting the survey) the legal lower bound. To avoid social behavior – for example, thoughts of how other individuals would be affected by the stated price – we told respondents to only focus on themselves. The survey can be found in Annex A. Having acquired these two different kinds of willingness to pay, we aimed to compare the components of the individual willingness to pay without any referendums to the willingness to pay in the referendum case.

3.3 Data & Results

Our survey participants were non-economic students of the University of Bayreuth. The survey was implemented via Lighthouse Studio by Sawtooth Software. We evaluated 482 (53 of them incomplete) initial responses, of which we filtered out vegan students and those not buying eggs. These students were excluded because they do not have a trade-off between buying eggs and other products, i.e., their stated willingness to pay is unreliable. 352 responses remained.

3.3.1 Individual Willingness to Pay

We start by comparing and interpreting the individual willingness to pay without public intervention (figure 3.1).

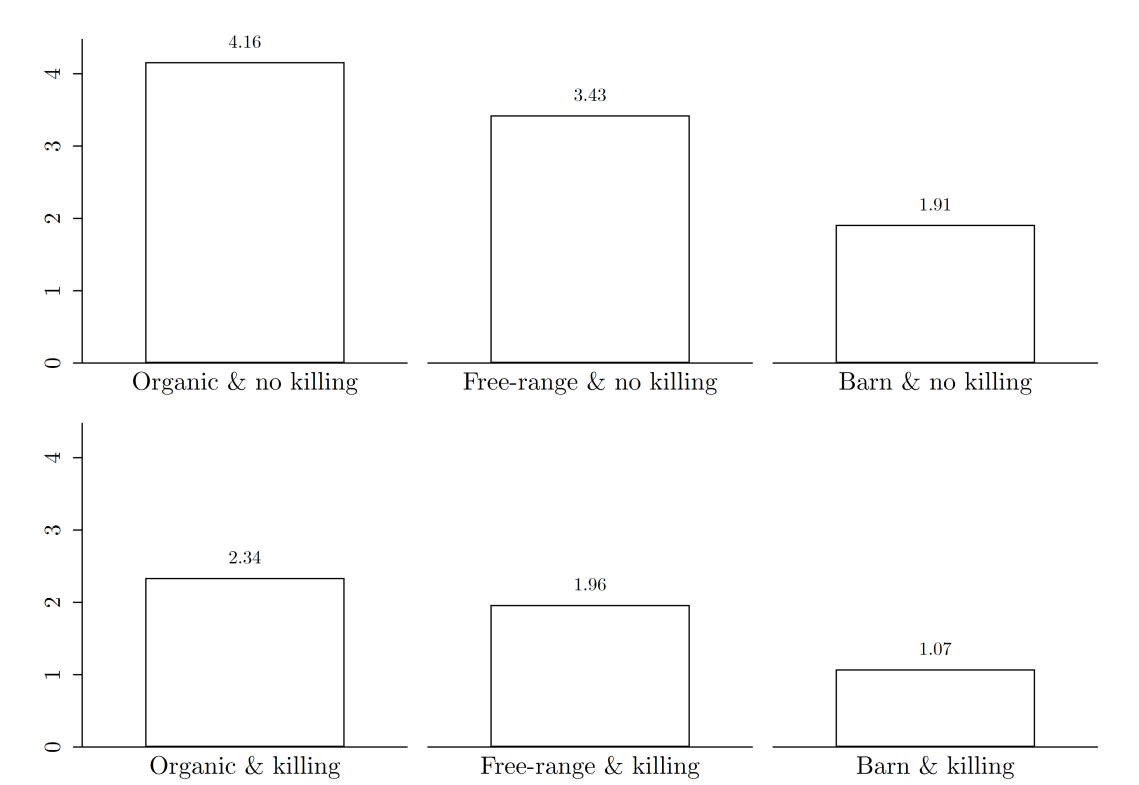

Figure 3.1: Individual willingness to pay for a box of ten eggs in € (mean)

Note that the stated individual willingness to pay differs significantly from average prices in the supermarket.[2] For products with male chick killing (lower row), only the average price for free-range eggs (1.96 €) is above the supermarket price (1.69 €). For organic (2.34 € < 2.89 €) and barn eggs (1.07 € < 1.29 €), the supermarket price is higher than the average stated willingness to pay.[3] This is in line with the participants' consumption behavior: Most students usually buy free-range eggs (figure 3.2).

[2] As reference we use prices for eggs gathered on 17th of June 2021 visiting an Aldi supermarket in Bayreuth.

[3] The observation holds for taking the median instead the mean. Medians: barn 0.85 €, free-range 2.00 €, organic 2.50 €.

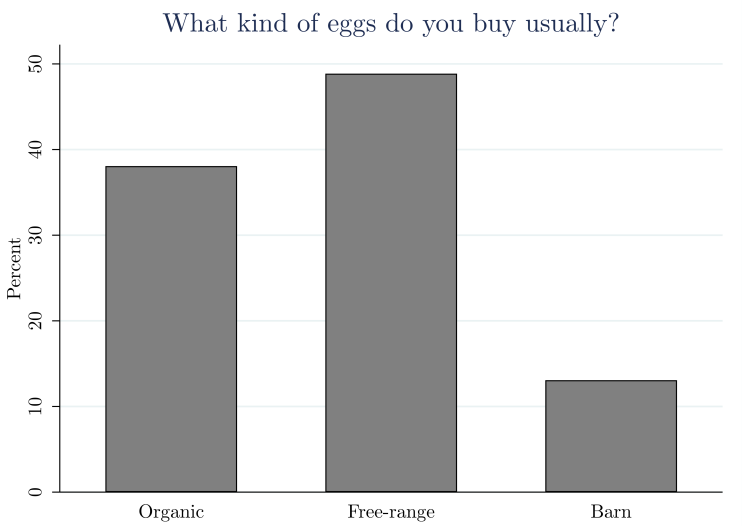

Figure 3.2: Usual choice of husbandry level at purchase

Compared to eggs with male chick killing, each willingness to pay without this property is on average higher than the respective supermarket price. At first glance, this seems to be a contradicting result. It suggests that consumers buy different packages of eggs simultaneously in one purchase as the willingness to pay is higher than the actual price in the supermarket. For sure, this is not the case. The willingness to pay states the maximum amount a person is willing and able to pay for a good. Following the economic theory, a willingness to pay can be calculated using a budget and a utility function. Both of these functions include at least two goods. Otherwise, the entire budget would be spent for one good as no opportunity cost exists. In our setting, survey participants are not directly confronted with their opportunity cost. Each individual might interpret opportunity cost differently depending on how the question is understood. On the one hand, the reference good can be a numéraire. In this case, the willingness to pay gives the maximum amount of money for a box of eggs if no other eggs are available. The trade-off is between eggs and all other goods. On the other hand, the reference goods can be other varieties of eggs. As eggs can be seen as substitutes, a consumer would only buy one product in each purchase situation with the best ratio between marginal utility and price. This implies that the prices of the other varieties of eggs are known or assumed implicitly. Thus, stating a willingness to pay depends on what other varieties of eggs are available at which prices. As no reference prices were given in the survey, we interpret the willingness to pay for a box of eggs as if no alternative eggs were available. However, it is important to keep in

mind that the results in the survey might include both interpretations of willingness to pay, which would lead to different conclusions.

Besides husbandry, we also asked participants if they usually buy eggs with male chick killing. In addition, we offered a third option where participants could state that they are unaware if they are buying eggs with or without male chick killing. We added this option as many pre-testers mentioned this property being unknown to them. Only one of the respondents answered that she is buying eggs with male chick killing, whereas about 40 percent responded that they do not buy eggs with chick killing. However, the majority (about 60 percent) did not know whether they buy eggs with or without chick killing.

The stated preference for killing male chicks seems to influence the individual willingness to pay (figure 3.1). Regressing the individual willingness to pay on male chick killing (while controlling for husbandry) shows an average decrease by 1.32 € for a box of ten eggs. This is the average amount individuals are willing to pay additionally for a box of ten eggs if produced without the killing of male chicks in our survey. Such an interpretation would assume that the willingness to pay for male chick killing is independent of the husbandry level. However, this is not the case as the difference between the willingness to pay for male chick killing varies significantly for the different types of husbandry: For organic eggs, the difference is -1.82 €, for free-range -1.46 €, and for barn -0.84 €. One possible reason is that some participants are unwilling to pay for products with low husbandry standards. Their willingness to pay for these products is zero. Let us assume that one individual is not buying eggs with a husbandry level barn. The resulting difference for eggs with male chick killing and without for barn would be zero. Thus, it is likely that the difference between products with and without male chick killing increases with the husbandry level.

The higher the husbandry standard, the more likely a willingness to pay above zero exists. Excluding participants that have a willingness to pay of zero from the regression leads to a lower willingness to pay for the prevention of male chick killing on average. However, the differences between the willingness to pay for male chick killing given different levels of husbandry decrease but do not disappear.

As explained before, the stated individual willingness to pay without public intervention includes a willingness to pay for social incentives. So far, we implicitly assumed that abstaining from male chick killing has the same effect on social incentives for all

husbandry levels. Hence, this should result in the same willingness to pay for male chick killing. However, this might not be the case. Knowing that male chicks are not killed, but the remaining female chicks suffer under worse husbandry conditions might not, or only in a small amount, silence one's conscience. If we think of our conscience as a production function, the different goods needed to produce "conscience" are possibly not substitutes but complements or something in between substitutes and complements. And to make this even more complex: The form of the production function might even be different for every individual. This can explain why for higher husbandry levels, the willingness to pay for no killing of male chicks increases as its effect on social incentives is higher.

Similarly, we can interpret the changes between the different levels of husbandry (table 3.1).

	Organic - Free-Range	Free-Range - Barn
No Killing	0,73	1,52
Killing	0,38	0,89

Table 3.1: Differences of the willingness to pay between husbandry levels

Note that the amount people are willing to pay for better husbandry decreases with its level. On average, they are willing to pay around double as much for an improvement from barn to free-range than from free-range to organic. Diminishing returns on the utility seem to be a plausible reason. However, a lack of knowledge concerning the definition of "organic" might also drive the results. It is unclear if people know which living standards are provided to hens under organic husbandry. Furthermore, even the various organic certificates differ significantly in their husbandry standards.

The diminishing returns could be caused by three utility components: taste, health, and social incentives. Which of these factors is driving the results is not immediately apparent. Most of the participants see a strong influence of animal welfare on taste and health, as figure 3.3 shows.

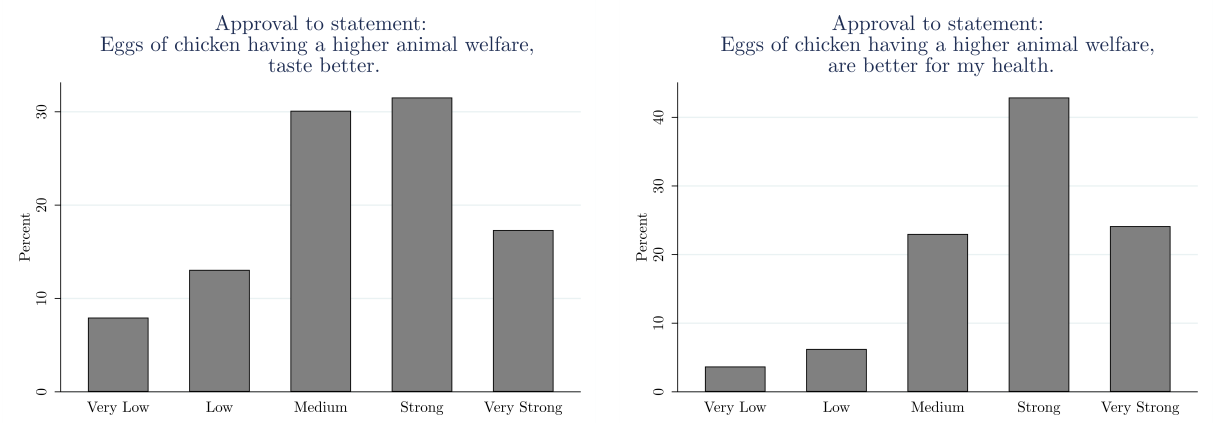

Figure 3.3: Factors influencing individual willingness to pay

We further asked participants to bring price, taste, health, and animal welfare into order regarding their influence on the decision to buy a product. Especially health and animal welfare are the most important criteria (figure 3.4). This is in line with the previous results.

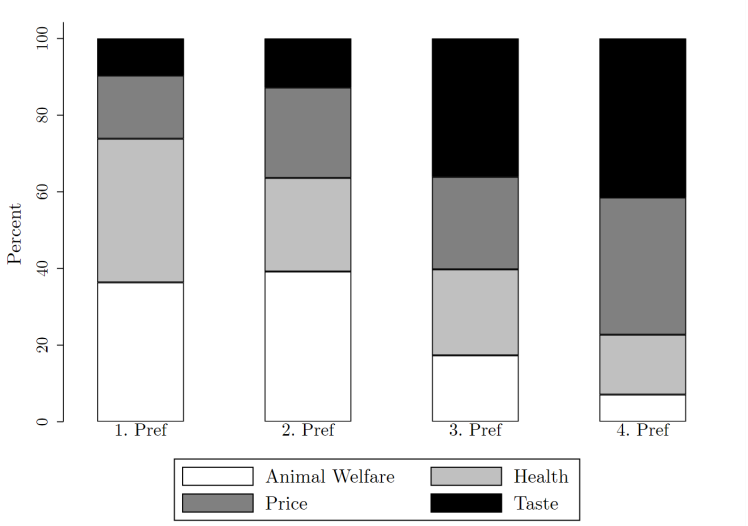

Figure 3.4: Preferences

3.3.2 Willingness to Pay with Public Intervention

In the second part of our survey, participants were asked about their willingness to pay in the referendum case (with public intervention).

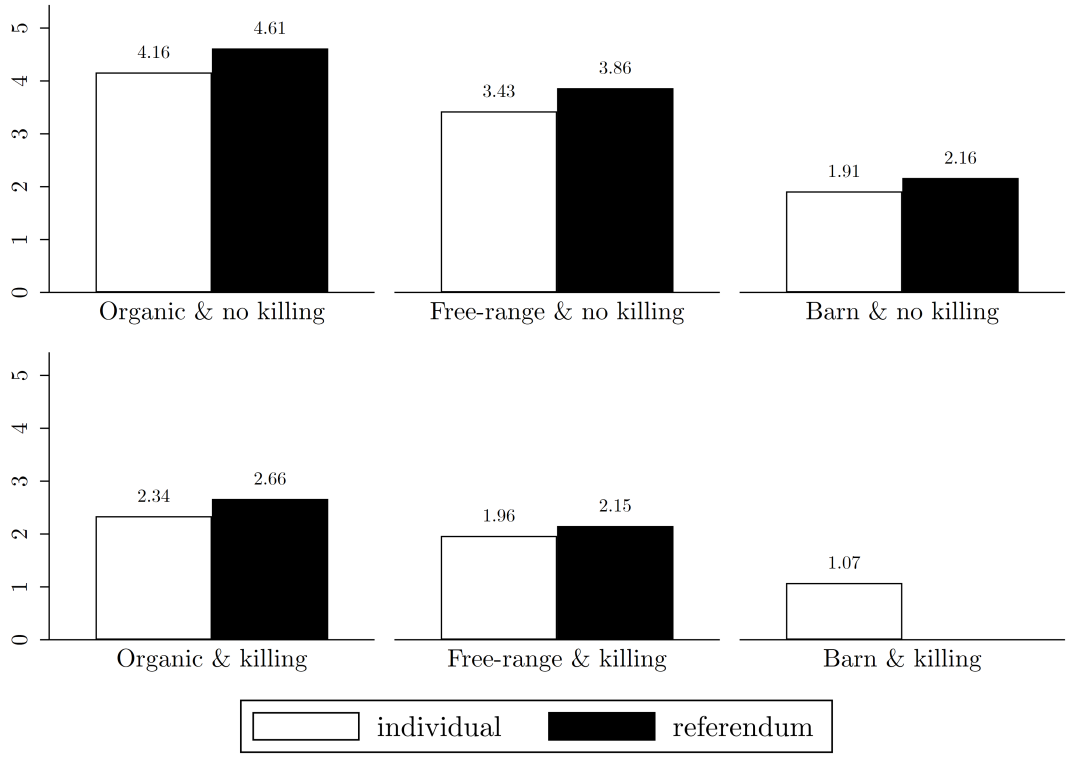

Figure 3.5: Comparison of the two kinds of willingness to pay for a box of ten eggs in € (mean)

As depicted in figure 3.5, there is a significant difference between the stated individual willingness to pay and the referendum case. The higher willingness to pay in the second case suggests that people are aware of the free-rider problem. We asked individuals in which case and why they would be willing to pay a higher price for eggs: In the individual case, in the case of the state setting a certain standard, or the same amount in both cases.

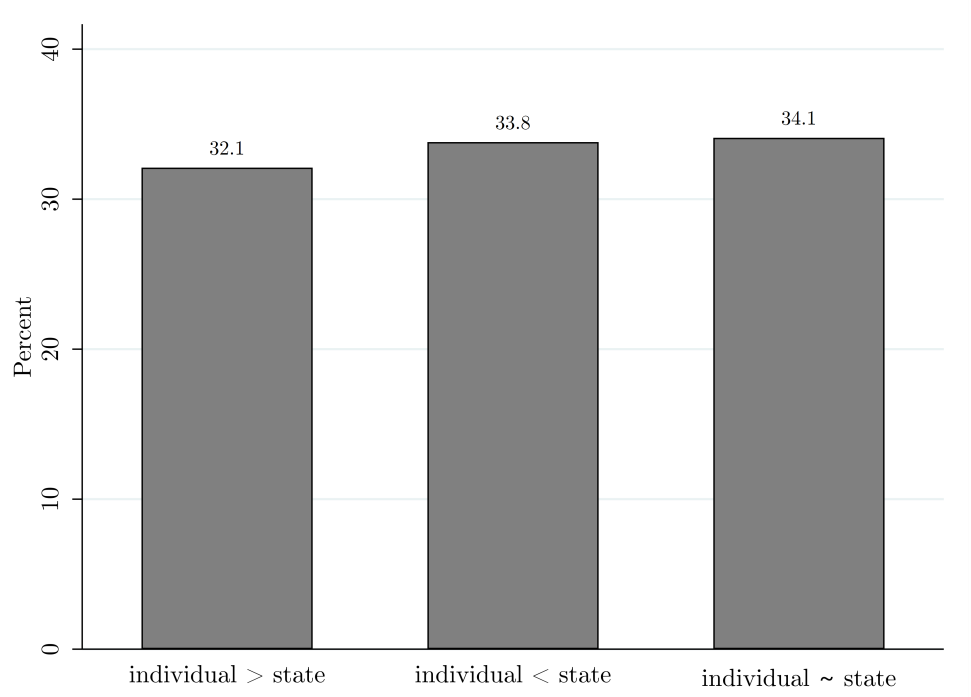

Figure 3.6: Individual choice vs. state standard

Figure 3.6 shows that the options are chosen almost equally. However, all groups have a similar willingness to pay for all products, i.e. the referendum willingness to pay is higher than the individual one. Individuals who prefer a public standard argue mainly that an individual choice leads to free riding. But also other reasons are stated: Some individuals argue that a public standard reduces transaction costs as they do not have to inform themselves anymore about the level of animal welfare. Others argue that forcing oneself to a certain standard is easier, a merit argument suggesting missing self-commitment. However, this argument is only valid if individuals see animal welfare as a private or small public good, not as a large public good. Missing self-commitment implies a mismatch of short-term and long-term utility maximization. Buying eggs with a lower husbandry standard provides a utility gain in the short term, whereas it diminishes utility in the long term. A utility decrease implies an impact on the welfare of hens, which is not given if the individual impact is marginal.

People that prefer an individual choice have various consistent arguments as well. They are mainly based on preferences for a free choice:

Firstly, individuals might experience uncertainties regarding their present and future income. Especially at the end of the month with decreasing budget, they still want to be able to buy eggs. This reasoning shows an interesting property of animal welfare.

It can be defined as a luxury good as described by Baumol et al. (1979). Only when other preferences are satisfied to a certain degree the preference for this good turns into a willingness to pay. In other words, a change in income – not a change in preferences – drives the demand for the public good. With public intervention, people with lower income are also forced to accept a certain standard, even if they do not want a higher level of the public (luxury) good. The answers of this and another survey, we conducted with around 1000 participants (Gogoll and Schlieszus 2021a), indicate a strong positive correlation between willingness to pay for higher standards and the income of the households.

Secondly, students argued that – even if they could afford and want a certain standard – they do not want to force other individuals having lower incomes to provide this level of welfare. Regarding policy implications, it seems to be reasonable in case of introducing new standards regarding animal welfare to compensate lower incomes in order to establish a Pareto-superiority.

Thirdly, even if individuals are willing to pay for the provision of the public good today, they might disagree with a standard tomorrow. Individuals argue that they want to be free to choose the level of a specific good regularly, as is the case with private goods. Individuals can change their desired amount of a private good in the next period to maximize their utility. For public goods, this is hardly possible. If a standard is set, it is unlikely to change within the following years. For producers, this establishes reliability in expectations, which is necessary in the case of public goods. If a standard for animal welfare increases, the demand for certain kinds of eggs, e.g., with male chick killing, would become zero. This example shows that from an economic perspective, a flexible change of the level of the public good is hardly efficient. In turn, fixed standards can fail to achieve the household optimum if income or preferences change. This leads to a willingness to pay for being able to choose between all options or – the other way around – a willingness to pay against the implementation of a standard.

A last group of individuals is against a standard even though they are aware that the current standard is below their desired consumption amount of the public good. They argue that the decision regarding animal welfare is a personal decision. This argument is still valid while being aware of the free-rider problem. We can interpret it as a kind of constitutional preference: Even if introducing a standard for this public good would increase the individual's utility, introducing standards for other public goods might de-

crease their utility even more. To prevent the establishment of standards for other public goods, an individual can be willing to abstain from the desired standard regarding this public good.

We have seen that there are arguments for and against the establishment of standards, which are increasing and decreasing the stated willingness to pay for public intervention. Just interpreting the measured amount as "real" willingness to pay is too simple as other factors also play an important role. This is essential if our findings shall be translated into policy implications because various preferences must be considered. These preferences can be (partly) fulfilled with different political measures. By separating the components of the willingness to pay, policymakers can analyze these instruments more precisely and select the welfare maximizing ones.

3.3.3 Comparison of the Individual and Referendum Willingness to Pay

In the following chapter, we identify and compare the two kinds of willingness to pay, based on figure 3.5. Intuitively, one would interpret the difference between the stated individual and the stated referendum willingness as the willingness to pay for the public good animal welfare. However, this is not necessarily the case. Firstly, the individual willingness to pay depends on social incentives. Secondly, the referendum willingness to pay is biased by various other preferences (e.g., for free choice as explained above). These preferences influence the stated willingness to pay. Thus, let us first take a theoretical look at the components of the stated willingness to pay for each scenario.

In this paper, we differentiate between the following components:

1. Apart from other preferences, the pure willingness to pay for eggs (WTP_{eggs}) without any other properties is constant.

2. The willingness to pay for taste and health ($WTP_{taste\ \&\ health}$) might vary between but not within husbandry levels.

3. The willingness to pay for social incentives (WTP_{si}) exists in the individual case and can be separated into one for the husbandry level ($WTP_{si\ husbandry}$) and one for the prevention of male chick killing ($WTP_{si\ no\ kill}$). We assume that no willingness to pay for social incentives is involved in the referendum case.

4. The willingness to pay for animal welfare (WTP_{aw}) exists only in the referendum case and can be separated into one for the husbandry level ($\text{WTP}_{\text{aw husbandry}}$) and one for the prevention of male chick killing ($\text{WTP}_{\text{aw no kill}}$).

5. The willingness to pay can also depend on other preferences not covered in this list ($\text{WTP}_{\text{other}}$). For example, the willingness to pay for free choice should only be present in the referendum scenarios. However, it is unclear whether and how much this willingness to pay differs between the implemented standards. For now, we assume that these other preferences only exist in the referendum case and are constant therein.

Let us compare the individual willingness to pay (WTP_{ind}) and the willingness to pay in the referendum case (WTP_{ref}) with and without male chick killing. For simplification, we describe the stated willingness to pay for each scenario cumulatively:

$$WTP_{\text{ind;kill}} = WTP_{\text{eggs}} + WTP_{\text{taste \& health}} + WTP_{\text{si husbandry}} \tag{3.1}$$

$$WTP_{\text{ind;no kill}} = WTP_{\text{eggs}} + WTP_{\text{taste \& health}} + WTP_{\text{si husbandry}} + WTP_{\text{si no kill}} \tag{3.2}$$

$$WTP_{\text{ref; kill}} = WTP_{\text{eggs}} + WTP_{\text{taste \& health}} + WTP_{\text{aw husbandry}} + WTP_{\text{other}} \tag{3.3}$$

$$WTP_{\text{ref; no kill}} = WTP_{\text{eggs}} + WTP_{\text{taste \& health}} + WTP_{\text{aw husbandry}} + WTP_{\text{aw no kill}} + WTP_{\text{other}} \tag{3.4}$$

Calculating the total willingness to pay by adding the different components implies that the components are independent of each other. For example, the willingness to pay for preventing male chick killing would be independent of the one for the husbandry level. However, our data and results do not support this assumption. Social incentives but also animal welfare might partly be perceived as a complement. For instance, one's conscience is not silenced, knowing that no male chicks are killed while the laying hens must still endure bad husbandry conditions. For practical reasons, we will keep the additive character but calculate the willingness to pay separately for different husbandry levels and the property of chick killing.

We calculate the willingness to pay for the different components using the stated formula. For the willingness to pay for social incentives for preventing male chick killing, we can subtract the stated individual willingness to pay, including male chick killing (equation 3.1) from the stated individual one without male chick killing (equation 3.2). The difference should be the willingness to pay for social incentives to prevent male chick killing. For example, for free-range eggs we get:

$$WTP_{\text{si no kill}} = WTP_{\text{ind;no kill}} - WTP_{\text{ind;kill}} = 3,43\,€ - 1,96\,€ = 1,47\,€$$

Calculating the willingness to pay for animal welfare follows the same intuition. By subtracting the stated referendum willingness to pay for eggs with male chick killing (equation 3.3) from the stated referendum one without male chick killing (equation 3.4), we get in the free range case:

$$WTP_{\text{aw no kill}} = WTP_{\text{ref;no kill}} - WTP_{\text{ref;kill}} = 3,86\,€ - 2,15\,€ = 1,71\,€$$

Table 3.2 shows the results for all types of husbandry:

	Organic	Free-Range	Barn
WTP_{si}	1,82	1,47	0,84
WTP_{aw}	1,95	1,71	1,09

Table 3.2: Calculating the willingness to pay for preventing male chick killing

We calculate the willingness to pay for social incentives and animal welfare for different husbandry levels with the same approach. As stated above, the willingness to pay for the husbandry level varies with the property of male chick killing. Therefore, we have to calculate them separately. Another reason for separating the willingness to pay is the diminishing marginal utility of increasing standards. As social incentives for husbandry cannot be distinguished from preferences for taste and health, we can only calculate the aggregate. Table 3.3 shows the results.

	barn → free-range		free-range → organic	
	kill	no kill	kill	no kill
$WTP_{\text{social incentives}} + WTP_{\text{taste \& health}}$	0,89	1,52	0,38	0,73
$WTP_{\text{animal welfare}} + WTP_{\text{taste \& health}}$	1,08	1,7	0,51	0,75

Table 3.3: Calculating the willingness to pay for different types of husbandry

The calculation for the willingness to pay for animal welfare (equation 3.3 and 3.4) includes the component WTP_{other}. It reflects that the willingness to pay in the referendum case is biased by other preferences and restrictions, which increase (↑) or decrease (↓) the willingness to pay stated in the referendum scenario:

- merit preference (↑): force oneself to consume a better husbandry standard,
- information restriction (↑): transaction cost induced by comparing standards of the respective products,
- income restriction (↓): possibility of buying eggs with low income in the present and future,
- social preference (↓): everybody should be able to buy eggs,
- optimization restriction (↓): a fixed level of animal welfare prevents flexible individual optimal budget allocation,
- constitutional preference (↓): public intervention in one area might be followed by others in various areas.

The calculation above implies that the willingness to pay for the described components is equal for all referendum scenarios. However, in reality, this seems to be unlikely. For example, the willingness to pay for the prevention of male chick killing resulting from social preferences is probably higher having better husbandry conditions. Thus, other preferences bias the calculated willingness to pay for animal welfare.

Furthermore, all calculated results could also suffer from a prominence bias. This bias occurs when surveys focus on a topic that respondents usually do not focus upon in their decision-making. This leads to greater attention compared to a real shopping situation. As mentioned above, the majority (about 60 percent) did not know whether they buy

eggs with or without chick killing. However, as most respondents understand that the survey is about animal welfare, they may overstate their respective willingness to pay.

Biases are, in general, very prominent in contingent valuation approaches. Some authors even argue that contingent valuation approaches are not feasible to measure the willingness to pay in general (Diamond and Hausman 1994 and Hausman 2012). Schläpfer and Hanley (2006) for instance, argue that the "real" willingness to pay in referendums in Switzerland is considerably lower than the one measured via contingent valuation beforehand. Thus, our survey's stated individual and referendum willingness to pay may be biased.

It is not our goal to precisely estimate the willingness to pay for animal welfare and social incentives. Instead, we aim to specify the functional form and the components of the willingness to pay in our two scenarios. Therefore, these biases are relevant and noteworthy, but more importantly we have to highlight some theoretical challenges in more detail in the following discussion.

3.4 Discussion

With the theoretical framework introduced in the last chapter, the components of the willingness to pay linked to public goods can be analyzed consistently. However, there are still some theoretical challenges and considerations primarily linked to interpreting the (public) good animal welfare, which are discussed in the following chapter.

Animal welfare as a good

For animal welfare to be part of an individual's utility function, it has to be seen as a good. In contrast to common goods, animal welfare cannot be bought directly but is rather linked to animal products such as milk, meat, or eggs. The production conditions of these goods determine the level of the good animal welfare. Thus, the good is a result of externalities. People consuming products from animals unintentionally affect the utility of other people. Buying products linked with high (low) animal welfare leads to a positive (negative) external effect. Several public goods show this property: Climate (change), for instance, is a result of externalities. Neither flying nor planting a tree is a direct purchase decision for or against the public good climate. However, each decision influences the

public good. Thus, the property that the public good cannot be purchased directly (like a dike for coastal protection) is not a reason for not treating it as a (public) good that influences individuals' welfare.

In contrast to the public good climate, animal welfare can traditionally be characterized as a psychological external effect. In comparison to technological externalities, this implies that the induced cost of the external effect cannot be measured directly. The loss of utility for every individual has to be estimated by using each individuals' willingness to pay. Even though the impact of a change in the level of the public good cannot be measured directly, it is still part of the utility function and thus should not be ignored. Instead, we see utility as a holistic concept where all aspects of human life impacting their welfare are covered. Other examples like social justice show intuitively that intangible goods are essential for individuals' utility. Thus, also goods that affect humans without a physical relation have to be analyzed by economists and policy makers potentially have to intervene. If the public sector decides to intervene and provide a public good, this intervention must be based on the (correct) willingness to pay for these goods. Otherwise, politicians can misuse such psychological externalities to set standards for increasing their own individual welfare. This is possible since the cost are not as inter-subjective measurable as for technological externalities. Only by measuring changes in the willingness to pay, this misuse can be prevented.

Animal welfare in theory, practice and survey

In economic literature, a public good is defined as a good that is non-rivalrous and non-excludable in consumption. Interpreting animal welfare as the overall (or average) welfare of animals, these characteristics are fulfilled. Nobody can be excluded from the utility of higher overall animal welfare, and the utility gained by one individual – for instance, due to better husbandry systems – does not decrease the utility of another person.

While animal welfare must be understood as a public good theoretically, this does not have to be the case in reality. Comparing the theoretical arguments to the already cited market data supports the definition of animal welfare as a public good though. On the one hand, "only" 15.4 percent of the fresh eggs that are purchased by German households are organically produced (Bund Ökologische Lebensmittelwirtschaft 2021). On the other hand, studies suggest that the majority of Germans would support increasing animal

welfare levels if they were enforced on a public level (Bundesministerium für Ernährung und Landwirtschaft 2019; Sorg et al. 2021). One could explain this difference with the property non-excludability, which establishes the incentive to free-ride and not participate in the provision of the public good. The influence on the overall level of animal welfare is marginal, because the size of the public good is large. Small-sized public goods can be provided – even without public intervention – using different mechanisms (Olson 1971). As there are around 45 million laying hens in Germany (Bundesanstalt für Landwirtschaft und Ernährung 2021), overall animal welfare can definitely be viewed as a large public good. For an individual, it is almost impossible to change animal welfare via financial sponsoring or claiming reciprocal behavior.

To control for this view, we asked individuals in our survey to what extent they agree with the following statement: "With my purchase of eggs, I personally influence chicken's well-being."

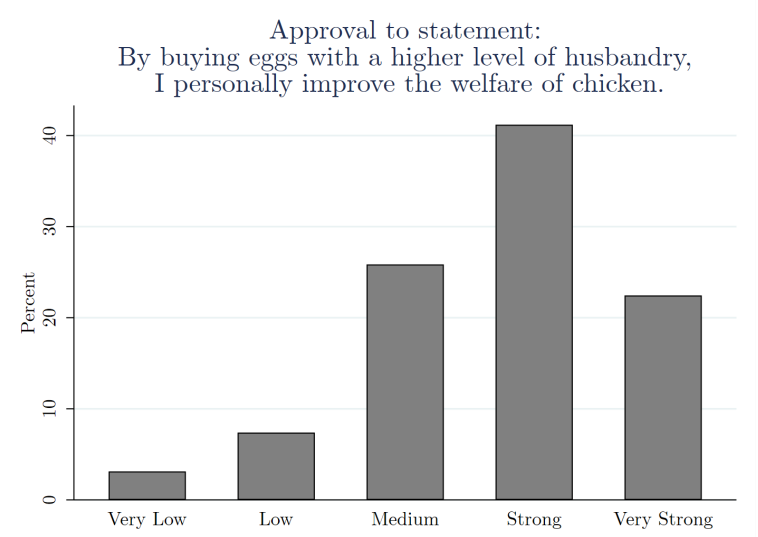

Figure 3.7: Well-being of chicken and personal choice

As figure 3.7 shows, about 60 percent of the participants state that with their purchase, they have a strong or even very strong influence on the well-being of chicken. This does not seem to be in line with the definition of a public good and contradicts the theory the market data introduced above. How can these responses be explained?

Firstly, the problem might stem from the composition of the participants of the survey. The survey participants are not a representative draw of the population. Therefore, a sample-selection bias might be present. This can be supported by the socio-demographic

factors of the survey participants compared to the whole population (age, university environment, low tax payment).

Secondly, individuals might not understand animal welfare as a large public good. The aggregate of animal welfare consists of the welfare of single animals. Consumers might focus on the well-being of these single animals, which they support with their product choice. For an individual, it is more important not being responsible for one or some badly treated animals instead of being interested in improving the average or overall well-being of animals. In this case, the good "animal welfare" is a small public good, and each individual has a non-marginal impact. The individual purchase decision leads to an increase or decrease in a single animal's welfare.

Individuals might also change their behavior based on this view. As explained above, if their impact is not marginal anymore, they can change the level of the public good on an individual basis. They might then even try to compensate the "missing" willingness to pay of other individuals. By paying more for animal welfare they can achieve a higher level of animal welfare. Thus, the individual willingness to pay might be higher than in the referendum case. If a standard is enforced by law, for individuals it is not necessary to compensate for the behavior of others. Thus, they might decrease their willingness to pay in the referendum case.

Even if individuals understand animal welfare as a public good, many participants supposedly do not see a difference between paying individually or with public intervention. Some of our respondents do not see the benefit of a publicly forced provision of the public good. However, this is crucial for our calculation of the different kinds of willingness to pay. If people do not understand the rules of the game, we can fairly expect them to distinguish plausibly between the two scenarios. This is supported by a strand of literature suggesting that individuals have to understand the rules of the game before they are able to maximize their utility. In repeated public goods games, individuals may start with cooperation in the first iterations. But this cooperation breaks down after the players understand the rules of the game (see e.g. Andreoni 1995; Gale et al. 1995; Roth and Erev 1995; Palfrey and Prisbrey 1997; Cooper and Stockman 2002; Guillen et al. 2007; Feige et al. 2014). This would mean that many respondents may not have thought enough about animal welfare to understand it as a public good and the need for public provision through establishing public rules.

3.5 Conclusion and Implications

In this paper we aimed to identify and analyze the willingness to pay for social incentives and the public good animal welfare. Therefore, we implemented a contingent valuation survey. Individuals had to state their willingness to pay for a box of ten eggs with different husbandry levels and with and without the killing of male chicks. Individuals had to take this choice under two scenarios: In one scenario, they had to choose individually, in the other scenario, they had to state their willingness to pay in a referendum setting. In the latter setting, the chosen price was the upper bound for which they were just willing to approve the referendum and the implementation of the respective standard(s). Deducted from the model we established in Gogoll and Schlieszus (2021b), the willingness to pay in the first case should include individuals' social incentives. The willingness to pay in the second case should include their "real" willingness to pay for the public good.

The stated individual willingness to pay for one attribute varied across the products. For example, the willingness to pay for the prevention of male chick killing was higher for the husbandry level organic than for barn. This might indicate, that these properties are seen more as complements than substitutes. In contrast, the willingness to pay for switching from free-range to organic is lower than the willingness to pay from barn to free-range. Beside information asymmetries regarding the husbandry standards, a plausible explanation is also diminishing utility. However, the diminishing utility might be linked to the preferences of taste and health and not necessarily to social incentives.

The measurement of the willingness to pay in the referendum case showed, that beside a preference for animal welfare other preferences and restrictions influence the stated willingness to pay as well. Merit preferences and transaction cost due to screening of standards increase the willingness to pay whereas a desire of free choice due to income restriction, social preferences, optimization restriction and constitutional preferences diminish the stated willingness to pay.

The main purpose of our survey was not to gather a precise estimate of the willingness to pay for social incentives and animal welfare. Instead, we were aiming to give a consistent theoretical framework for differentiating the two kinds of willingness to pay and other components. Thus, we split the different components and tried to give a way

for calculation. As a result we should get – from a theoretical perspective – the "pure" willingness to pay for social incentives and the public good.

But there is more to measuring the willingness to pay consistently. It is required to decide whether public intervention is necessary or not. This also covers the question which standard to set. The optimal provision of the public good not only depends on the willingness to pay for social incentives and the public good but also on the production cost. For discrete standards like preventing male chick killing or organic husbandry, specific production costs exist. Due to social incentives, individuals are willing to pay for a certain standard without public intervention. Eggs of this standard will be bought even without public intervention if the willingness to pay is above production cost. Thus, some level of the public good will be provided already. The willingness to pay through social incentives is higher than the cost of the standard. For example, the individual willingness to pay might exceed the production cost to prevent male chick killing. Then, no public intervention is necessary. For a high husbandry standard like organic, the cost of production might exceed the willingness to pay for social incentives. Now, public intervention is needed if the willingness to pay for the public good is above production cost.

This is in line with other examples for public goods: In Germany, no law forces people to vote in elections, e.g., for the parliament. However, more than 50 percent of the German population votes regularly. In contrast, flying is not decreasing even though climate change is a well-known problem. This might be explained by ("production") cost for voting being perceived as low whereas ("production") cost of reducing flying is perceived as high. In the first example, the cost can be "covered" by social incentives. Even if an individual's influence is marginal, the cost might also be perceived as marginal. For the second example, this is not the case.

Following our model, the need for public intervention is given if, on the one hand, the cost of production exceeds the willingness to pay for social incentives and, on the other hand, it is below the willingness to pay for the public good.

Chapter 4

How Willingness to Pay leads to Public Choice

4.1 Introduction

On a free market individuals exchange their goods to increase their utility. The market mechanism (under perfect competition and information) normally leads to a Pareto efficient allocation for private goods: Individuals exchange goods and services until no ones' utility can be increased without diminishing the utility of somebody else (Arrow and Debreu 1954; Mas-Colell et al. 1995). However, for public goods, this mechanism fails. Although individuals have a preference for the provision of public goods, their "genuine" willingness to pay for the good will not be revealed on the market due to the free-rider problem (Samuelson 1954; Olson 1971; Brubaker 1975; Sandler 1992). Only a small share of this willingness to pay – to fulfill social incentives such as silencing one's conscience or gaining reputation (Gogoll and Schlieszus 2021b) – will be revealed on the market. The free-rider problem results in a provision of public goods via the market mechanism, which is below optimum. However, the existence of public goods, such as national defense, infrastructure or even climate is crucial for the individual utility. The question remains, if and (if so) how individuals can satisfy their preferences for public goods if not via the regular market mechanism.

For small public goods (pubic goods consumed by a limited number of individuals in a small area) free-riding will be less dominant (if it exists at all) due to reciprocity (Axelrod 1984; Nowak and Sigmund 2005; Ule et al. 2009; Mani et al. 2013). Social incentives such as the fear of social sanctions or the hope of social benefits (Olson 1971; Kreps et al. 1982; Ostrom 1990; Bornstein et al. 1990), but also social incentives not linked to reactions of other individuals e.g. altruism (Margolis 1983; Taylor 1987; Guagnano

et al. 1994) can stabilize the revealed willingness to pay. Especially for large public goods that many people can access across a country, region or the world this mechanism fails. Instead, an entity is needed which forces individuals to pay and that uses the collected money to provide public goods. This might be a government, which collects taxes and determines the level of public goods provided. However, this level is neither set arbitrarily nor independently of individuals' choices since in democracies the government is elected by the same individuals.

Public choice literature i.e the median voter theorem explains this process of provision of public goods (Black 1948; Downs 1957; Black 1958; Holcombe 1989; Batina and Ihori 2005). The theorem uses the voters' preferences and budgets to establish a convergence process of parties, which leads to the provision of public goods. However, it is not possible to model the supply within this framework. I tried to solve this problem by implementing the willingness to pay in a common price-quantity diagram. This representation helps with modeling the supply and makes it easier to analyze changes of preferences and budgets.

In this paper, I aim to show with a simple microeconomic model, how the willingness to pay determines a voter's choice of a political party. In contrast to a "common" household optimization, for individuals it is not possible to simply pick the optimal level of a public good. The level of the public good is the same for all households within a state. Thus, I will analyze how individuals maximize their utility choosing between non-optimal combinations. This optimization behavior is reflected in the voting decision of each individual. Using this calculus and including a supply side that produces the public good enables to analyze the behavior of politicians as self-interested mediators between supply and demand. Finally, I aim to answer the question: How does the individuals' willingness to pay lead to the provision of public goods?

For this purpose, I develop a simple microeconomic model in several steps: First, I analyze how a voter will optimally allocate her budget given a government and a certain level of the public good. Second, I will analyze which party a voter will choose, given arbitrarily proposed combinations of quantity and price of the public good (which determines the amount of private goods an individual can consume). Third, I will explain how this calculus of the voter determines the provision of the public good in the cases of a political monopolist, perfect competition and imperfect competition on the political market. Finally, some possible implications of the model are drawn.

4.2 Model

4.2.1 Utility Maximization for a Fixed Level of a Public Good

At first, I want to show how an individual maximizes its utility given a fixed level of a public good. This can be shown by starting from the perspective of one utility-maximizing individual. Let the utility be given by a common Cobb-Douglas function

$$U(x_c, x_p) = x_p^{\alpha} x_c^{\beta} \tag{4.1}$$

with one private good x_p and one public good x_c. α shows the preference for the private good relative to the preference for the public good β. For simplicity, the private and the public good will not be differentiated further. Assuming that

$$0 < \alpha < 1 \text{ and } 0 < \beta < 1 \tag{AS1}$$

ensures that both goods are part of the utility function. Using monotonic transformation allows to assume that

$$\alpha + \beta = 1. \tag{AS2}$$

The budget restriction is given by

$$m = x_p p_p + p_c x_c. \tag{4.2}$$

Public goods are characterized by the properties of non-excludability and non-rivalry in consumption. Every unit of the public good x_c is available to all individuals. Thus, the price for one unit of the public good does not have to be paid in total by each individual. Let the price for one unit of the public good p_c be the individual share of the total price for one unit of the public good. This share is given by the price for one unit divided by the number of tax payers.

Compared to a "common" household optimization with respect to two private goods, the individual cannot choose the level of the public good it wants to consume. The consumption of the public good is equal for each individual within a state. Let the level

of the public good be set by the government. Every citizen has to pay the poll tax $p_c x_c$. The individual's optimal response is to take the remaining part of the budget, which is not needed for financing x_c, and using it for the consumption of x_p.

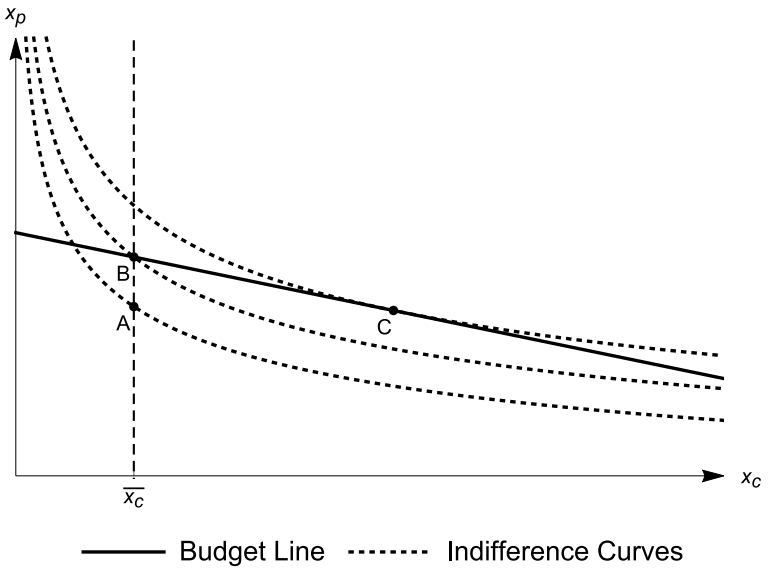

Figure 4.1: Household optimization with quantitative restriction

Assume that the provided level of the public good is given by $\overline{x_c}$. Now consider for exemplary points A, B and C. Starting from point A, the individual can achieve a higher utility (indifference curve) if it spends more on the private good x_p. At point B, the budget is completely spent. The only option to further increase the utility (without exceeding individual's budget) is by shifting consumption from the private to the public good, e.g., point C. However, this is not possible due to the fixed consumption level of the public good. Thus, the best response for a given level of $\overline{x_c}$ is given by

$$x_p^* = \frac{m - \overline{x_c} p_c}{p_p}. \tag{4.3}$$

4.2.2 Selection of the Utility Maximizing Combination

Different political parties propose different (for now randomly selected) combinations of a level/amount x_c and price p_c of the public good. $x_c * p_c$ is the total amount each individual has to pay for the proposed level of the public good. This amount is collected as income independent poll tax. Knowing how an individual will maximize its utility for a given level of the public good, let it now choose between these different proposed combinations. The

individual elects the party that proposes a combination that is maximizing its utility.[1] The elected party collects the announced poll tax and provides the proposed combination. Thereby, the product $x_c * p_c$ times the number of tax payers represents the maximum amount which can be used for financing this level of the public good.

Which combination will be chosen by this individual, if it can choose between different proposed combinations of parties? To answer this question, let us compare five proposed example combinations D to H (see figure 4.3). At first, we can consider the individual's budget. The curve that determines the maximal affordable consumption level of x_c is given by dividing the budget m by the price of the public good p_c. Solving for x_c yields

$$p_c = \frac{m}{x_c}.$$

This provides the budget curve (see figure 4.2).

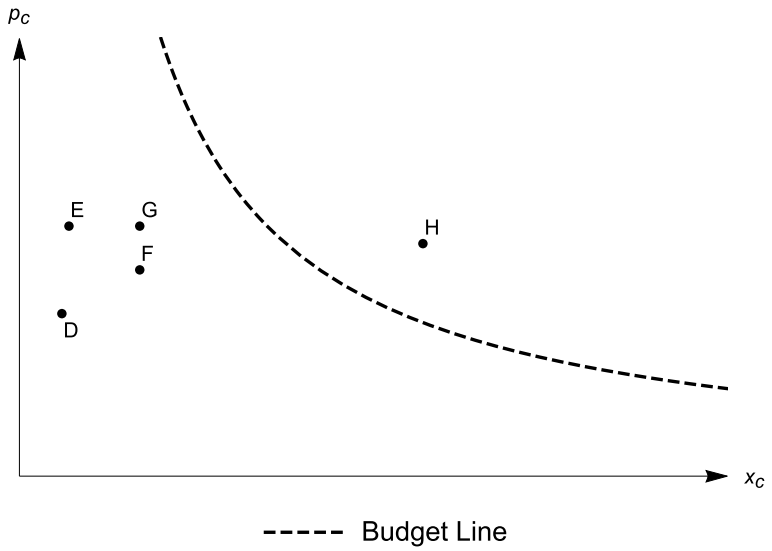

Figure 4.2: Budget curve

On this curve the budget is completely spent for the public good. The resulting utility is zero as no private goods can be consumed. Combinations above the budget curve are not possible in this model. The poll tax would exceed the budget of the individual. Thus, combination H in figure 4.2 can be ruled out.

[1] For simplicity, strategic voting behavior will not be considered.

A second way of comparing the remaining combinations is by implementing a common demand curve (see figure 4.3)

$$D(p_c) = \frac{\beta m}{(\alpha + \beta) p_c}. \tag{4.4}$$

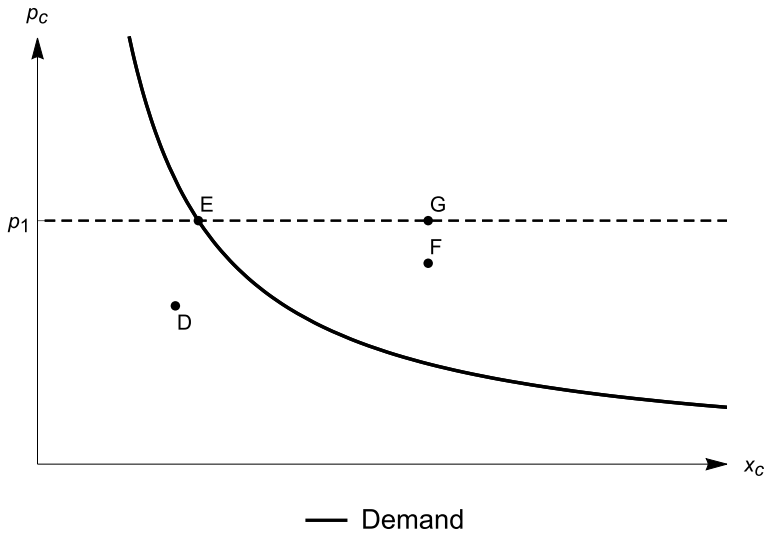

Figure 4.3: Demand curve

For regular household optimization, this curve shows for a given price p_c the utility-maximizing level of the considered good. However, that does not imply that the utility for the individual is equal everywhere on the demand curve. On the contrary: The utility along the demand curve increases as the price decreases (proof see Annex B.1). An individual would prefer any point on the demand curve with a lower price. Thus, if multiple combinations are proposed on the demand curve, those with higher prices can be ruled out. For a fixed level of the public good, an individual would always prefer the combination with a lower price (proof see Annex B.2). Now consider two combinations with the same (unit) price, but different levels. Assume that the levels are both lower or both higher than the level on the demand curve. The combination closer to the demand curve gives a higher utility as preferences are single-peaked (proof see Annex B.3). Thus, we can rule out point G as a possible choice of the considered voter (see figure 4.3).

It is likely that not all proposed combinations are lying on the demand curve or have the same price or the same level of the public good as another combination. Therefore, the only reasonable measure for evaluating the remaining combinations is the direct comparison of the resulting utilities. Calculating the respective utility yields that combination

D gives the highest utility ($U_D = 65; U_E = 62; U_F = 59$)[2] and is thus chosen by the voter. For a more general and non-discrete comparison of different combinations, all points with the same utility can be depicted on an "indifference curve" in the price-quantity diagram. Using the utility function (equation 4.1) and substituting the private good x_p by the optimal response function for the respective good (equation 4.3), yields a utility function that only depends on the public good x_c,

$$U(x_c) = \left(\frac{m - x_c p_c}{p_p}\right)^{\alpha} x_c^{\beta}. \tag{4.5}$$

Setting this expression equal to a constant utility value ($\overline{U}$) and solving for the price p_c yields the respective indifference curve[3] for a constant utility value:

$$p_c = \frac{m - p_p(\frac{\overline{U}}{x_c^{\beta}})^{\frac{1}{\alpha}}}{x_c} = I_{\overline{U}}. \tag{4.6}$$

Using the calculated utility of the three combinations and implementing the respective indifference curves gives figure 4.4:

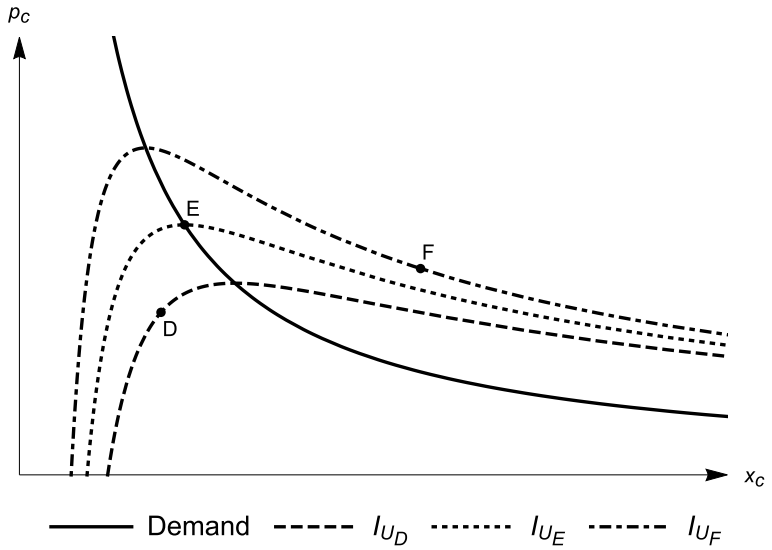

Figure 4.4: Indifference curves in the price-quantity diagram

A comparison of the three different indifference curves shows that the higher the indifference curve, the lower its utility. This is in line with the previous observation that combinations on the demand curve have a higher utility the lower the price. Each

[2]Values calculated by setting $\alpha = 0.8$, $p_p = 7.5$ and $m = 1000$.

[3]It is important to mention that in contrast to a "common" indifference curve this one includes the budget, which is needed to calculate the consumption of the private good.

indifference curve has its maximum price on the demand curve. For a given utility, this point represents the highest price possible. If the consumer has to consume an amount of the public good which is not on the demand curve, the price of the public good must be lower to keep utility constant. The lower price compensates for the undesired level of the public good that the individual has to consume. This compensation results from the possibility to buy more public goods (points right to the optimum) or more private goods (left to the optimum). The deducted indifference curves in the price-quantity diagram enable us to compare every proposed combination of political parties. Now, it is possible to investigate whether and how parties anticipate voters' optimization to maximize their votes.

4.2.3 Supply of Parties

So far, the combinations of the public good, proposed by different parties, were just arbitrarily chosen. However, it is reasonable that the selection of these combinations by parties follows a certain calculus. Public choice literature suggests that politicians want to (mis)use their power to maximize their own welfare (Downs 1957).[4] This can be done by collecting more taxes for the provision of public goods than actually needed. The difference between the cost of production for the public good and collected tax revenues can be used for increasing their welfare.

For calculating this difference we have to implement the supply of public goods into the model. Let us assume that we have a perfect competitive market where different firms produce the public good. For simplicity, we further assume that the public good can be produced at constant marginal cost. Fixed cost are included in the marginal cost (long-term perspective) or absent. As we consider public goods, the individual marginal cost for a unit c_c is equal to the total cost for a unit divided by the number of taxpayers.

To increase their welfare, politicians can propose a level of x_c at a higher price than production cost (see combination G in figure 4.5). The difference μ, which is the price they get from the taxpayer p_c minus the price that they have to pay for the production of the public good c_c, aggregated over all provided public goods, represents their welfare

[4] With his book "An economic theory of democracy" Downs (1957) was the pioneer of analyzing political behavior based on the utility maximization of politicians. Many further literature relates to and is based on his ideas. Another important model in this context is the budget-maximizing model developed by Niskanen 1971. In comparison to Downs, he focuses on budget-seeking of bureaucrats, which are not investigated in this model.

gain (striped square). For an individual, it represents a loss of utility as the individual can spend less on private goods. This difference can be considered as an inefficiency.

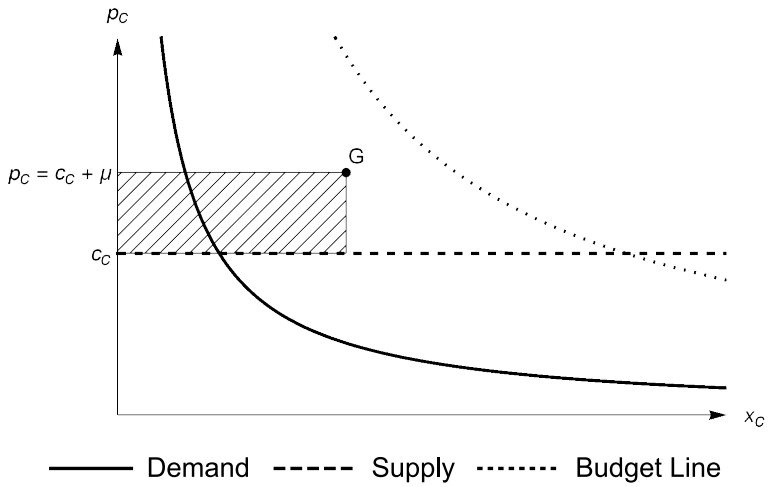

Figure 4.5: Rent-seeking of politicians

The following subchapters aim to analyze how different types of markets (monopolist, perfect competition, imperfect competition) lead to the provision of public goods. Is and (if so) in which way is the inefficiency maximizing calculus of politicians restricted and guided by the willingness to pay of individuals?

4.2.3.1 Monopolist

Let us consider the situation of a monopolist on the political market. Having a political monopolist implies that there are no other parties and there is no competition and no reelection restriction (autocracy).

Compared to a market of private goods with one monopolist, people do not have the freedom to stop their consumption. They are forced by law to pay the tax, which is set by the government. However, they can refuse to pay it. This is in line with utility-maximization calculus if the sanction multiplied with the probability of detection is lower than the price p_c multiplied with the amount x_c set by the monopolist (Becker 1968). Furthermore, they can leave the country (exit option) to escape high tax rates. Compared to the avoidance cost a private monopolist induces, these options are costly for individuals. As a consequence, limiting the power of the government by legal restrictions seems to be important for a society. Bad governance resulting in a dysfunctional political competition is decreasing the welfare of a society massively.

Let us determine the optimal provided level of the public good for a political monopolist. Looking at only one individual, the political monopolist can enlarge its rent by increasing the price p_c. In order to fully obtain the individual's budget it is reasonable to focus only on combinations on the budget curve. Revenues are equal for every combination on the budget curve. The highest profits can be generated by providing only slightly more than zero public goods as the aggregated costs are at the lowest due to the small amount of produced public goods. However, for the people's utility, it is the worst case. It is likely that more and more people will try to choose the exit option, avoid paying taxes, or have an incentive to work against the political monopolist by building an opposition and/or starting a revolution. In this model, the individual marginal cost for one unit of the public good c_c would increase as the number of tax payers decreases. This would lead to a reduction of inefficiencies of politicians as more of the revenues are needed to finance the public good.

For sure, the political monopolist has an incentive to take measures to prevent such behavior. However, this induces costs in addition to the costs caused by successful tax evasion. Therefore, it seems to be inefficient to increase the price too heavily for only a small level of the public goods. Enlarging the provided amount of public goods in combination with a small mark-up for every unit, might be a more efficient strategy. If the monopolist provides a unit cheaper (i.e. where marginal costs are lower than the imposed tax rate), his accumulated rent increases with every additional supplied unit. Thus, it is likely that in non-competitive political markets, the government will provide an excessive amount of public goods, especially those where they can secretly set a price that is drastically above the production cost.

4.2.3.2 Perfect Competition

Let us switch from a political monopolist to a perfect competitive political market. In contrast to a political monopolist, parties have to win an election first. For simplicity, we use a first-past-the-post electoral system, where the party with most votes wins an election and forms the government. Thus, it is always the primary goal of parties to garner the most votes among all parties.

Parties can propose a combination on the supply-curve or above. Combinations below the curve are not affordable as the tax revenues are not high enough to cover the cost of

production. However, parties could try to attract voters by proposing such combinations. If parties only want to be elected one time ("one shot game"), voters might believe that the proposed combination is offered. In more stage games with a competitive political market, this strategy is likely to fail as individuals will not reelect a party that did not keep their promises and elect a different one. For simplicity, we assume perfect information s.t. the proposed combinations are also finally offered.

If a party proposes a combination above marginal cost of production, another party has an incentive to provide the same amount at slightly lower prices. The voter will always vote for the party that proposes the same level at a lower price since utility is higher for the individual (see previous section). This competition will result in an efficient provision of public goods at cost of production. The result is identical to Down's efficiency theorem (Downs 1957).

The question remains which level of the public good parties will propose. If there is just one voter (or all voters are equal regarding their preferences and budget), a party will propose its combination at the intersection of the supply and demand curve. Every other combination has a lower utility for the consumer or is not feasible.

Let us now take a look at a situation with three voters having the same preferences but different budgets. The resulting three demand curves can be seen in figure 4.6.

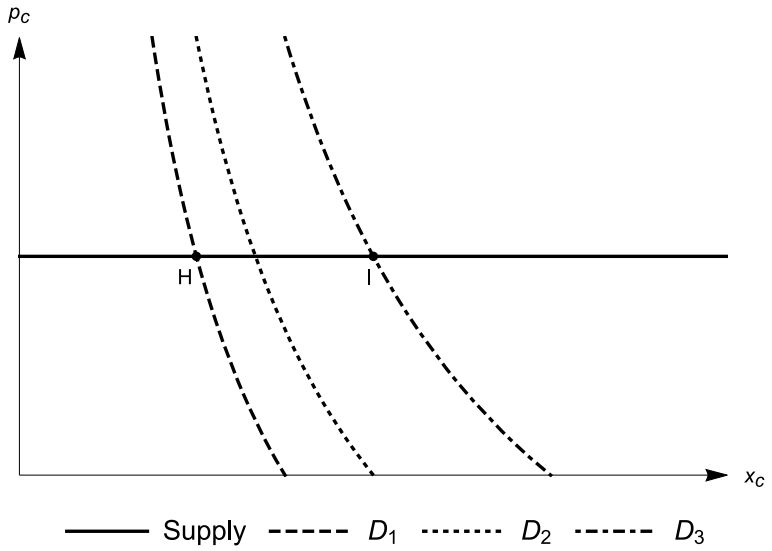

Figure 4.6: Different individuals and proposed combinations of parties

Individual three (one) has the highest (lowest) budget resulting in the highest (lowest) willingness to pay for the public good. Assume that we have two parties, each proposing a combination of public goods at marginal cost of production. Let party one start from

point H, party two from I. In this situation, voter one would vote for party one and voter three for party two as it is their optimal choice. For voter two, both combinations are not optimal. We can investigate its voting choice by comparing its indifference curves for the two given combinations (figure 4.7).

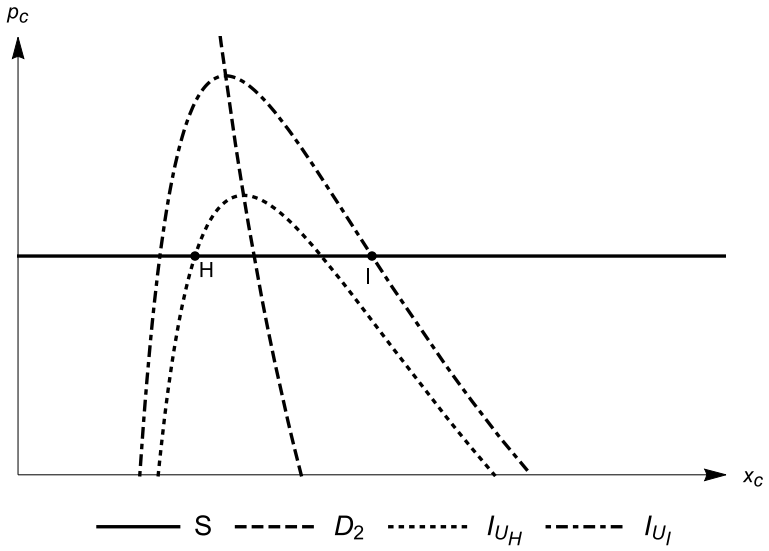

Figure 4.7: Indifference curves of voter two

The dotted and dot-dashed curve show the two indifferent curves with the respective utility that voter two would get if party one (combination H) or two (combination I) is elected. The utility of voter two is higher if party one wins the election and combination H is provided (lower indifference curve). Party two anticipates the voter's choice and has an incentive to change the proposed combination to win the election. Voter two will switch his choice if the combination leads to a higher utility. This is the case if party two proposes a combination between the intersections of the indifference curve of combination H with the marginal cost function. For example, this is combination K in figure 4.8.

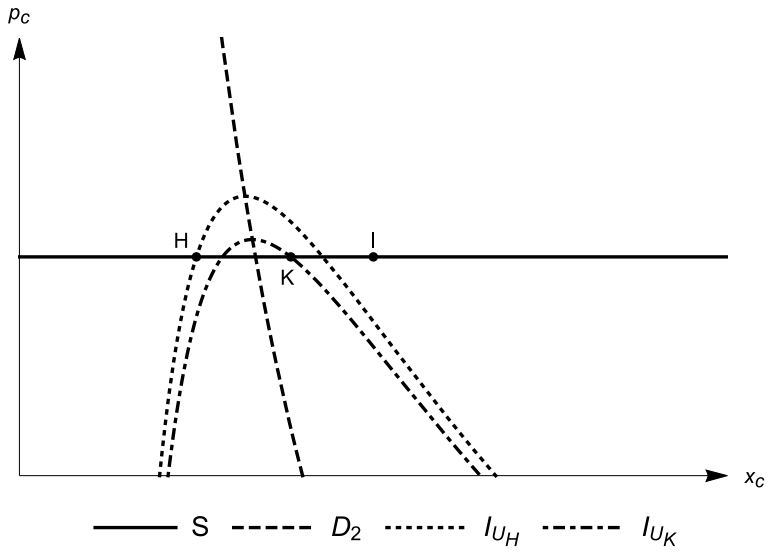

Figure 4.8: Anticipation of losing party

If party two provides combination K, voter two will switch, and party two will win the election if the choice of voter one and three remains unchanged. This condition holds as the utility of voter one and three are monotonously decreasing for all combinations beside their maxima at the intersection of their demand and supply (see proof Annex B.3). Due to the change of the proposed combination of party two, party one would now loose the election and has an incentive to change its proposed combination as well. Crucial is again voter two. If party one would, for example, try to get the vote of voter three, she will always lose voter one and not win the election if she does not convince voter two as well. Thus, party one will choose a combination between the intersections of the indifference curve of combination K with the marginal cost function. This process of anticipation leads to a convergence to combination L, the optimal combination of voter two, see figure 4.9.

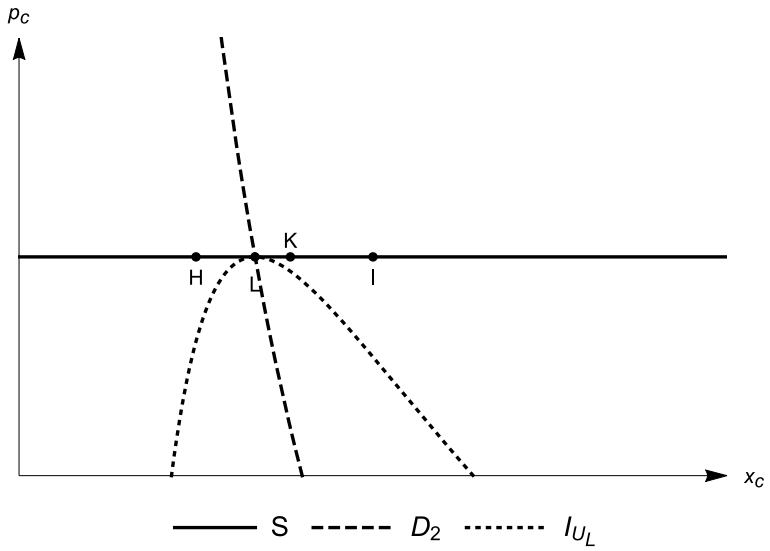

Figure 4.9: Convergence to median voter

If both parties propose combination L, they are in equilibrium, as they do not have an incentive to change their combination. Any other combination would lead to losing the vote of voter two and result in losing the election. This convergence process leads to the same result as the median-voter theorem, i.e., parties will always propose the combination of the median voter (see Hotelling 1929; Black 1948; Downs 1957; for a literature review of median voter theorem see Holcombe (1989), Batina and Ihori (2005), and Adams et al. (2020)).

So far we have used the strong assumption of constant marginal cost of production for the public good. However, it is possible that marginal production cost are increasing with the level of the public good. For example, for an environmental public good like climate, for a higher level of the public good emissions have to be decreased. Whereas the first unit of emissions can be avoided at quite low cost, for every further unit the marginal abatement cost increases. Thus, figure 4.10 shows a supply function with increasing marginal cost.

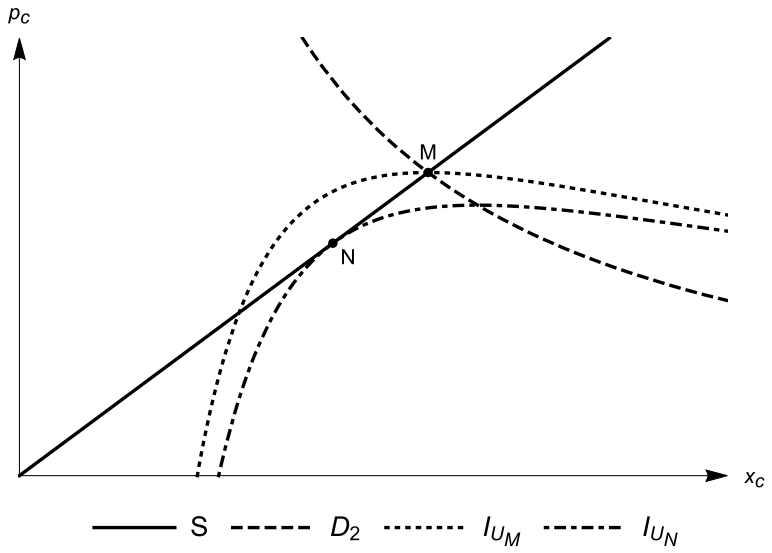

Figure 4.10: Convergence to median voter at increasing marginal cost

For constant marginal cost of production the intersection of the supply and demand of the median voter determines the utility maximizing combination of the voter. This equilibrium gives a utility for individual two that is demonstrated by the indifference curve I_{U_M}. In contrast to the intuition, this is not the utility-maximizing point for voter two on the marginal cost curve. He would prefer a lower consumption of the public good x_c. The utility-maximizing point for individual two is reached at point N.

The process of convergence of parties to the combination of the median voter is constant though. Each individual has its maximum on the marginal cost curve. Beside its utility maximum the utility is monotonously decreasing on the marginal cost curve, hence the path that parties will propose combinations on (proof see Annex B.4). Thus, the same process of anticipation of parties and convergence results. Only the final proposed combination of the parties is at point N and not at point M, the intersection of the demand and supply curve.

4.2.3.3 Imperfect Competition

Following the literature, the median voter theorem holds only for two parties (Rowley 1984). A higher number of parties does not lead to a stable equilibrium (except with very strong assumptions) (Adams et al. 2020). With only two parties proposing combinations, it seems reasonable to assume that they have some scope to generate inefficiencies. The start remains the status quo situation as before (3 voters, 2 parties 1 & 2 proposing combinations H & I respectively, see figure 4.7). In addition, let us assume that they

produce as many inefficiencies as possible in order to increase their welfare. However, their first goal remains winning the election, so that they are able to collect taxes to misuse them. As before, party two wins the election as voters one and two vote for this party. In contrast to the previous situation, party two would not propose a combination on the marginal cost curve. To win the election and gain welfare by inefficiencies, it has to choose a combination within the area between the intersections of the indifference curve of combination H and the marginal cost curve (see striped area in figure 4.11).

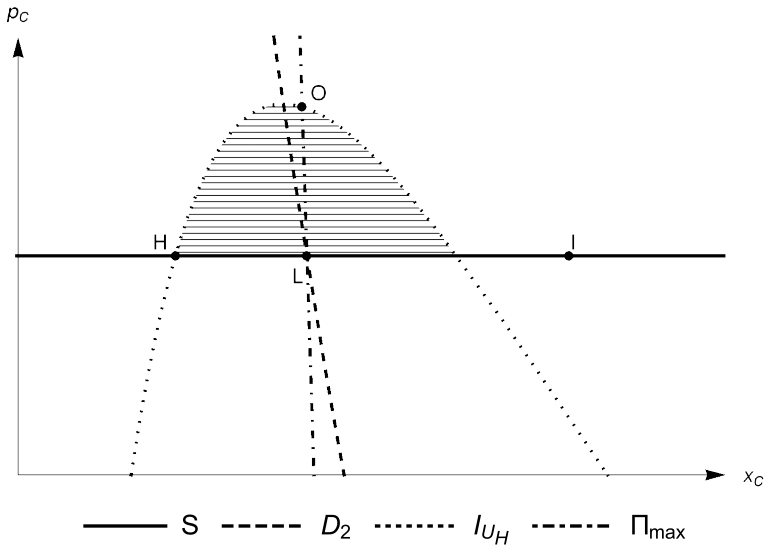

Figure 4.11: Convergence with inefficiencies

This combination will no longer be on the marginal cost curve but will have a higher price in order to maximize inefficiencies. The function

$$\Pi_{max}(x_c) = \frac{\beta m - \alpha c x_c}{\beta x_c} \tag{4.7}$$

shows the inefficiency-maximizing combination for each utility of voter two (for proof see Annex B.5). Using this formula the combination of maximal inefficiencies in this area at point O in figure 4.11 can be determined. If party two proposes this combination voter two is indifferent between electing party one and two as combinations at points H and O give her the same utility. Thus, a combination on the inefficiency maximizing curve right below combination O leads to winning the election. At the same time, this point is maximizing inefficiencies. To win the election while maximizing inefficiencies, party one would now calculate this inefficiency-maximizing point of the area within the intersections of the indifference curve of the new combination of party two and the marginal cost curve.

The utility of voter two (and all other voters; for proof see Annex B.6) increases for combinations along the inefficiency maximizing curve closer to the optimal bundle of the median voter. Thus, a convergence process along this function starts which finally leads to the provision of the combination of the median voter. This implies that even for two parties allowing them to maximize their inefficiencies under the "election restriction" an efficient provision without inefficiencies results.

4.3 Implications

With this willingness to pay for public goods it is possible to evaluate the influences on the provision of public goods by political parties. As shown above, the parties will provide the combination that is at the utility-maximizing point of the median voter. This enables us to analyze the drivers of the provision of public goods.

Let us first consider changes of the median voter while still being the median voter. With a shift of preference or income the considered individual will remain in its relative position s.t. it is still the median-voter. The change of preferences of the median voter in the direction of public goods (β increases; α decreases) directly leads to a shift in the proposed combinations by parties and a higher provision of public goods. People are willing to abstain from private goods in order to get a higher level of public goods. An increasing budget results in the same shift. In this case, the median voter is not willing to abstain from private goods but uses some part of the additional income to demand more public goods. As simple as this conclusion might look, it is essential. If income increases – which is the case for most countries in the world and the world average[5] – and the median income is affected significantly, the demanded amount of public goods increases automatically. In a competitive political system with two parties, this shift results in an increased provision of public goods. Using this calculus, observed changes of the provision of public goods in reality can be easily explained by changes of the willingness to pay caused by an increasing income.

Let us apply this result on the environment as an example for a public good: In a situation with a high level of environmental protection but low income people are willing

[5]World Development Indicators of the Worldbank show that GDP per capita, PPP (constant 2017 international $) comparing years 2000 and 2020 increased for 151 out of 182 countries, for which these data are available. For this period world average increased by 46%.

to accept some destruction of the environment to get more private goods. The level of the environment is "too high", and individuals would vote for the party that is providing a lower level of public goods. This would imply that the individuals can consume more private goods. Thus, it is only logical that higher destruction of the environment can be observed in low income countries. However, with an increasing income, we expect a turning point where the level of protection of the environment will increase automatically: The demanded level of the public good by the median voter is now higher than the actual level of the public good. From this turning point on, the destruction of the public good decreases, provided that income is further increasing. This result is also known as environmental Kuznets curve and empirically controversial (Schneider 2022; Chu 2021; Moomaw and Unruh 1997). Deviations from the constructed model could be caused by different reasons, e.g.:

1. The illustrated model holds only for two parties. It is unclear, how different political systems involving more parties could change the results.

2. Not only income but also preferences might shift over time as they may be affected by exogenous shocks. Furthermore, there is not just one public good, s.t. also preferences between different public goods might change.

3. Depending on the size of the public goods, the free-rider problem remains and the willingness to pay is not revealed. For larger public goods like climate, there is no entity that can force individuals to pay for this good. Thus, a higher income is not automatically leading to a higher provision of the public good.[6]

Beside the discussion on a specific public good, literature shows a positive correlation between income and the provision of the public goods (Inman 1978; Deacon 2009).

So far, we have focused on the median voter. As long as this median voter remains constant, a change in the preferences or budget of other voters within the society does not affect the provision of public goods. Only if preferences or income of the median voter change, the provision of public goods increases or decreases. If the income of the 40 percent of the population that has a higher willingness to pay than the median voter increases, the provision of public goods is not changing. Suppose the income of the 40 percent of

[6]However, as the willingness to pay for the public good is rising, it is likely that people support parties willing to solve the free-rider problem on a higher political level in cooperation with other countries. This might also result in a higher provision of larger public goods.

the population that has a lower willingness to pay than the median voter decreases. In this case, the provision of public goods is not changing as long as they can still afford the provided combination. This example gives an intuition why redistribution of income can be Pareto-superior to the status quo. Transferring income from the rich to the poor can lead to a higher provision of public goods if the median voter is affected. A higher utility for people having a higher willingness to pay for the public good than the median voter might arise. Therefore, the lost utility due to lower consumption of private goods must be smaller than the gained utility due to the increased public good provision. Figure 4.12 shows that a budget reduction (with budget being shifted to the median voter) can lead to a higher utility due to the provision of more public goods (combination at point Q gives higher utility than combination P at lower budget).

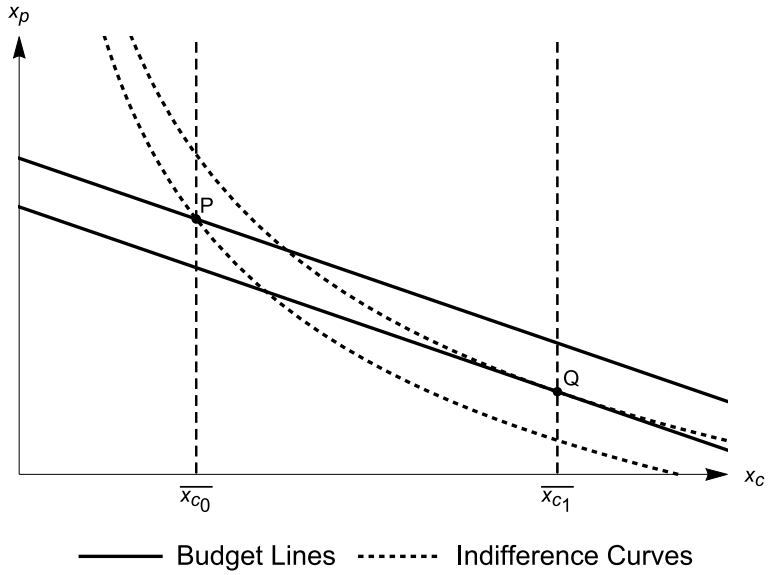

Figure 4.12: Pareto-efficient redistribution

Such a transfer could also be achieved by changing the tax from a lump sum tax to a proportional or even progressive tax on income. For the model, this would imply different prices for the same amount of the public good depending on a person's income.

4.4 Conclusion and Extensions

In contrast to household optimization for private goods, individuals cannot choose the amount of the public good they want to consume. The government determines it. The only way to change the provided combination of public goods is through voting. Parties

propose different quantity-price combinations of public goods. Indifference curves can be implemented in the price-quantity diagram to compare these combinations and investigate what party an individual would vote for. These indifference curves show different utility levels of the individual and can be used to compare every combination of price and quantity of a public good (which implies that the remaining budget is spent on private consumption).

In a competitive political market, a party proposing a combination at a price higher than the production cost of the public good will always lose the election. Another party can offer the same amount at a lower price. Since this combination gives a higher utility, a party offering a combination with "inefficiencies" will always be sorted out by the political competition. In a two party system, where voters have different budgets, parties have an incentive to change their proposed combination until it represents the utility-maximizing combination of the median voter. Only by providing this combination, they can win the election. This is true even for imperfect competition.

These results imply that a change in the provision of public goods can only be achieved by changing the median voter's preferences or budget. For growing economies (and a growth which is at least as uniformly distributed such that it affects the median voter) with a competitive political system, this means that more public goods are demanded and provided automatically. No change of preferences is needed to increase the level of the public good. Furthermore, redistribution or the unequal burden of tax for the provision of public goods can lead to a Pareto-superior outcome: If the utility decrease caused by redistribution is lower than the gain due to a higher provision of public goods, everybody's utility increases compared to the status quo.

Having explained the potential implications of the willingness to pay based median-voter model it is important to focus on possible extensions. As explained, the voters' willingness to pay is the only channel that can change the provision of public goods. In reality, we can observe that individuals donate money to interest groups to change the provision of public goods. In the given model this should not affect the provision of public goods as the budget and preferences of the median voter are not changing. This result remains valid as long as perfect information is assumed. In reality, this assumption is not fulfilled though. The lack of knowledge is twofold then, affecting the voters and the parties.

First, let us focus on interdependencies between public and private goods. For example, certain private goods could be provided for a lower price if public goods have a high level (e.g., a skiing holiday is cheaper if there is less global warming because the slopes do not have to be snowed artificially). The utility of other private goods might depend on the level of the public goods (e.g., clean air and a holiday trip). In this case, the willingness to pay for public goods is influenced by its effect on private goods. The higher the effect of public goods on private goods, the higher the willingness to pay for public goods. Thus, information on this relationship plays a crucial role in the provision of public goods by parties. Interest groups could use their budget to influence voters, hence their willingness to pay by showing that the effect of the level of a public good on private goods is lower or higher than actually expected. The given information might change the utility calculus of individuals and affect the willingness to pay of the median voter. Thus, this leads to a higher or lower provision of a public good. As a consequence, it can be reasonable to abstain from spending certain parts of the budget on private goods and invest it into interest groups instead. If the provided information changes the provision of public goods, this might increase utility to a higher level as the less consumed private goods decrease it.

Second, missing information leads to the problem that parties do not know "who" the median voter is. This uncertainty can be exploited by interest groups. They can contact politicians directly to convince them that the median voter wants more or less of a specific public good. Furthermore, they can use media, such as television, newspaper or social media, to make it appear that a particular measure is or is not in line with the median voter. This can also change the perception of politicians (and parties) what and which amount of public goods the median voter wants to have and hence affect its provision. Thus, with a lack of information parties will provide the combination of the "perceived" median voter.

The introduced extension can close the gap between the median-voter theorem and theories on interest groups (Olson 1971; Becker 1983) and gives an important approach for further research. Furthermore, this model provides the opportunity to link two theories of determining the demand for public goods (Batina and Ihori 2005). Beside the median-voter theorem another way of determining the demand for public goods is gathering information about the willingness to pay of individuals in an incentive compatible

framework (Clarke 1971; Groves 1973). As both approaches can deal with the willingness to pay for public goods of individuals it is worth to explore whether they lead to the same results.

Chapter 5

Is the Median Voter Still Alive? An Empirical Linguistic Analysis of the U.S. Presidential Elections in 2016

Felix Schlieszus, Kathrin Muth & Johanna Barop[1]

5.1 Introduction

Which political position should a candidate choose to win an election? The median voter theorem (Downs 1957) as part of political economy provides a simple tool to answer this question. From a theoretical perspective, individuals vote for the candidate whose position aligns best with their own position. Since candidates aim to maximize their votes, they adapt their positions in order to attract more voters. As a consequence, the candidates, i.e., their positions, converge to an equilibrium, where the positions of both candidates coincide and are determined by the median voter's preferences. In this equilibrium no candidate has an incentive to switch their position again because they would lose votes otherwise.

Assessing the validity of the median voter theorem is not straightforward. We can neither directly observe voters' positions nor the position of the median voter. Moreover, the theorem implies a static equilibrium. However, it does not specify the convergence process. It is reasonable that both candidates align their positions with the one of the median voter from the beginning of the election race on. Thus, analyzing the convergence of the candidates during the election race is not a valid test of the median voter theorem. However, if the median voter is changing due to an exogenous shock within this election race, we should be able to measure this shift in the candidates' positions.

[1]Contribution: Felix Schlieszus 75%, Kathrin Muth 15%, Johanna Barop 10%.

Such an exogenous shock occurs in the run-up to the presidential elections in the United States (U.S.). The U.S. presidential elections consist of two parts, the primaries and the presidential election. During the primary election, the Democratic and the Republican party choose their presidential candidate. If only two candidates have the opportunity to win their party's nomination race, the median voter theorem predicts that both will choose their positions according to the position of their party's median voter. After the primary election, the presidential candidates will focus on the presidential election and thus adjust their position to the preferences of the median voter of all citizens. As this median voter is unlikely to be the same for all citizens and within the parties, this voting system causes a shift in the median voter's position. This shift is needed to evaluate the theorem in practice, consistent with theory.

Thus, our research question is: Can we empirically show a convergence of candidates' positions during the presidential elections in the U.S. in the transition from primaries to presidential elections?

To answer this question we analyze candidates' campaign speeches. We use Wordfish, an algorithm determining the positions of speeches on a single dimension (left-right). The estimated positions of the speeches are used to observe and estimate the change in candidates' positions caused by the change in the median voter.

Our research contributes to a growing literature in different academic fields analyzing political speeches with focus on the the median voter theorem (Banda et al. 2019; Sparks 2020; Gross et al., n.d.; Kelly 2020; Schaefer 2020). The papers most closely related to our research are from Banda et al. (2019) and Gross et al. (n.d.) as they are using a similar setting and data set for their analysis. They use the median voter theorem to show that their created Cue Lag Ideological Proportions (CLIP) model is correct and candidates shift to the median during the election process. In contrast, we use the Wordfish algorithm in a setting that is consistent with theory to validate the median voter theorem for the U.S. election race 2016.

The course of this paper is as follows: Chapter 5.2 describes the application of the median voter theorem to the presidential elections in the U.S. The methodology of the applied Wordfish algorithm is explained in chapter 5.3. In chapter 5.4, we introduce the empirical model – a reversed difference-in-difference approach. We present the results of

our findings in chapter 5.5. Chapter 5.6 analyses the robustness of our empirical results based on different adaptions of the model and discusses our findings.

5.2 Median Voter Theorem and Presidential Elections in the U.S.

In order to evaluate the median voter theorem in practice, we need a political system that is compatible with the basic assumptions of the theorem. We identified the U.S. presidential elections as a suitable setting. Table 5.1 compares the assumptions of the median voter theorem with the U.S. presidential elections processes:

	Median Voter Theorem	Presidential Elections U.S.
Parties	Two parties	
Election winning	Simple majority, the winner takes all	
Utility maximization calculus	Selection of candidates with minimal distance to own positions	Strategical voting possible in primaries
Relevant decision dimensions	One dimension	Multiple dimensions
Preferences of households	Single peaked preferences (monotonous decreasing)	Multi-peaked preferences possible
Voters	Everybody votes	Non-voters possible

Table 5.1: Model assumptions and reality

The first main assumption of the median voter theorem is a two-party system, which the U.S. is commonly referred to as a prominent example. In reality, for both, the primary and presidential elections, more than two candidates run for a win. This presents a serious challenge to the model because in a system with more than two candidates the convergence process does not lead to a static equilibrium. However, both elections are governed by the winner-takes-all principle, which supports strong candidates. Receiving a high – but not the highest – number of votes does not benefit the candidate. So even for more than two candidates, the question remains which candidates have an impact on the election results or positioning of other candidates. Since 1868, the president has been a nominee of

either the Democrats or the Republicans at the presidential elections. Furthermore, third parties' and independent candidates' overall share of delegates in the Electoral College reached a maximum of ca. 8 percent in the 1968 presidential election. Thus, history suggests that the influence of independent and third-party candidates is low.

For the primaries of the 2016 elections, Donald Trump garnered enough votes on April 26$^{\text{th}}$ so that the other candidates, i.e. Ted Cruz, could not win the race for the presidential candidate for the Republican party anymore. The median voter theorem predicts that from April 27$^{\text{th}}$ on Trump's position should coincide with the median of all citizens. In the Democratic party, Bernie Sanders and Hillary Clinton had a close race to become the presidential candidate. All other candidates could not receive any delegates, so that the median voter theorem should hold. On June 7$^{\text{th}}$, Clinton had so many votes that Sanders could not have caught up with her anymore. Thus, for the period until June 6$^{\text{th}}$ we should obtain a static equilibrium at the party's median voter. Afterwards, we expect Clinton to align her positions to the median voter of all citizens.

Strategic voting in the primaries poses another problem to the applicability of the theorem. Whereas in the presidential election there is no reason to deviate from choosing the candidate closest to one's own preferences, the structure of the primaries may trigger strategic voting. We identify two types of strategic voting that may disturb the predictions of the theorem. Both types could cause an incentive for candidates to choose a position other than their party's median voter.

The first type is push-over voting (raiding) (Farquharson 1969). Based on the different types of primaries and caucuses, in some states, it is possible for non-party members to vote in the primary of their non-preferred party. Voting for the preferred candidate of the other party can reduce costs if the other party wins the presidential election. A candidate might choose a position closer to the general population's median voter rather than their party's in order to attract such votes. However, we can also imagine the opposite decision. One could vote for the other party's candidate one perceives as "weaker" in the primary of the non-preferred party in order to support the chance of one's favorite candidate in the presidential election. According to the median voter theorem, this would be the candidate whose position differs most from the median voter of all citizens. This could provide an incentive for the candidate to diverge from the presidential election median voter.

The second type of strategic voting is compromising (Farquharson 1969). Voters could, for strategic reason, not vote for their favorite candidate in the primary if his chances of winning in the presidential race are perceived as small. They may instead vote for a candidate further away from their own preferences. We suppose that those "second-best" candidates, are candidates closer to the presidential election median voter. Both types of strategic voting could affect the shift of the candidate's position from primary median voter to presidential election median voter.

The voters' relevant decision dimensions pose another deviation from the assumptions of the median voter theorem. According to the basic median voter model, the voters' decision process is one-dimensional. Traditionally, it is assumed that they only have preferences over the amount of public and private goods, they would like to consume. However, in real-life, candidates' campaign pledges and voters' considerations consist of multiple decision dimensions like domestic and foreign policy, environmental and tax policy, etc. This affects both, analyzing the voters' decisions and the measurement of the candidates' positions. Furthermore, we cannot regularly observe the candidates' positions. In the next chapter, we demonstrate how we use the Wordfish algorithm in order to unify these multiple dimensions.

5.3 Methodology

In recent literature, four methods are commonly used to measure the positions of candidates (Grimmer and Stewart 2013): Surveys of voters, expert surveys, hand coding (coders assign categories (left/ right/ conservative/ liberal etc.) to different sections of texts), and computer-based content analysis (e.g., by Wordscores or Wordfish). We employ the last method to estimate the candidates' positions and use the word scaling algorithm Wordfish, introduced by Slapin and Proksch (2008). The program extracts political positions from text documents using the R statistical language. Documents can be placed into a single dimension, thus it is not necessary to divide documents into different policy areas. Furthermore, the program does not rely on anchoring documents to serve as reference points. Thus, a manual selection of an anchoring document is not necessary and a potential bias through this choice is prevented. The political position is estimated by the

relative differences in the candidates' word usage which are distinguished by a statistical model of word counts.

We now briefly explain the Wordfish algorithm. The frequency of each word in each document is counted. This is our independent variable y_{ijt}, where i is the candidate, j is the word, and t is the date of the document. The algorithm's underlying assumption is that the word frequency in a political document is generated by a Poisson process:

$$P(y_{ijt}) = \frac{\lambda^{y_{ijt}}}{y_{ijt}!} * e^{-\lambda} \tag{5.1}$$

The algorithm determines the value of λ which maximizes the likelihood that word j occurs y times in a certain document t[2] of a certain candidate i. In the most simple case, λ is equal to y_{ijt}, if we only have one document and one candidate. If there are different i and t λ will be estimated using the following model:

$$\lambda_{ijt} = exp(\alpha_{it} + \psi_j + \beta_j * \omega_{it}) \tag{5.2}$$

where α_{it} is the candidate-date fixed effect, ψ_j is a word-fixed-effect, β_j is the word weight and ω_{it} is candidate i's position at document t. The fixed effects are necessary to control for effects on y unrelated to the candidate's position. The algorithm controls for candidate-fixed and word-fixed effects and uses the remaining variation in choice of words to determine a candidate's political position. The candidate-date fixed effect controls for all effects linked to a specific document. For example, the length of the documents may vary: the longer the document, the higher the word frequencies. However, this does not imply any change in the candidate's position. For example in cases of long documents, λ will be determined by the candidate-date fixed effect, canceling out changes of candidates at a certain document. The word-fixed-effect controls for words commonly used in all documents by all candidates and thus does not vary significantly over time and candidates. We do not expect such words to impact the candidate's position either. For these words, λ will be determined by the word-fixed effect ψ_j. The remaining variety is used to determine the position of each document of each candidate. In order to determine ω, the word weight of every word is determined. A high word weight implies the relevance of one word for

[2]For our purpose, t is a certain document and not the date of a document as we use speeches as documents (see below) and there are multiple speeches on several days.

distinguishing between candidates' positions. The word "healthcare" for example might be used more often by Democratic than by Republican candidates. The more often one word is used by the Democratic candidate in comparison to the Republican one, the higher the word weight. In a second step, the position of each document is determined using these word weights. Wordfish will analyze how often a certain word with a previously determined word weight was used in a given document by a certain candidate. If the candidate uses many words with a high word weight (having the same political direction) the document will be assigned an extreme political position. This process cannot be observed at once but is the result of a bootstrap procedure. A more detailed look into Wordfish is given by Slapin and Proksch (2008).

We now take a closer look at the data that is used as the input for Wordfish. In order to serve our purposes, our source must cover the appropriate time span, offer a sufficient frequency of published documents, and portray only the candidate's opinion. We considered four possible types of documents as a basis for determining the political position of candidates:

- **Manifestos.** Used e.g., by Slapin and Proksch (2008), manifestos present a promising source. Their sufficient length and broad subject area avoid the problem that not only the positions but the mentioned topics determine the position of a candidate. However, only one manifesto is published per presidential election, and therefore a comparison between the position at the primaries and the presidential election is not possible.

- **Newspaper articles.** In contrast to manifestos, newspaper articles are published frequently and in large numbers. If it were possible to filter out the position of a candidate in this article, we could precisely observe changes over time. However, the positions of journalists and newspaper companies will interfere with the positions of the candidates. Media bias in the U.S., its extent, causes and implications are extensively discussed in the literature.[3] We, therefore, believe that it is not a

[3]For example, Groseclose and Milyo (2005), Baron (2006), and Chiang and Knight (2011). For a comprehensive summary of media bias in the context of presidential elections see D'Alessio (2012). Even though recent literature suggests that the public perception of the scope and influence of U.S. media bias may be overestimated (Watts et al. 1999; Budak et al. 2016), our analysis focuses on the candidate's position only and not on the election race's news coverage.

promising approach to differentiate between the position of the author and the one of the candidate.

- **TV-debates.** TV debates between the candidates appear to be promising sources as the moderator interviews both candidates regarding the same topics, preventing the problem of measuring different positions due to differences in topics. However, the debates' composition and frequency limit their usefulness for our purposes. The debates in primaries often take place when more than two candidates are left in the nomination race. At this point in time, the median voter theorem does not give us a theoretical prediction of the positions. We cannot use this time span to test the median voter theorem. Thus, measuring the candidates' positions does not serve our purpose.

- **Speeches.** During the election campaign, candidates travel from city to city and give speeches to promote themselves. In these speeches, they express their political position and try to convince people to vote for them. Thereby, they not only address the audience but also a larger public via media. This is the most frequent and unbiased source of the candidates' positions we can observe. Therefore, it is an important base for the voters' decisions and we use it as the documents of our analysis.

The speeches we analyze are provided by The American Presidency Project and the candidates' old campaign websites, which we access via the digital library of the Internet Archive Wayback Machine.

The American Presidency Project is an online source for presidential public documents. The project also includes presidential candidate debates, statements and press releases of presidential candidates, political party platforms, and presidential nomination and acceptance speeches from nominating conventions. The Presidency Project's data pool is updated regularly by data provided by the White House media office, the Government Printing Office, and the National Archives and checked against other sources (John Woolley 2020).[4]

The Internet Archive Wayback Machine is a non-profit online library crawling and preserving the history of webpages, even of currently offline ones (Internet Archive 2020).

[4]For a more detailed description of the sources and the updating process, see https://www.presidency.ucsb.edu/about.

We used the library to access the 2016 version of the candidates' campaign websites (https://www.donaldjtrump.com and https://www.hillaryclinton.com), which posted records of additional speeches. In order to obtain the text documents, we crawled the election day version[5] of the respective campaign website. Where we crawled speeches twice, we choose the American Presidency Project version.

One could argue that the sources of our data cause a data selection bias, since the pool of speeches that we identified cannot possibly cover all the speeches, public and private, big and small, that the presidential candidates give. We argue that by checking both partisan and neutral sources for speeches, our data pool contains the most relevant, well-known public speeches. These are at the same time the speeches that are likely to reach voters since they will be shared on social media and reported about. When candidates give private or smaller speeches or such with little media coverage, they likely do not give them with the intent of reaching the median voter. Rather, such speeches will be aimed at a specific target group. Therefore, we do not expect that not including these speeches constitutes a problem for our analysis.

After crawling these speeches, we cleaned the text documents (removing HTML-Tags, numbers, etc.), deleted stop-words, and applied the Python Porter-Steamer algorithm to retrieve the word stems. Then we hand-cleaned the speeches to remove interjections and reactions by the audience or comments by other speakers (e.g., introduction words by local authorities), which have not been tackled by our cleaning algorithms. Next, we use Wordfish to determine the political positions of speeches. Wordfish offers different settings for its algorithm. We will turn to those in more detail in section 5.6 for robustness checks.

5.4 Empirical Strategy

In general, we want to estimate whether a change in the median voter leads to an adaption of candidates' positions. We face the problem that recent events and topics will impact the content of candidates' speeches. For example, a terror attack might lead to increased disputes on internal security and a more right-wing vocabulary. Therefore, we cannot make statements on individual position changes of candidates from left to right.[6] We

[5] If there were multiple election day versions, we crawled the latest one.

[6] It's important to note that "left" and "right" are determined ex-post to the estimation of the position of speeches. We select the position of the Republican as "right" and the one of the Democrat as "left".

can only compare the difference between the positions of the Democratic and Republican nominees during the primaries to the difference between the candidates during the presidential elections. Initiated by the shift of the median voter of Clinton, we analyze whether the candidates' positions converge.

The empirical strategy is similar to a difference-in-difference approach. However, for a difference-in-difference approach, the two compared groups should have similar trends before the treatment. In our case, this assumption is not met by theory. We expect similar positions of the candidates during the presidential election, whereas we expect different positions in the primaries. An estimation strategy for this reversed difference-in-difference setting was developed by Kim and Lee (2019). Thus, our empirical model is given by

$$\omega_{TD} = \beta_0 + \beta_1 T + \beta_2 D + \beta_3 (1 - D + D * T) + \epsilon_{TD}$$

where ω_{TD} is the position of a candidate's speech, β_0 is a constant, T a time-dummy, which is 0 during the primaries and 1 after, and D a party dummy, which is 1 for Democrats and 0 for Republicans. For the interaction term, table 5.2 shows its value depending on D and T.

	D=0	D=1
T=0	1	0
T=1	1	1

Table 5.2: Interaction term in reversed difference-in-difference estimation

For a regular interaction term in a difference-in-difference setting, the interaction term is always zero beside the period when the treatment group and the treatment period are given. In our case this would be $D = 1$ and $T = 1$. In comparison, for the difference-in-difference in reverse setting the interaction term is only equal to zero when the treatment group is given and the treatment period is not. For our model, this is the case when $D = 1$ and $T = 0$. Only for Clinton (treatment group) before she was determined as candidate for the Democrats, we do not expect an alignment with the position of the median voter of all citizens.

Applying this model, the coefficient β_1 should filter out the time trend. β_2 can be interpreted as the initial difference between candidates. β_3 provides us with a measure for the candidates' convergence. In our setting, a positive β_3 indicates convergence, whereas a negative β_3 indicates divergence. If we find a statistically significant effect, we can conclude that a shift in the median voter leads to an adjustment of candidates' positions.

5.5 Results

5.5.1 Wordfish

In this chapter, we present the results of the Wordfish estimation. 258 speeches form the basis of our analysis. 88 of these speeches were given by Clinton, whereas 170 were given by Trump. The time period of speeches is between April 26$^{\text{th}}$ (the day Trump won over the total majority of Republican delegates) and November 7$^{\text{th}}$ (the day before the presidential election). Figure 5.1 shows the results of the estimation by the Wordfish algorithm.

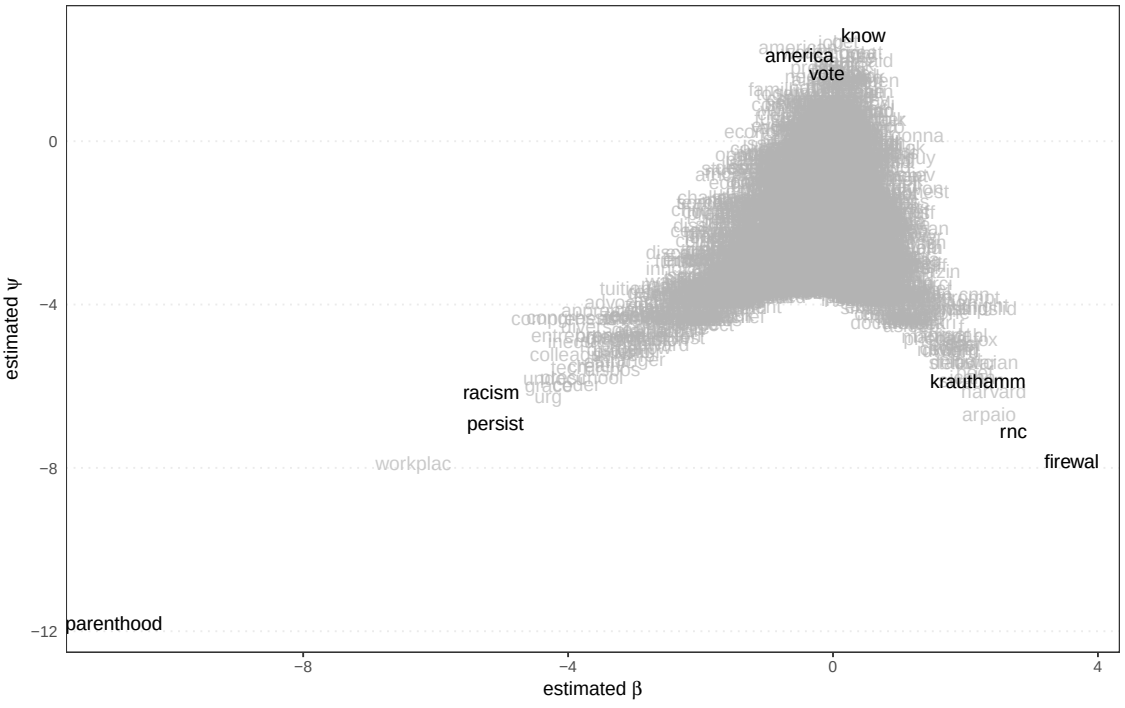

Figure 5.1: Estimated word-fixed-effects and word weights

As explained in chapter 5.3, ψ_j is the word-fixed-effect and β_j the word weight. Words frequently used by both candidates like "know", "America", or "vote", have a high word-

fixed-effect, whereas their word weight is low. This implies that these words can hardly help to differentiate the positions of the candidates. These words build the top of the so-called "Eiffel Tower", which is typical for a Wordfish estimation (Slapin and Proksch 2008). In contrast, words at the lateral base of the "tower" have a low word-fixed-effect and a high word weight. These words are the most important ones to differentiate the position of the candidates. Table 5.3 presents these words for our estimation.

	Trump		Clinton	
Rank	Word	β_j	Word	β_j
1	firwal	3.61	parenthood	-10.86
2	rnc	2.72	workplac	-6.33
3	havard	2.43	racism	-5.16
4	arpaio	2.35	persist	-5.10
5	fox	2.30	urg	-4.30
6	landslid	2.29	grace	-4.29
7	knight	2.27	undocu	-4.20
8	krauthamm	2.19	comprehens	-4.06
9	beef	2.14	colleagu	-4.04
10	cnn	2.13	tech	-3.98

Table 5.3: Highest absolute word weights of word stems in Trump's and Clinton's speeches

The selection of words (i.e. word stems) that Wordfish assigns high absolute word weights reflects other findings from previous literature on the rhetoric of the 2016 U.S. election race. Trump employs more noun phrases and names compared to Clinton (Savoy 2018), which is reflected by the names "RNC", "Havard", "Arpaio", "Fox", "Knight", "Krauthammer", and "CNN" being among the top ten words with the most extreme word weights for Trump in our analysis. For example, Trump refers to his endorsement by the Republican National Congress (RNC), former sheriff Joe Arpaio (speech in California, June 1st), and former basketball coach Bobby Knight (Speech in California, April 29th). He mentions his Republican critic Charles Krauthammer (Speech in California, April 29th),

quotes recent polls in Fox News, and denounces Harvard elites (Speech in Pennsylvania, June 11th). The words which Wordfish assigns positive word weights reflect Trump's right-wing political positions. Take "arpaio": Joe Arpaio referred to himself as "America's toughest sherrif", taking an outspoken position against illegal immigration. Advocating a restrictive immigration policy is associated with right-wing politics. Wordfish consequently assigns "arpaio" a word weight of 2.35. Qualitative analyses of Trump's rhetoric argue that Trump strategically appeals to the psychology of the white working class with his choice of words, topics, and language style (Lamont et al. 2017; Homolar and Scholz 2019; Kelly 2020; Schaefer 2020). Wordfish assigns high word scores to these words which is evidence of this strategy.

Clinton, on the other hand, speaks about her support for Planned Parenthood and women's reproductive rights (Speech in Rhode Island, April 28th) – a highly contentious issue in U.S. politics, which Wordfish consequently awards the highest absolute word weight. Clinton is a pro-choice advocate – a politically liberal position, which is reflected by the word weight of -10.86. As these findings show, Wordfish seems to accurately capture the different political positions of the candidates.

5.5.2 Estimation

Next, we take a look at the positions of the candidates' speeches over time (figure 5.2).

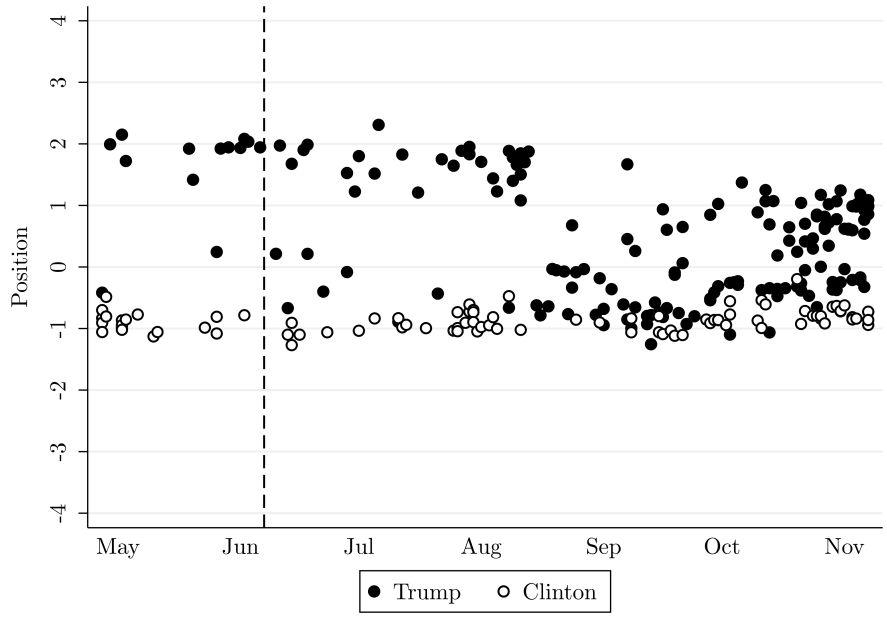

Figure 5.2: Positions of speeches over time by candidates

Each dot represents the position of one speech. It is important to keep in mind that the total values for the position of each speech have no further meaning. Just relative positions of speeches are crucial. The dashed line shows the date when Clinton gathered the majority of total Democratic delegates. Before this date, we expect Clinton to align with the median voter of the Democrats. After this date, we expect that her position coincides with the one of the median voter of all citizens. Trump had the majority of total Republican delegates in the primary election since the April 26$^{\text{th}}$. We expect that his positions coincide with the median voter of all citizens during the entire observation period. We can see a convergence between the two candidates' positions between primaries and the presidential election. This observation is supported by the regression results:

	(1)
	Basic
D	-1.219***
	(0.0754)
T	-1.251***
	(0.223)
Interaction	1.291***
	(0.226)
Constant	0.316***
	(0.0827)
Observations	258
Adjusted R^2	0.462

Standard errors (robust) in parentheses
* p<0.10, ** p<0.05, *** p<0.01

Table 5.4: Basic regression

The regression table shows that all coefficients are significant. Clinton's speeches differ significantly from Trump's speeches ($D = 1$ for Clinton). As her coefficient is negative, we assume that lower (higher) values can be interpreted as "more left (right)" positions. In the period after both candidates have been determined ($T = 1$), speeches are more left than before. The interaction term has a positive sign and is significant on a 1 percent level. This implies convergence. In the next chapter, we check how robust these results are.

5.6 Robustness Checks

To check the robustness of our results, we control for potential issues in the Wordfish and the reversed difference-in-difference estimation.

Sparsity & Maximum Word Frequency

For estimating the positions of the speeches using Wordfish, several parameters have to be specified. One of these parameters is the sparsity. Words that only appear very rarely in all speeches have a large impact on the positions. These rare words can bias the position of speeches, especially if they are not of political nature. To diminish this potential source of bias it is common to exclude these words. For our baseline setting, we use a sparsity level of 97 percent. This means that Wordfish excludes words that occur in 3 percent or less of all speeches. Furthermore, to improve the precision of Wordfish's estimates, it is common to exclude words that are used in almost all documents. Thus, we exclude words that occur in 97 percent or more of all speeches. For robustness checks, we use different sparsity levels and also change the frequency for the exclusion of words frequently used. Table C.1 in Annex C.1 shows that the results are robust for all these specifications. We conclude that the observed convergence is not caused by including too many rare or frequent words.

(Swing) States

In the U.S., the "the-winner-takes-it-all" principle exists not only on the national level but also within most states. The candidate with the most votes in one state gets all delegates of that state for the Electoral College. For many states, the result can be predicted prior to the election. Often, a stable majority of citizen votes for one party. Thus, candidates focus especially on swing states where sometimes Republicans and sometimes Democrats win the election. This fact could also influence our estimation: Candidates might align their positions according to the swing-state median voter. Furthermore, they might adapt their speeches to their current audience. We expect that this is not the case. The speeches are partly streamed by television and journalists report on the speeches in the newspaper and on social media. Thus, it is unlikely that a major shift in positions between the speeches of the candidates occurs. However, to control for potential bias, we conducted several

estimations as robustness checks (see table C.2 in Appendix C.2). We implement a swing-state-dummy (estimation 2) and, in addition, a swing-state-interaction term (estimation 3). Furthermore, we estimate using data from swing states only (estimation 4) and use fixed effects for all states (estimation 5). The coefficients for the party, the treatment effect, and the interaction term remain significant for all estimations. It is important to mention that 194 of the 258 speeches were given in swing states. Thus, it is possible that candidates align their positions to the swing-states median voter. Estimation 4 shows that the convergence is even higher than in all other estimations. The regressions support the theoretically established hypothesis that the positions in the speeches do not differ significantly across states.

Different Intervals

Candidates do not give speeches on every single day of the entire election race. As shown in figure 5.2, the majority of speeches are given near the end of the election race. This might bias the results, as the final days before the presidential election receives more attention. We control for this problem by using different time intervals. There are two alternative ways to implement this: On the one hand, we can collapse the data and take the mean for a day, a week, or a month. On the other hand, we can aggregate speeches in advance and let Wordfish estimate the position of the candidate for the respective day, week, or month.

Table 5.5 shows the results of the estimations using the first method. Using the second method, we obtain similar results (see table C.3 in Annex C.3).

	(1) Basic	(2) Days	(3) Weeks	(4) Months
D	-1.219***	-1.231***	-1.336***	-1.340***
	(0.0754)	(0.0977)	(0.162)	(0.292)
T	-1.251***	-1.247***	-0.783*	-0.714
	(0.223)	(0.232)	(0.465)	(0.452)
Interaction	1.291***	1.277***	0.812*	0.742
	(0.226)	(0.237)	(0.469)	(0.459)
Constant	0.316***	0.330***	0.441**	0.461
	(0.0827)	(0.107)	(0.167)	(0.300)
Observations	258	168	52	14
Adjusted R^2	0.462	0.522	0.640	0.779

Standard errors (robust) in parentheses
* p<0.10, ** p<0.05, *** p<0.01

Table 5.5: Regression using means of days, weeks, and months

The direction of results stays valid. However, the effects for the time trend and the interaction term, and the significance level for these variables decrease. In contrast, the coefficient for differentiating between Democrats and Republicans stays constant in magnitude and significance. In figure 5.3 (figure C.1 in Annex C.3 for the second method) we can see the change of positions over time using different intervals.

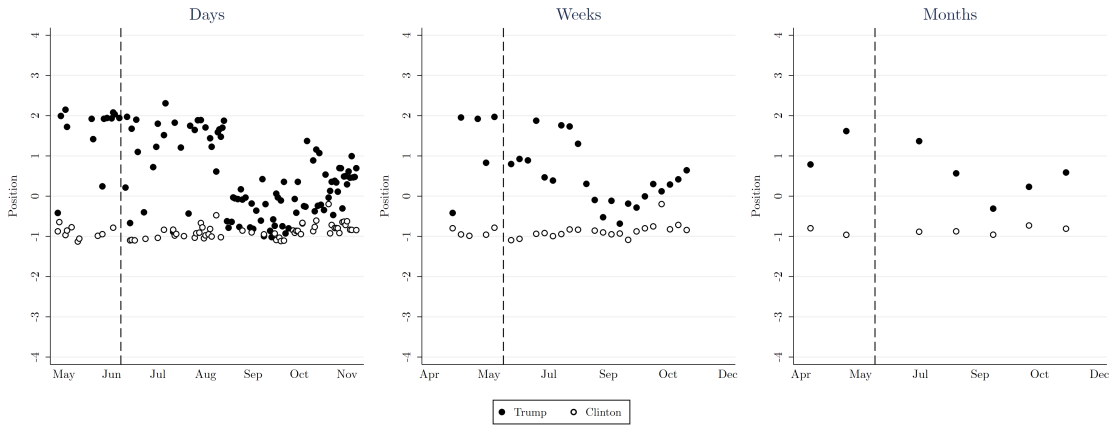

Figure 5.3: Positions of speeches over time using means of days, weeks, and months

The decreasing coefficients show that speeches are not equally distributed over time. In September and October Trump gave almost 50 percent of the speeches from our dataset. For these months Wordfish assigns positions that are quite left in comparison to the

other months. This effect drives the results of the whole estimation and is reduced by collapsing data to weeks and months. In reality, this behavior does not seem to be unusual. Changing one's position suddenly might scare off voters. Thus, a slight change of the positions might be the more promising strategy and could explain the trend of Trump's positions of speeches after the primaries. However, this could not explain the increasing difference at the end of the election race. It is possible that Trump tried to differentiate his positions from the ones of Clinton to motivate more people to go to the election. The prevention of non-voting might stop a to strong convergence of candidates predicted by the median voter theorem.

The diminishing significance is driven by an increasing standard error due to the reduced number of observations. In addition, speeches of Trump have a higher standard deviation. For the basic estimation, the standard deviation of Clinton's speeches is 0.17, whereas it is 0.95 for the speeches of Trump. While for Clinton the positions of her speeches do not vary much over time, the positions of Trump's speeches "jump" in short intervals. The reasons for this higher variance might be caused by a problem in estimating the positions of speeches: The problem of distinguishing positions and topics.

Positions and Topics

The variance of positions of Trump's speeches might be caused by a differentiation in topics and not in positions. The positions of the candidates are estimated by Wordfish comparing the used words in every speech. Using different words results in more different positions. However, using different words could also be caused by talking about different topics. It is possible that the topics Trump covers differ much between his speeches. This way, he might try to appeal to different voters. Thus, the variance might not show different positions but only the variance across topics.

This problem could also explain the measured convergence between Trump and Clinton. During the primaries of the Democrats, Trump did not know his opposing candidate. Furthermore, Clinton and Sanders covered different topics in their election campaigns. Thus, Trump might have desisted from covering their topics. After Clinton was set as candidate of the Democrats, this might have changed and Trump focused and covered Clinton's topics in his speeches. Especially near the end of the election race, Trump might have picked up more of Clinton's topics to attack her. On the one hand, this would

imply that the nomination of the democratic candidate was not exogenous for Trump: Clinton's nomination changed the topics of Trump's speeches. Thus, Trump cannot be seen as unaffected control group anymore and the results of the (reversed) difference-in-difference setting cannot be interpreted as a causal effect. On the other hand, this could imply that the measured convergence is just a convergence in topics and not in positions. Trump might not align his position to the one of the median voter.

To control for this problem the speeches were manually coded for topics. 45 topics could be identified in the speeches, e.g., abortion and LGBTQ rights or trade deficit. Clinton covered 20 of these topics, whereas Trump covered 44 of these topics.[7] This difference suggests that Trump is trying to get more voters by talking about more topics.

As a first control, we linked each speech to its topics using dummy variables for every topic. We used these dummies to include topic-fixed effects in the basic regression. Figure 5.6 shows the results.

	(1) Basic	(2) Topic-fixed effects
D	-1.219***	-0.500**
	(0.0754)	(0.213)
T	-1.251***	-0.423*
	(0.223)	(0.216)
Interaction	1.291***	0.473**
	(0.226)	(0.232)
Constant	0.316***	-0.120
	(0.0827)	(0.216)
Topic FE	no	yes
Observations	258	258
Adjusted R^2	0.462	0.780

Standard errors (robust) in parentheses
* p<0.10, ** p<0.05, *** p<0.01

Table 5.6: Regression using topic-fixed effects

Estimation two shows the results including topic-fixed effects for all speeches. In comparison to the results of the basic model (estimation one) the magnitude of the coefficient of the interaction term decreased by almost two-thirds. The significance decreased to the five percent level. This seems to support the hypothesis that at least some part of the

[7] These results might be biased as the speeches of Clinton were coded at first.

convergence is caused by a convergence in topics. However, the remaining coefficient still supports the hypothesis that there is also convergence in positions. We looked at the topics which become highly significant using topic-fixed effects. These topics are for example: supporting African and Latino Americans, increasing wages, or the second amendment to the constitution, which guarantees the right to bear arms. These topics cannot be seen independently of positions. It is likely that talking about these topics coincides with a position that is more left or right. Thus, separating topics and positions might lead to underestimating the convergence in positions.

Secondly, we collapsed the data by days, weeks, and months. Then, we dropped observations for time periods only one candidate held speeches in. This way, we can compare the differences in the positions of the candidates.[8] For calculating the differences in topics we calculated the share of different topics for each time period. Figure 5.4 shows the results.

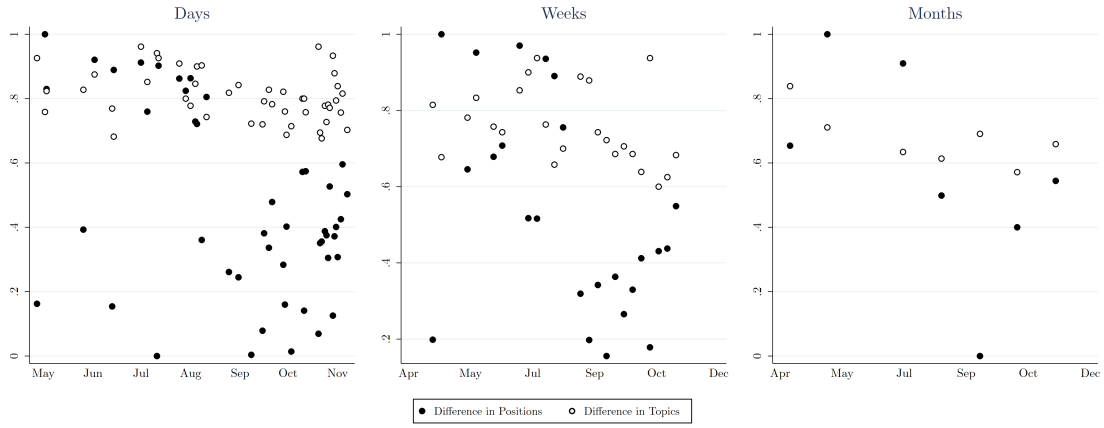

Figure 5.4: Differences of positions and topics between candidates

It is important to mention that in comparison to the previous estimations many observations were dropped as a lot of time periods do not include observations of Clinton and Trump (e.g., for the same day). Looking at the graphs we can hardly see that there is a relation between the difference in topics and the difference in positions. A smaller difference in topics does not significantly lead to a smaller difference in positions. This supports the hypothesis that the positions measured by Wordfish are not driven by topics and show the position of the candidate.

[8]For an easier comparison we scaled the results to an interval between 0 and 1.

Thirdly, we investigated several examples manually. We compared the speeches of Trump which are directly following each other and which are having a large difference regarding their estimated positions. For example, these were speeches on September 30th and October 3rd. The respective positions, estimated with Wordfish, are 1,02 and -1,10. The share of different topics was 88 percent. We did the same for speeches on October 12th (1,07) and October 13th (-1,06). The share of different topics was lower (67 percent). To analyze whether the difference in estimated positions of Wordfish is caused by the different topics we compared the left and right speeches separately regarding their share of different topics. For left speeches, the share was 85 percent and 31 percent for right speeches. For other examples this observation could be reproduced: Left and right speeches differ significantly in topics, but also left speeches of Trump have a huge difference in topics, whereas right speeches are less different in their topics. This would imply that "right" position estimates of Wordfish are partly driven by topics, whereas left positions are not/ less. For our estimation, this means that the convergence of positions could be even stronger than expected. This is the case if the "right" positions after the primaries are more left because values are estimated "too" right due to topics. However, as topics before primaries are affected as well, convergence could also be overestimated.

In conclusion, we do not suppose that the measured convergence is mainly driven by a convergence in topics.

5.7 Conclusion

In our research, we empirically analyzed the convergence process of candidates' positions during the presidential elections in the U.S. in 2016 in the transition between primaries and presidential elections. We try to answer the question whether the median voter theorem still applies today.

In comparison to other settings, which are focusing on whether a convergence exists in general, we developed an approach that is consistent with theory. In 2016, Clinton and Sanders had a close race for being the presidential candidate of the Democrats, while Trump was determined as the Republican candidate earlier. Thus, we expect that Trump already aligned to the median voter of all citizens over the whole period whereas Clinton switches from the median voter of the Democrats to the median voter of all citizens after

the primaries. We use the Wordfish algorithm to estimate the position of the campaign speeches. Using the reversed difference-in-difference approach of Kim and Lee (2019) we estimate the assumed convergence between primaries and the presidential election.

We find a convergence of positions (significant at the 1 percent level) in the transition between primaries and the presidential election. Robustness tests show that the effect holds for different specifications of Wordfish and controlling for the effect of (swing) states. Collapsing speeches in time intervals (weeks and months) diminishes coefficients and significance levels. This is caused by the huge variance of Trump's positions of speeches within short intervals. A potential explanation is that Wordfish cannot distinguish between positions and topics. An analysis of manually coded topics supports this hypothesis only partly. However, more research is needed for a proper distinction between positions and topics using Wordfish.

With respect to our research question, we can conclude that the median voter theorem still has explanatory power. Our data shows a convergence of both candidates in the U.S. presidential election in 2016. Also our estimations and robustness checks support this finding.

Chapter 6

Conclusion

This chapter summarizes the main findings of the four papers, highlights each contribution, and discusses related challenges.

In the first paper, we developed a microeconomic model to distinguish the willingness to pay for public goods from the one for social incentives. The discussion on social incentives linked to public goods is not new in the literature. However, the willingness to pay is not separated into a willingness to pay for social incentives and a willingness to pay for public goods. Distinguishing these two allows for measuring the willingness to pay properly without mixing it up with other preferences, e.g., for silencing one's conscience or gaining reputation. A reliable willingness to pay is a necessary basis to provide helpful policy advice, i.e., to decide what amount of money should be invested in which public good.

Our findings do not imply that the willingness to pay for the public good and social incentives must not be linked. As shown in the extensions, we can, for instance, model that social incentives decline if the level of the public good increases. Thus, it is likely that social incentives do not occur independently of the preference and the level of the public good. This problem might also be the biggest challenge for further research. The paper cannot – and is not aiming to – explain why and in what size the willingness to pay for social incentives occurs in relation to one's preference for a public good. However, the paper allows to analyze the impact of prices on the willingness to pay for social incentives. Higher prices for the provision of the public good will lead to a lower provision based on social incentives. This might explain why, e.g., elections in Germany still face a high voter turnout. The price for voting might be perceived as low. In comparison, the abdication of flying might be perceived as more expensive (higher opportunity cost). Thus, social incentives might not be sufficient to reduce behavior that causes climate change. This paper establishes the foundation to investigate the private and public provision of the collective good by separating the willingness to pay and the underlying preferences. While

we can determine price effects, more research is needed to investigate the link between preferences for social incentives and the public good.

In our second paper, we applied this separation on the example of the public good animal welfare. The Quasi-Monarch setting, which we implemented through a hypothetical referendum, was used to distinguish between the willingness to pay for social incentives and public goods. However, this example shows that many other preferences also affect the stated willingness to pay. The contribution of this paper is to give a framework how the two kinds of willingness to pay can be distinguished from other preferences, e.g., for taste, health, and free choice. Furthermore, the components of the willingness to pay in the referendum case have not been analyzed before and state a significant contribution finding the appropriate policy measure.

The biggest challenge in this paper is the public good animal welfare itself. Many individuals do not perceive animal welfare as a large public good that they cannot influence with their purchase decisions. Thus, the stated and calculated willingness to pay must be interpreted cautiously. For further research, it is important to apply the framework to public goods where individuals expect their influence to be marginal. This seems to be the case for public goods for which the cost of provision is high, e.g., climate. It is likely that the willingness to pay for social incentives and the one for the public good differ significantly for these goods.

The willingness to pay for social incentives will be revealed on the market. Individuals buy eggs with higher husbandry standards or compensate for flight emissions. However, this is not the case for the willingness to pay for public goods. This willingness to pay will not be revealed on the market due to the free-rider problem. In my third paper, I tried to find a consistent way to show how this willingness is revealed. This can only be done via the political market. The results are identical to the ones of the median voter theorem. However, the new framework and representations allow to include different properties of the supply side and compare results in a price-quantity diagram. Implementing indifference curves in the price-quantity diagram is a new feature and contributes a new instrument to the literature.

My model assumes that the private and the public good are independent. The level of the public good does not affect the quality or price of the private good. This assumption might be adequate, considering public goods like better animal husbandry. However, many

public goods form the basis for producing private goods. For example, climate change increases the price of many private goods. Farmers have to compensate fewer rainfalls with artificial irrigation. Protection against thunderstorms has to be increased, which induces additional costs. Increasing forest fires enlarge the damage to private property. In these cases, the public good can be seen as a complement to other goods or as a component of the prices of the private goods. Modifying the relationship between the private and public good is an important area for further research. However, it is likely that the higher the influence of the public good on the private good, the higher the willingness to pay for the public good. The derived results are unlikely to deviate significantly from the established median voter theorem.

While the median voter model is simple and unassailable in theory, its application, in reality, is problematic. Literature tries to find a convergence process to the median voter. However, the median voter model is a static model. No statements on the convergence process can be made. Thus, we developed a model which is more in line with theory. We use a switch of the median voter in the transition between the primary and main election in U.S. presidential elections. The findings support that there is a convergence as expected. However, this convergence is not in line with theory as the candidate that should coincide with the median voter of all citizens from the beginning on converges. One challenge for the analysis is that the tool we use to determine the position of speeches (wordfish) cannot differentiate between topics and positions. A manual evaluation of speeches supports that the convergence is not driven by topics. However, more research must be done on how positions and topics can be differentiated in estimating the positions of speeches. The main problem of our analysis is the assumption that the election of one candidate in the primaries is not influencing the other candidate. Anecdotic and empirical analysis show that this is not the case. Thus, a causal link between the change of the median voter and convergence cannot be established.

Bibliography

Adamowicz, Wiktor L., Peter C. Boxall, Michael Williams, and Jordan J. Louviere. 1998. "Stated Preference Approaches for Measuring Passive Use Values: Choice Experiments and Contingent Valuation." *American Journal of Agricultural Economics* 80 (1): 64–75.

Adams, James, Samuel Merrill, and Roi Zur. 2020. "The Spatial Voting Model." In *The SAGE Handbook of Research Methods in Political Science and International Relations,* edited by Luigi Curini and Robert Franzese, 205–223. London: SAGE Publications.

Adv. 2018. *AIRPORT Airport Travel Survey 2018.* Accessed June 11, 2021. https://www.adv.aero/wp-content/uploads/2018/06/Airport-Travel_Survey_2018_Reisealternativen.pdf.

Andreoni, James. 1990. "Impure Altruism and Donations to Public Goods: A Theory of Warm-Glow Giving." *The Economic Journal* 100 (401): 464–477.

———. 1995. "Cooperation in Public-Goods Experiments: Kindness or Confusion?" *The American Economic Review* 85 (4): 891–904.

Anomaly, Jonathan. 2015. "Public goods and government action." *Politics, Philosophy & Economics* 14 (2): 109–128.

Arrow, Kenneth J., and Gérard Debreu. 1954. "Existence of an equilibrium for a competitive economy." *Econometrica* 22 (3): 265–290.

Axelrod, Robert M. 1984. *The evolution of cooperation.* New York, NY: Basic Books.

Banda, Kevin K., Thomas M. Carsey, and John Curiel. 2019. "Incumbency status and candidate responsiveness to voters in two-stage elections beginning with a primary." *Journal of Elections, Public Opinion and Parties,* 1–19.

Baron, David P. 2006. "Persistent media bias." *Journal of Public Economics* 90 (1-2): 1–36.

Batina, Raymond G., and Toshihiro Ihori. 2005. *Public Goods: Theories and Evidence.* Berlin and Heidelberg: Springer.

Baumol, William J., Wallace E. Oates, and Sue A. Blackman. 1979. *Economics, environmental policy, and the quality of life.* Englewood Cliffs, NJ: Prentice-Hall.

Becker, Gary S. 1968. "Crime and punishment: An economic approach." *Journal of Political Economy* 76 (2): 169–217.

———. 1983. "A theory of competition among pressure groups for political influence." *The Quarterly Journal of Economics* 98 (3): 371–400.

Black, Duncan. 1948. "On the Rationale of Group Decision-making." *Journal of Political Economy* 56 (1): 23–34.

———. 1958. *The theory of committees and elections.* Cambridge: University Press.

Book, Joakim. 2019. *The Real Reason Nobody Takes Environmental Activists Seriously.* Accessed June 11, 2021. https://www.aier.org/article/the-real-reason-nobody-takes-environmental-activists-seriously/.

Börgers, Tilman, and Rajiv Sarin. 1997. "Learning Through Reinforcement and Replicator Dynamics." *Journal of Economic Theory* 77 (1): 1–14.

Bornstein, Gary, Ido Erev, and Orna Rosen. 1990. "Intergroup competition as a structural solution to social dilemmas." *Social Behaviour* 5 (4): 247–260.

Boyd, Robert, and Peter J. Richerson. 1985. *Culture and the evolutionary process.* Chicago, IL: University of Chicago Press.

Bray, Heather J., and Rachel A. Ankeny. 2017. "Happy Chickens Lay Tastier Eggs: Motivations for Buying Free-range Eggs in Australia." *Anthrozoös* 30 (2): 213–226.

Brubaker, Earl R. 1975. "Free Ride, Free Revelation, or Golden Rule?" *The Journal of Law and Economics* 18 (1): 147–161.

Budak, Ceren, Sharad Goel, and Justin M. Rao. 2016. "Fair and Balanced? Quantifying Media Bias through Crowdsourced Content Analysis." *Public Opinion Quarterly* 80 (S1): 250–271.

Budescu, David V., Amnon Rapoport, and Ramzi Suleiman. 1990. "Resource dilemmas with environmental uncertainty and asymmetric players." *European Journal of Social Psychology* 20 (6): 475–487.

Bund Ökologische Lebensmittelwirtschaft. 2021. *Branchen Report 2021: Ökologische Lebensmittelwirtschaft.* Accessed August 5, 2021. https://www.boelw.de/fileadmin/user_upload/Dokumente/Zahlen_und_Fakten/Brosch%C3%BCre_2021/B%C3%96LW_Branchenreport_2021_web.pdf.

Bundesanstalt für Landwirtschaft und Ernährung. 2021. *Legehennenhaltung in Deutschland.* Accessed August 26, 2021. https://www.praxis-agrar.de/tier/gefluegel/legehennenhaltung-in-deutschland.

Bundesministerium für Ernährung und Landwirtschaft. 2019. *Deutschland, wie es isst: Der BMEL-Ernährungsreport 2019.* https://www.bmel.de/SharedDocs/Downloads/DE/Broschueren/Ernaehrungsreport2019.pdf;jsessionid=1B824A46FDA118A6C5E97877AAE2586B.live831?__blob=publicationFile&v=4.

———. 2021. *Vorgehen zum Umbau der Tierhaltung bekräftigt.* Accessed August 5, 2021. https://www.bmel.de/SharedDocs/Pressemitteilungen/DE/2021/078-borchert-kommission.html;jsessionid=388178362740E5812D0B9E44C99398CA.live841.

Chiang, C.-F., and B. Knight. 2011. "Media Bias and Influence: Evidence from Newspaper Endorsements." *The Review of Economic Studies* 78 (3): 795–820.

Chu, Lan Khanh. 2021. "Economic structure and environmental Kuznets curve hypothesis: new evidence from economic complexity." *Applied Economics Letters* 28 (7): 612–616.

Clarke, Edward H. 1971. "Multipart pricing of public goods." *Public Choice* 11 (1): 17–33.

Coleman, James S. 1986. "Social Structure and the Emergence of Norms among Rational Actors." In *Paradoxical Effects of Social Behavior,* edited by Andreas Diekmann and Peter Mitter, 55–83. Heidelberg: Physica-Verlag.

Cooper, David J., and Carol Kraker Stockman. 2002. "Fairness and learning: an experimental examination." *Games and Economic Behavior* 41 (1): 26–45.

D'Alessio, Dave. 2012. *Media bias in presidential election coverage, 1948-2008: Evaluation via formal measurement.* Lexington Studies in Political Communication. Lanham, Md: Lexington Books. http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10546775.

Dawes, Robyn M. 1980. "Social Dilemmas." *Annual Review of Psychology* 31 (1): 169–193.

Deacon, Robert T. 2009. "Public good provision under dictatorship and democracy." *Public Choice.*

Desvousges, William H., F. Reed Johnson, Richard Dunford, Kevin J. Boyle, Sara Hudson, and K. Nicole Wilson. 1992. *Measuring Nonuse Damages Using Contingent Valuation: An Experimental Evaluation of Accuracy.* Research Triangle Park, NC: RTI Press.

Diamond, Peter A., and Jerry A. Hausman. 1994. "Contingent Valuation: Is Some Number Better than No Number?" *Journal of Economic Perspectives* 8 (4): 45–64.

Donofrio, Stephen, Patrick Maguire, Steve Zwick, and William Merry. 2021. "State of the Voluntary Carbon Markets 2020." *Ecosystem Marketplace Insights Brief.*

Downs, Anthony. 1957. "An Economic Theory of Political Action in a Democracy." *Journal of Political Economy* 65 (2): 135–150.

Elster, Jon. 1985. "Rationality, Morality, and Collective Action." *Ethics* 96 (1): 136–155.

———. 1989. *The Cement of Society.* Cambridge: Cambridge University Press.

Esteban, Joan, and Debraj Ray. 2001. "Collective Action and the Group Size Paradox." *The American Political Science Review* 95 (3): 663–672.

Farquharson, Robin. 1969. *Theory of voting.* Oxford: Blackwell.

Feige, Christian, Karl-Martin Ehrhart, and Jan Krämer. 2014. "Voting on contributions to a threshold public goods game - an experimental investigation." *KIT Working paper series in economics* 60.

Fischbacher, Urs, and Simon Gächter. 2010. "Social Preferences, Beliefs, and the Dynamics of Free Riding in Public Goods Experiments." *The American Economic Review* 100 (1): 541–556.

Fleishman, John A. 1988. "The Effects of Decision Framing and Others' Behavior on Cooperation in a Social Dilemma." *Journal of Conflict Resolution* 32 (1): 162–180.

Frank, Robert H., Thomas Gilovich, and Dennis T. Regan. 1993. "The evolution of one-shot cooperation: An experiment." *Ethology and Sociobiology* 14 (4): 247–256.

Freeman, Albert Myrick, Joseph A. Herriges, and Catherine L. Kling. 2014. *The measurement of environmental and resource values: Theory and methods.* 3rd ed. Abingdon: Resources for the future.

Gale, John, Kenneth G. Binmore, and Larry Samuelson. 1995. "Learning to be imperfect: The ultimatum game." *Games and Economic Behavior* 8 (1): 56–90.

Gogoll, Niklas, and Felix Schlieszus. 2021a. *How (not) to measure the willingness to pay for public goods : Challenges estimating willingness to pay for animal welfare with an ACBC.* University of Bayreuth, Bayreuth. Accessed August 17, 2022. https://eref.uni-bayreuth.de/71426/.

———. 2021b. *Why Being a Frequent Flyer and an Environmental Activist is no Contradiction: The Willingness to Pay for Public Goods and its Components.* University of Bayreuth, Bayreuth. Accessed August 7, 2022. https://www.vwl5.uni-bayreuth.de/pool/dokumente/Working-Paper/Gogoll-_-Schlieszus---Frequent-Flyer-Environmental-Activist.pdf.

Grimmer, Justin, and Brandon M. Stewart. 2013. "Text as Data: The Promise and Pitfalls of Automatic Content Analysis Methods for Political Texts." *Political Analysis* 21 (3): 267–297.

Groseclose, T., and J. Milyo. 2005. "A Measure of Media Bias." *The Quarterly Journal of Economics* 120 (4): 1191–1237.

Gross, Justin H., Brice Acree, Yanchuan Sim, and Noah A. Smith. n.d. "Testing the Etch-a-Sketch Hypothesis: A Computational Analysis of Mitt Romney's Ideological Makeover During the 2012 Primary vs. General Elections." *American Political Science Association 2013 Annual Meeting Paper* 2013. Accessed August 18, 2020. https://ssrn.com/abstract=2299991.

Groves, Theodore. 1973. "Incentives in Teams." *Econometrica* 41 (4): 617–631.

Guagnano, Gregory A., Thomas Dietz, and Paul C. Stern. 1994. "Willingness to Pay for Public Goods: A Test of the Contribution Model." *Psychological Science* 5 (6): 411–415.

Guillen, Pablo, Christiane Schwieren, and Gianandrea Staffiero. 2007. "Why feed the Leviathan?" *Public Choice* 130 (1-2): 115–128.

Güney, Osman Inanç, and Luca Giraldo. 2020. "Consumers' attitudes and willingness to pay for organic eggs." *British Food Journal* 122 (2): 678–692.

Güth, Werner. 1995. "An evolutionary approach to explaining cooperative behavior by reciprocal incentives." *International Journal of Game Theory* 24 (4): 323–344.

Hanley, Nick, Robert E. Wright, and Wiktor L. Adamowicz. 1998. "Using Choice Experiments to Value the Environment." *Environmental and Resource Economics* 11 (3/4): 413–428.

Hausman, Jerry A. 2012. "Contingent Valuation: From Dubious to Hopeless." *Journal of Economic Perspectives* 26 (4): 43–56.

Hine, Donald W., and Robert Gifford. 1996. "Individual Restraint and Group Efficiency in Commons Dilemmas: The Effects of Two Types of Environmental Uncertainty1." *Journal of Applied Social Psychology* 26 (11): 993–1009.

Holcombe, Randall G. 1989. "The median voter model in public choice theory." *Public Choice* 61 (2): 115–125.

Homolar, Alexandra, and Ronny Scholz. 2019. "The power of Trump-speak: populist crisis narratives and ontological security." *Cambridge Review of International Affairs* 32 (3): 344–364.

Hotelling, Harold. 1929. "Stability in competition." *The Economic Journal* 39 (153): 41–57.

Inman, Robert P. 1978. "Testing political economy's 'as if' proposition: is the median income voter really decisive?" *Public Choice* 33 (4): 45–65.

Internet Archive. 2020. *Wayback Machine.* Accessed August 20, 2020. https://archive.org/web/.

Jagers, Sverker C., Niklas Harring, Åsa Löfgren, Martin Sjöstedt, Francisco Alpizar, Bengt Brülde, David Langlet, et al. 2020. "On the preconditions for large-scale collective action." *Ambio* 49 (7): 1282–1296.

John Woolley, Gerhard Peters. 2020. *The American Presidency Project.* Edited by UC Santa Barbara. Accessed August 20, 2020. https://www.presidency.ucsb.edu/about.

Kahneman, Daniel, and Jack L. Knetsch. 1992. "Valuing public goods: The purchase of moral satisfaction." *Journal of Environmental Economics and Management* 22 (1): 57–70.

Kelly, Casey Ryan. 2020. "Donald J. Trump and the rhetoric of ressentiment." *Quarterly Journal of Speech* 106 (1): 2–24.

Keser, Claudia, and Frans van Winden. 2000. "Conditional Cooperation and Voluntary Contributions to Public Goods." *The Scandinavian Journal of Economics* 102 (1): 23–39.

Kim, Kimin, and Myoung-jae Lee. 2019. "Difference in differences in reverse." *Empirical Economics* 57 (3): 705–725.

Kreps, David M., Paul Milgrom, John Roberts, and Robert Wilson. 1982. "Rational cooperation in the finitely repeated prisoners' dilemma." *Journal of Economic Theory* 27 (2): 245–252.

Lamont, Michèle, Bo Yun Park, and Elena Ayala-Hurtado. 2017. "Trump's electoral speeches and his appeal to the American white working class." *The British journal of sociology* 68 (1): S153–S180.

Louviere, Jordan J., and George Woodworth. 1983. "Design and Analysis of Simulated Consumer Choice or Allocation Experiments: An Approach Based on Aggregate Data." *Journal of Marketing Research* 20 (4): 350–367.

Mani, Ankur, Iyad Rahwan, and Alex Pentland. 2013. "Inducing peer pressure to promote cooperation." *Scientific reports* 3 (1735).

Margolis, Howard. 1983. "Selfishness, Altruism, and Rationality: A Theory of Social Choice." *The American Political Science Review* 77 (4): 1130–1131.

Mas-Colell, Andreu, Michael Dennis Whinston, and Jerry R. Green. 1995. *Microeconomic theory.* New York, NY: Oxford University Press.

McCabe, Kevin A., Stephen J. Rassenti, and Vernon L. Smith. 1996. "Game theory and reciprocity in some extensive form experimental games." *PNAS* 93 (23): 13421–13428.

Montgomery, Michael R., and Richard Bean. 1999. "Market failure, government failure, and the private supply of public goods: The case of climate-controlled walkway networks." *Public Choice* 99 (3/4): 403–437.

Moomaw, William R., and Gregory C. Unruh. 1997. "Are environmental Kuznets curves misleading us? The case of CO 2 emissions." *Environment and Development Economics* 2 (4): 451–463.

Moreh, Jacob. 1994. "Game theory and common-sense morality." *Social Science Information* 33 (1): 93–115.

Niskanen, William A. 1971. *Bureaucracy and representative government.* Chicago, Ill.: Aldine-Atherton.

Nowak, Martin A., and Karl Sigmund. 2005. "Evolution of indirect reciprocity." *Nature* 437 (7063): 1291–1298.

Olson, Mancur. 1971. *The logic of collective action: Public goods and the theory of groups.* 2. ed. Cambridge, MA: Harvard University Press.

Ostrom, Elinor. 1990. *Governing the commons: The evolution of institutions for collective action.* Cambridge: Cambridge University Press.

———. 1998. "A Behavioral Approach to the Rational Choice Theory of Collective Action." *The American Political Science Review* 92 (1): 1–22.

———. 2000. "Collective Action and the Evolution of Social Norms." *Journal of Economic Perspectives* 14 (3): 137–158.

Palfrey, Thomas R., and Jeffrey E. Prisbrey. 1997. "Anomalous Behavior in Public Goods Experiments: How Much and Why?" *The American Economic Review* 87 (5): 829–846.

Pecorino, Paul, and Akram Temimi. 2008. "The Group Size Paradox Revisited." *Journal of Public Economic Theory* 10 (5): 785–799.

Perman, Roger, Yue Ma, Michael S. Common, David Maddison, and James McGilvray. 2011. *Natural resource and environmental economics.* 4th ed. Boston, MA: Addison Wesley.

Pettersson, Isabelle Claire, Claire Alexandra Weeks, Lorna Rachel Maven Wilson, and Christine Janet Nicol. 2016. "Consumer perceptions of free-range laying hen welfare." *British Food Journal* 118 (8): 1999–2013.

Rapoport, Amnon, and Ramzi Suleiman. 1993. "Incremental Contribution in Step-Level Public Goods Games with Asymmetric Players." *Organizational Behavior and Human Decision Processes* 55 (2): 171–194.

Roberts, Russell D. 1984. "A Positive Model of Private Charity and Public Transfers." *Journal of Political Economy* 92 (1): 136–148.

Roth, Alvin E., and Ido Erev. 1995. "Learning in extensive-form games: Experimental data and simple dynamic models in the intermediate term." *Games and Economic Behavior* 8 (1): 164–212.

Rowley, K., Charles. 1984. "The Relevance of the Median Voter Theorem." *Journal of Institutional and Theoretical Economics* 140 (1): 104–126.

Sabia, Daniel R. 1988. "Rationality, Collective Action, and Karl Marx." *American Journal of Political Science* 32 (1): 50–71.

Sally, David. 1995. "Conversation and Cooperation in Social Dilemmas." *Rationality and Society* 7 (1): 58–92.

Samuelson, Paul A. 1954. "The Pure Theory of Public Expenditure." *The Review of Economics and Statistics* 36 (4): 387–389.

Sandler, Todd. 1992. *Collective action: Theory and applications.* Ann Arbor, MI: University of Michigan Press.

Savoy, Jacques. 2018. "Analysis of the style and the rhetoric of the 2016 US presidential primaries." *Digital Scholarship in the Humanities* 33 (1): 143–159.

Schaefer, Donovan O. 2020. "Whiteness and civilization: shame, race, and the rhetoric of Donald Trump." *Communication and Critical/Cultural Studies* 17 (1): 1–18.

Schläpfer, Felix, and Nick Hanley. 2006. "Contingent Valuation and Collective Choice." *Kyklos* 59 (1): 115–135.

Schneider, Nicolas. 2022. "Sustainable development or environmental Kuznets curve: some unresolved controversies." *International Journal of Environmental Studies,* 1–4.

Sen, Amartya K. 1967. "Isolation, Assurance and the Social Rate of Discount." *The Quarterly Journal of Economics* 81 (1): 112–124.

———. 1977. "Rational Fools: A Critique of the Behavioral Foundations of Economic Theory." *Philosophy & public affairs* 6 (4): 317–344.

Shaw, William H. 1984. "Marxism, Revolution, and Rationality." In *After Marx,* edited by Terence Ball and James Farr, 12–35. Cambridge: Cambridge University Press.

Slapin, Jonathan B., and Sven-Oliver Proksch. 2008. "A Scaling Model for Estimating Time-Series Party Positions from Texts." *American Journal of Political Science* 52 (3): 705–722.

Sorg, Diana, Anne Klatt, Nils Ole Plambeck, and Lea Köder. 2021. "Perspektiven für eine umweltverträgliche Nutztierhaltung in Deutschland." *Umweltbundesamt.*

Sparks, Steven. 2020. "Campaign Dynamics of the Top-Two Primary: Invoking Competition and Representational Pressure in one-party Contests." *Representation* 56 (2): 229–251.

Taylor, Michael. 1987. *The possibility of cooperation.* Cambridge: Cambridge University Press.

Udehn, Lars. 1993. "Twenty-five Years with The Logic of Collective Action." *Acta Sociologica* 36 (3): 239–261.

Ule, Aljaz, Arthur Schram, Arno Riedl, and Timothy N. Cason. 2009. "Indirect punishment and generosity toward strangers." *Science* 326 (5960): 1701–1704.

Umweltbundesamt. 2018. *Umweltbewusstsein in Deutschland 2018: Ergebnisse einer repräsentativen Bevölkerungsumfrage.* Accessed June 11, 2021. https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/ubs2018_-_m_3.3_basisdatenbroschuere_barrierefrei-02_cps_bf.pdf.

Varian, Hal R. 1993. "Markets for public goods?" *Critical Review* 7 (4): 539–557.

Warr, Peter G. 1982. "Pareto optimal redistribution and private charity." *Journal of Public Economics* 19 (1): 131–138.

Watts, Mark D., David Domke, Dhavan V. Shah, and David P. Fan. 1999. "Elite Cues and Media Bias in Presidential Campaigns." *Communication Research* 26 (2): 144–175.

Appendix A

Survey on the Willingness to Pay for Eggs

Lehrstuhl für Volkswirtschaftslehre V
Institutionenökonomik
Umfrage zur Zahlungsbereitschaft für Eier

Start

Liebe Teilnehmende,

im Rahmen einer unabhängigen, wissenschaftlichen Studie wollen wir in der folgenden Umfrage ermitteln, warum Sie wieviel für den Kauf von Eiern zahlen. Hierfür bitten wir um Ihre Unterstützung.
Die Dauer der Umfrage beträgt etwa **10 Minuten**. Alle Antworten werden selbstverständlich anonym gespeichert und sind nicht zurückzuverfolgen.

Wir bedanken uns für Ihre Teilnahme!

Niklas Gogoll & Felix Schlieszus
Wissenschaftliche Mitarbeiter der Universität Bayreuth

Für Rückfragen, Ideen oder Anmerkungen können Sie uns gerne unter felix.schlieszus@uni-bayreuth.de erreichen.

Weiter

Lehrstuhl für Volkswirtschaftslehre V
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Umfrage zur Zahlungsbereitschaft für Eier

Datenschutz

Einverständnis zur Verwendung Ihrer Daten und Mindestalter

Datenschutz_Allgemein_1

☐

Datenschutz_Allgemein_1

Ich erkläre mich damit einverstanden, dass im Rahmen dieser Studie Daten in anonymisierter Form erhoben und auf den Servern des Umfragenbetreibers Sawtooth Software aufgezeichnet werden. Die Einwilligung zur Erhebung und Verarbeitung der Daten ist unwiderruflich, da aufgrund der anonymisierten Form der Umfrage keine teilnehmerbezogene Löschung durchgeführt werden kann.

Datenschutz_Alter_1

☐

Datenschutz_Alter_1

Ich bestätige, dass ich mindestens 18 Jahre alt bin.

Zurück Weiter

0% 100%

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Umfrage zur Zahlungsbereitschaft für Eier

Essensgewohnheiten

Wie würden Sie Ihre Essgewohnheiten am ehesten beschreiben?

Wenn keine der Alternativen exakt zu Ihnen passt, wählen Sie die naheliegendste Alternative.

Essensgewohnheiten=1 ○ Ich esse tierische Erzeugnisse (Käse etc.) und Fleischprodukte.

Essensgewohnheiten=2 ○ Ich esse tierische Erzeugnisse, aber keine Fleischprodukte.

Essensgewohnheiten=3 ○ Ich esse weder tierische Erzeugnisse noch Fleischprodukte.

Eierkauf

Wie viele Eier (nicht Packungen!) kaufen Sie durchschnittlich pro Woche?

[ ]

Zurück Weiter

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Haltungsform

Für gewöhnlich kaufe ich Eier mit der Haltungsform...

- Haltungsform=1 ○ Bio
- Haltungsform=2 ○ Freilandhaltung
- Haltungsform=3 ○ Bodenhaltung

KT

Für gewöhnlich kaufe ich Eier, bei denen auf das Töten männlicher Küken verzichtet wird.

- KT=1 ○ Ja
- KT=2 ○ Nein
- KT=3 ○ Darauf achte ich beim Einkaufen nicht/ darauf habe ich bisher beim Einkaufen nicht geachtet.

Zurück Weiter

0% 100%

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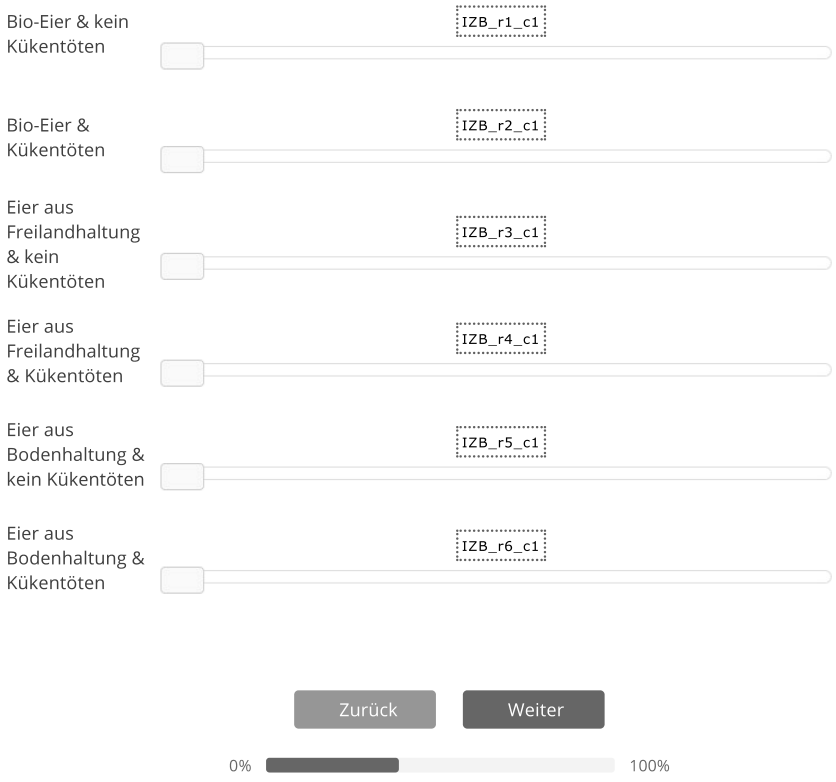
IZB

Im Folgenden möchten wir Ihre persönliche Zahlungsbereitschaft für Eier herausfinden, sprich wie viel sind Sie **maximal** bereit für eine bestimmte Packung Eier zu zahlen? Es gibt hier kein richtig oder falsch, besser oder schlechter.

Die nachfolgenden Eierpackungen (immer 10 Eier pro Packung, Größe L) unterscheiden sich hinsichtlich der Kriterien Haltungsform und dem Töten männlicher Küken.

Hinweis: Falls, Sie ein Produkt generell nicht kaufen würden, wählen Sie als Wert 0€ aus. Würden Sie mehr als 10€ für ein bestimmtes Produkt bezahlen, wählen Sie 10€ aus.



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Umfrage zur Zahlungsbereitschaft für Eier

IntroVB

Nehmen Sie an, dass der Staat das Tierwohl von Legehennen erhöhen will. Hierfür kann er Mindeststandards für Haltungsbedingungen und/oder zum Kükentöten für alle Hersteller verpflichtend einführen. Das heißt, es wäre dann nicht mehr möglich, Eier mit niedrigeren (schlechteren) Standards im Supermarkt zu kaufen.

Zurück Weiter

0% 100%

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VBZB

Der bisherige Mindeststandard entspricht dem der Bodenhaltung und das Töten männlicher Küken ist erlaubt. Bis zu welchem Preis für eine 10er Packung Eier würden Sie dem Vorschlag zur Erhöhung auf die folgenden Mindeststandards für alle Individuen noch zustimmen?
Es gibt hier kein richtig oder falsch, besser oder schlechter.

Die nachfolgenden Eierpackungen (immer 10 Eier pro Packung, Größe L) unterscheiden sich hinsichtlich der Kriterien Haltungsform und dem Töten männlicher Küken.

Hinweis: Falls, sie dem Vorschlag generell nicht zustimmen würden, wählen Sie als Wert 0€ aus. Würden Sie selbst einem Vorschlag zustimmen, der die Preise einer Packung auf mehr als 10€ erhöht, wählen Sie bitte den maximalen Wert (10€).

Machen Sie sich bei der Beantwortung bitte keine Gedanken darüber, ob sich andere Personen diesen Preis leisten können. Gehen Sie nur von Ihrer eigenen Situation aus!

Gehen Sie davon aus, dass es auch keinen Import von Eiern zu schlechteren Haltungsbedingungen aus dem Ausland geben wird.

	Value	
Bio-Eier & kein Kükentöten	VBZB_r1_c1	
Bio-Eier & Kükentöten	VBZB_r2_c1	
Eier aus Freilandhaltung & kein Kükentöten	VBZB_r3_c1	
Eier aus Freilandhaltung & Kükentöten	VBZB_r4_c1	
Eier aus Bodenhaltung & kein Kükentöten	VBZB_r5_c1	

Zurück Weiter

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IvsZB

In welchem Fall sind Sie eher bereit einen höheren Preis für Eier zu zahlen?

IvsZB=1 ○ wenn ich mir dies individuell aussuchen kann, sprich z.B. selbst entscheiden kann, ob ich Eier der Haltungsform Freiland kaufen möchte oder lieber Eier aus Bodenhaltung.

IvsZB=2 ○ wenn der Staat einen bestimmten Standard einführt und sich alle Individuen an diesen halten müssen.

IvsZB=3 ○ In beiden Fällen gleich viel

ZBWhy

Warum?
(Keine Pflichtantwort, aber Ihre Einschätzung ist äußerst relevant für unsere Forschung)

Zurück Weiter

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Praef

Sortieren Sie die folgenden Merkmale nach ihrer Wichtigkeit beim Kauf von **Eiern**. Verwenden Sie hierfür die Zahlen 1 (am wichtigsten) bis 4 (am unwichtigsten). Bitte verwenden Sie jede Zahl nur einmal.

Praef_1		Tierwohl
Praef_4		Geschmack
Praef_3		Preis
Praef_2		Eigene Gesundheit

Zurück Weiter

0% 100%

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Institutionenökonomik
Umfrage zur Zahlungsbereitschaft für Eier

TierwohlEier

Achten Sie beim Eierkauf auf das Tierwohl?

Überhaupt nicht	Eher nicht	Mittel	Eher schon	Sehr
TierwohlEier_r1=1	TierwohlEier_r1=2	TierwohlEier_r1=3	TierwohlEier_r1=4	TierwohlEier_r1=5

Interdependenzen

Inwieweit stimmen Sie folgenden Aussagen zu:

	Sehr wenig	Wenig	Mittel	Stark	Sehr star
Eier von Hühnern, denen es besser geht, schmecken auch besser.	Interdependenzen_r1=1	Interdependenzen_r1=2	Interdependenzen_r1=3	Interdependenzen_r1=4	Interdependenz
Eier von Hühnern, denen es besser geht, sind auch besser für die eigene Gesundheit.	Interdependenzen_r2=1	Interdependenzen_r2=2	Interdependenzen_r2=3	Interdependenzen_r2=4	Interdependenz
Mit dem Kauf von Eiern mit besserer Haltungsform der Hühner, sorge ich persönlich dafür, dass es Hühnern besser geht.	Interdependenzen_r3=1	Interdependenzen_r3=2	Interdependenzen_r3=3	Interdependenzen_r3=4	Interdependenz

Zurück Weiter

0% 100%

UNIVERSITÄT BAYREUTH

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IntroSozio

Zu guter letzt sind für eine genaue Auswertung der Umfrage einige persönliche Daten für uns entscheidend. Diese werden natürlich anonym erfasst und sind nicht zurückverfolgbar.

Alter

Welcher Altersgruppe gehören Sie an?

Geschlecht

Welchem Geschlecht fühlen Sie sich zugehörig?

- Geschlecht=1 ○ Weiblich
- Geschlecht=2 ○ Männlich
- Geschlecht=3 ○ Divers
- Geschlecht=4 ○ Keine Angabe

Bildungsstand

Welchen höchsten allgemeinbildenden Schulabschluss haben Sie?

MNettoeinkommen

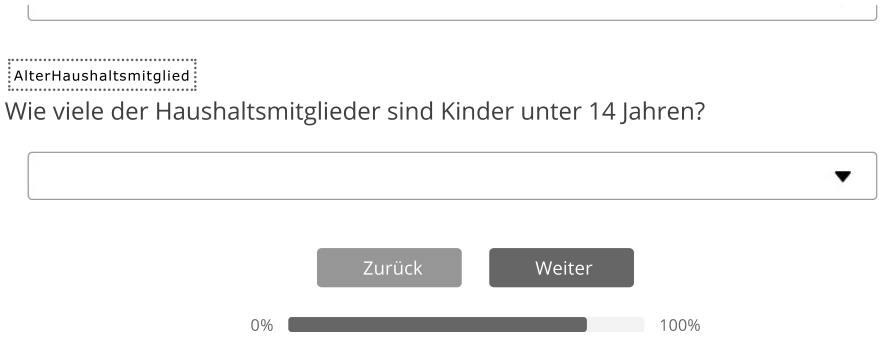
Wie hoch ist das monatliche Nettoeinkommen (also Einkommen nach Steuern) Ihres Haushalts?

Studiengang

Welchen Studiengang studieren Sie?

Haushaltsmitglied

Für wie viele Haushaltsmitglieder übernehmen Sie den Lebensmitteleinkauf?


AlterHaushaltsmitglied
Wie viele der Haushaltsmitglieder sind Kinder unter 14 Jahren?
Zurück
Weiter
0%
100%

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Feedback

Haben Sie Anmerkungen, Feedback oder Fragen an und für uns? Wir freuen uns über jeden Kommentar.

Zurück Weiter

0% 100%

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Ende

Vielen Dank für Ihre Teilnahme an der Umfrage!

Mit Ihren Angaben versuchen wir zu messen, wie sich Ihre individuelle Zahlungsbereitschaft für das Tierwohl verändert, wenn nur Sie alleine oder zwanghaft alle zur Verbesserung des Tierwohls beitragen. Dafür haben wir uns für das Beispiel Eier entschieden. Eine bessere Haltungsform könnte man auch aus anderen Gründen (Geschmack, Gewissen, Gesundheit etc.) bevorzugen. Beim Kükentöten hingegen spielt ausschließlich das Tierwohl eine Rolle. Dies ermöglicht die Schätzung Ihrer Zahlungsbereitschaften in beiden Situationen.

Wenn Sie daran interessiert sind: Erste Ergebnisse der Umfrage werden zeitnah auf der Homepage des SoSci Panels unter Studienergebnisse veröffentlicht.

Mit freundlichen Grüßen

Niklas Gogoll & Felix Schlieszus

Für Rückfragen, Ideen oder Anmerkungen können Sie uns gerne unter niklas.gogoll@uni-bayreuth.de erreichen.

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Appendix B

Mathematical Appendix

B.1 Utility & Demand Curve

Lemma B.1.1. *Combinations on the inverse demand curve with lower prices (higher amount of x_c) gain a higher utility than combinations on the inverse demand curve at higher prices (lower amount of x_C).*

$$U(D_{x_c}(p_{c1})) > U(D_{x_c}(p_{c2})) \text{ if } p_{c1} < p_{c2}$$

Proof. Using the utility function depending only on the collective good x_c and including the budget restriction (equation 4.5) yields

$$U(x_c) = \left(\frac{m - x_c p_c}{p_p}\right)^{\alpha} x_c^{\beta}. \tag{4.5}$$

Replacing the price of the collective good with the inverse demand function

$$D_{p_c}^{-1}(x_c) = \frac{\beta m}{(\alpha + \beta) x_c},$$

s.t. only the utility of the points on the inverse demand function is observed, yields

$$U(x_c) = \left(\frac{m - \frac{\beta m}{\alpha+\beta}}{p_p}\right)^{\alpha} {x_c}^{\beta}.$$

Differentiating this function with respect to x_c gives

$$\frac{dU(x_c)}{dx_c} = \left(\frac{m - \frac{\beta m}{\alpha+\beta}}{p_p}\right)^{\alpha} \beta {x_c}^{\beta-1}.$$

Using assumptions AS1 and AS2 it can be concluded that the derivative is positive and if x_c is increasing, which implies a price decrease in p_c, the utility is increasing. □

B.2 Lower Price at Constant Amount

Lemma B.2.1. *For a given amount of the collective good, the utility is higher with a lower price for p_c:*

$$U(p_{c_1}) > U(p_{c_2}) \text{ if } p_{c_1} < p_{c_2}$$

Proof. Using the utility function depending only on the collective good x_c and including the budget restriction (equation 4.5) yields

$$U(x_c) = \left(\frac{m - x_c p_c}{p_p}\right)^{\alpha} x_c^{\beta}. \tag{4.5}$$

Differentiating this function with respect to p_c leads to

$$\frac{dU(x_c)}{dp_c} = -\frac{\alpha {x_c}^{\beta+1} \left(\frac{m-p_c x_c}{p_p}\right)^{\alpha-1}}{p_p}.$$

This term is negative as all variables are positive and $m - p_c x_c \geq 0$ must hold s.t. budget restriction holds. It can be concluded that if the price of the collective good p_c is increasing for a fixed amount of the collective good x_c, the utility is decreasing. □

B.3 Utility beside Demand Function at Constant Price

Lemma B.3.1. *For any given price of the collective good p_c, the utility decreases for a higher or lower amount of the collective good x_c beside the combination on the demand function x_c^* monotonously:*

$$U(x_c^* + a) > U(x_c^* + b) \text{ if } a < b \text{ and } a > 0 \text{ \& } b > 0$$

and

$$U(x_c^* - a) > U(x_c^* - b) \text{ if } a < b \text{ and } a > 0 \text{ \& } b > 0$$

Proof. Using the utility function only depending on the collective good x_c and including the budget restriction (equation 4.5) yields

$$U(x_c) = \left(\frac{m - x_c p_c}{p_p}\right)^{\alpha} x_c^{\beta}. \tag{4.5}$$

Substituting x_c with the demand function (equation 4.4), which is providing the utility maximizing amount of the collective good x_c^* for a given price p_c, and adding x_c leads to

$$U(x_c^* + x_c) = \left(\frac{\beta m}{p_c(\alpha+\beta)} + x_c\right)^{\beta} \left(\frac{m - p_c\left(\frac{\beta m}{p_c(\alpha+\beta)} + x_c\right)}{p_p}\right)^{\alpha}.$$

Differentiating this function with respect to x_c yields

$$\frac{dU(x_c^* + x_c)}{dx_c} = \frac{{p_c}^2 x_c(\alpha+\beta)^3 \left(\frac{\beta m}{p_c(\alpha+\beta)} + x_c\right)^{\beta} \left(\frac{\frac{\alpha m}{\alpha+\beta} - p_c x_c}{p_p}\right)^{\alpha}}{(p_c x_c(\alpha+\beta) - \alpha m)(p_c x_c(\alpha+\beta) + \beta m)}. \tag{B.1}$$

For $x_c > 0$ this derivative (equation B.1) is negative. All variables are positive s.t. in the numerator only the part

$$\frac{\alpha m}{\alpha+\beta} - p_c x_c$$

can be negative. Using assumption AS2 this term simplifies to

$$\alpha m - p_c x_c. \tag{B.2}$$

For the denominator the only term which can be negative is

$$p_c x_c(\alpha + \beta) - \alpha m.$$

Using assumption AS2 this term simplifies to

$$p_c x_c - \alpha m. \tag{B.3}$$

If equation B.2 is positive, equation B.3 is negative or vice versa.[1] Thus, the whole term is negative, which implies that utility decreases for values of x_c above 0. It can be concluded, that for any amount higher than the amount on the demand curve, the utility for an individual is lower at any given price p_c.

For $x_c < 0$ the derivative (equation B.1) is positive. In addition to the calculus above, in the numerator x_c is negative, such that the whole term turns positive. Furthermore, in the numerator term

$$\frac{\beta m}{p_c(\alpha + \beta)} + x_c$$

can be negative. Using assumption AS2 this term simplifies to

$$\frac{\beta m}{p_c} + x_c. \tag{B.4}$$

In the denominator term

$$p_c x_c(\alpha + \beta) + \beta m$$

can be negative. Using assumption AS2 this term simplifies to

$$p_c x_c + \beta m. \tag{B.5}$$

[1] If $p_c x_c = \alpha m$ the utility is zero for any x_c and no utility maximum exists.

As equation B.4 and B.5 have the same sign, the whole term remains positive.[2] This implies that utility decreases for values of x_c below 0. It can be concluded, that for any amount lower than the amount on the demand curve, the utility for an individual is lower at any given price p_c. □

[2]For the case $p_c x_c = \beta m$ no derivative exists within the range of real numbers. However, this case can be ignored as this condition would imply (having negative value of x_c) that at least one of the variables p_c, β or m is negative, which is not allowed.

B.4 Monotonicity of Utility on Increasing Marginal Cost Curve

Lemma B.4.1. *For any combination beside the utility maximizing combination on the marginal cost curve, the utility decreases monotonously on the increasing marginal cost curve:*

$$U(A_{x_c}(x_c^* + a)) > U(A_{x_c}(x_c^* + b)) \text{ if } a < b \text{ and } a > 0 \text{ \& } b > 0$$

and

$$U(A_{x_c}(x_c^* - a)) > U(A_{x_c}(x_c^* - b)) \text{ if } a < b \text{ and } a > 0 \text{ \& } b > 0$$

Proof. At first, it is necessary to calculate the utility maximum on marginal cost curve: The utility maximum must be the tangential point with the lowest indifference curve (respective highest utility). Therefore, two conditions must be fullfilled:

1. The point of the marginal cost function and indifference curve must be identical. The marginal cost function is given by

$$A_{x_c}^{-1}(x_c) = x_c. \tag{B.6}$$

The indifference curve in price-quantity diagram is (see equation 4.6)

$$I_{\overline{U}}(x_c) = \frac{m - p_p(\frac{\overline{U}}{x_c^{\beta}})^{\frac{1}{\alpha}}}{x_c}. \tag{4.6}$$

Equating equation B.6 and 4.6 yields

$$x_c = \frac{m - p_p(\frac{\overline{U}}{x_c^{\beta}})^{\frac{1}{\alpha}}}{x_c}.$$

Solving for the constant utility value yields

$$\overline{U} = \left(\frac{x_c \left(\frac{m}{x_c} - x_c \right)}{p_p} \right)^{\alpha} {x_c}^{\beta}. \tag{B.7}$$

2. The slope of of the marginal cost function and the slope of the indifference curve must be identical. The slope of the marginal cost function is

$$\frac{dA_{x_c}^{-1}(x_c)}{dx_c} = 1. \tag{B.8}$$

The slope of the indifference curve is

$$\frac{dI_{\overline{U}}(x_c)}{dx_c} = \frac{p_p(\alpha+\beta)\left(\frac{\overline{U}}{{x_c}^{\beta}}\right)^{\frac{1}{\alpha}} - \alpha m}{\alpha {x_c}^2}. \tag{B.9}$$

Equating equations B.8 and B.9 yields

$$1 = \frac{p_p(\alpha+\beta)\left(\frac{\overline{U}}{{x_c}^{\beta}}\right)^{\frac{1}{\alpha}} - \alpha m}{\alpha {x_c}^2}.$$

Solving for the utility value yields

$$\overline{U} = \left(\frac{\alpha\left(m + {x_c}^2\right)}{p_p(\alpha+\beta)}\right)^{\alpha} {x_c}^{\beta}. \tag{B.10}$$

Equating B.7 and B.10 and solving for x_c yields the maximum utility on the marginal cost curve

$$x_c^* = \frac{\sqrt{\beta}\sqrt{m}}{\sqrt{2\alpha+\beta}}. \tag{B.11}$$

Using the utility function only depending on the collective good x_c and including the budget restriction (equation 4.5) yields

$$U(x_c) = \left(\frac{m - x_c p_c}{p_p}\right)^{\alpha} x_c^{\beta}. \tag{4.5}$$

Substituting the price of the collective good p_c with the marginal cost function leads to

$$U(x_c) = \left(\frac{m - x_c x_c}{p_p}\right)^{\alpha} x_c^{\beta}. \tag{4.5}$$

The second derivative of this function is

$$\frac{d^2U(x_c)}{dx_c^2} = \frac{(-2m{x_c}^2(2\alpha\beta+\alpha+(\beta-1)\beta)+{x_c}^4(2\alpha+\beta-1)(2\alpha+\beta)+(\beta-1)\beta m^2)}{(m-{x_c}^2)^2} * \frac{{x_c}^{\beta-2}\left(\frac{m-{x_c}^2}{p_p}\right)^\alpha}{(m-{x_c}^2)^2}.$$

Substituting x_c with the utility maximum x_c^* leads to

$$\frac{d^2U(x_c^*)}{dx_c^2} = -\frac{2^\alpha(2\alpha+\beta)^2\left(\frac{\sqrt{\beta}\sqrt{m}}{\sqrt{2\alpha+\beta}}\right)^\beta\left(\frac{\alpha m}{2\alpha p_p+\beta p_p}\right)^\alpha}{\alpha m}.$$

As all variables are positive this term is negative. This implies that the optimum is a global maximum and the utility decreases monotonously beside its maximum on the marginal cost curve.

□

B.5 Function of Inefficiency Maximizing Combinations

Lemma B.5.1. *Given a constant marginal cost of production function, a utility function and budget restriction,*

$$p_c = \frac{\beta m - \alpha c_c x_c}{\beta x_c} \tag{B.12}$$

is giving the curve of inefficiency maximizing points.

Proof. The indifference curves in the price-quantity diagram (equation 4.6) are given by

$$I_{\overline{U}}(x_c) = \frac{m - p_p(\frac{\overline{U}}{x_c^{\beta}})^{\frac{1}{\alpha}}}{x_c}. \tag{4.6}$$

The marginal cost function is given by

$$A_{x_c}^{-1}(x_c) = c_c,$$

where c_c is a positive real number. Any point between the indifference curve for the respective utility value and the supply function would lead to a higher utility level of the mentioned individual and thus in winning the election. The indifference curve itself would lead to a draw. In this area the combination having the highest total inefficiencies can be calculated. This can be achieved by multiplying the price given by the indifference curve minus the cost per unit, which is given by the marginal cost function, times the proposed amount of the collective good

$$\Pi(x_c) = \left(\frac{m - p_p(\frac{\overline{U}}{x_c^{\beta}})^{\frac{1}{\alpha}}}{x_c} - c_c \right) * x_c.$$

In order to get the maximum inefficiencies this term is differentiated with respect to x_c and set equal to zero

$$\frac{d\Pi(x_c)}{dx_c} = \frac{\beta p_p \left(\overline{U} {x_c}^{-\beta}\right)^{1/\alpha}}{\alpha x_c} - c_c = 0. \tag{B.13}$$

Using the utility function depending only on the collective good x_c and including the budget restriction (equation 4.5)

$$U(x_c) = {x_c}^{\beta} \left(\frac{m - p_c x_c}{p_p} \right)^{\alpha} \tag{4.5}$$

to substitute the constant utility-value in equation B.13, simplifying the term, solving it to p_c yields

$$p_c = \frac{\beta m - \alpha c_c x_c}{\beta x_c}. \tag{B.14}$$

This term provides for every amount of the collective good x_c the price p_c which maximizes inefficiencies for a party for a respective utility value. □

B.6 Utility Maximization on the path of inefficiency maximizing combinations for all voters

Lemma B.6.1. *Every combination on the inefficiency maximizing path which leads to a higher utility of the median voter, also leads to a higher utility of the other voters:*

$$U_2(\Pi_{max}(x_{c_1})) > U_2(\Pi_{max}(x_{c_2})) \text{ if } U_{MV}(\Pi_{max}(x_{c_1})) > U_{MV}(\Pi_{max}(x_{c_2}))$$

Proof. Let the budget of a second individual be m_2. Preferences remain the same, s.t. the utility function U_2 only changes as private goods x_p are replaced by the remaining budget not used for collective goods.

$$U_2 = x_p^{\alpha} x_c^{\beta} = {x_c}^{\beta} \left(\frac{m_2 - p_c x_c}{p_p} \right)^{\alpha}$$

results as utility function. For p_c the inefficiency maximizing function (equation B.12) is substituted

$$U_2 = {x_c}^{\beta} \left(\frac{m_2 - \frac{\beta m - \alpha c x_c}{\beta}}{p_p} \right)^{\alpha_2}.$$

Differentiating with respect to x_c yields

$$\frac{dU_2(x_c)}{dx_c} = \frac{\alpha^2 k {x_c}^{\beta} \left(\frac{m_2 - \frac{\beta m - \alpha c x_c}{\beta}}{p_p} \right)^{\alpha - 1}}{\beta p_p} + \beta {x_c}^{\beta - 1} \left(\frac{m_2 - \frac{\beta m - \alpha c x_c}{\beta}}{p_p} \right)^{\alpha}.$$

Using assumtions AS1 and AS2 the derived value must be positive for an increasing x_c and a solution within the range of real numbers. U_2 is increasing with x_c, which implies that voters will always choose the point on the path where corresponding combination is containing more x_c, hence also the median voter has the higher utility. □

Appendix C

Graphs and Tables

C.1 Sparsity & Maximum Word Frequency

	(1)	(2)	(3)	(4)	(5)
Sparsity	97%	95%	95%	100%	100%
MaxDF	97%	95%	100%	95%	100%
D	-1.219***	-1.159***	-1.113***	-1.286***	-1.245***
	(0.0754)	(0.0777)	(0.0802)	(0.0736)	(0.0761)
T	-1.251***	-1.318***	-1.296***	-1.191***	-1.177***
	(0.223)	(0.224)	(0.230)	(0.217)	(0.224)
Interaction	1.291***	1.353***	1.340***	1.251***	1.244***
	(0.226)	(0.229)	(0.235)	(0.221)	(0.229)
Constant	0.316***	0.296***	0.273***	0.323***	0.303***
	(0.0827)	(0.0871)	(0.0907)	(0.0821)	(0.0860)
Observations	258	258	258	258	258
Adjusted R^2	0.462	0.437	0.408	0.497	0.470

Standard errors (robust) in parentheses, * p<0.10, ** p<0.05, *** p<0.01

Table C.1: Regression with different sparsities and maximum document frequencies

C.2 (Swing) states

	(1) Basic	(2) Swing State Dummy	(3) Swing State Interaction	(4) Only Swing States	(5) State Fixed Effects
D	-1.219***	-1.220***	-1.221***	-1.209***	-1.230***
	(0.0754)	(0.0755)	(0.0756)	(0.0827)	(0.0884)
T	-1.251***	-1.301***	-1.318***	-1.577***	-1.090***
	(0.223)	(0.235)	(0.239)	(0.0802)	(0.282)
Interaction	1.291***	1.308***	1.247***	1.703***	1.361***
	(0.226)	(0.227)	(0.229)	(0.0978)	(0.221)
SwSt		0.0669	-0.101		
		(0.116)	(0.0662)		
SwSt_int			0.191		
			(0.147)		
Constant	0.316***	0.294***	0.353***	0.241**	-1.117***
	(0.0827)	(0.0909)	(0.0858)	(0.0978)	(0.221)
State FE	no	no	no	no	yes
Observations	258	258	258	194	258
Adjusted R^2	0.462	0.461	0.459	0.380	0.460

Standard errors (robust) in parentheses. * p<0.10, ** p<0.05, *** p<0.01

Table C.2: Regression with swing states and state fixed effects and dummies

C.3 Intervals

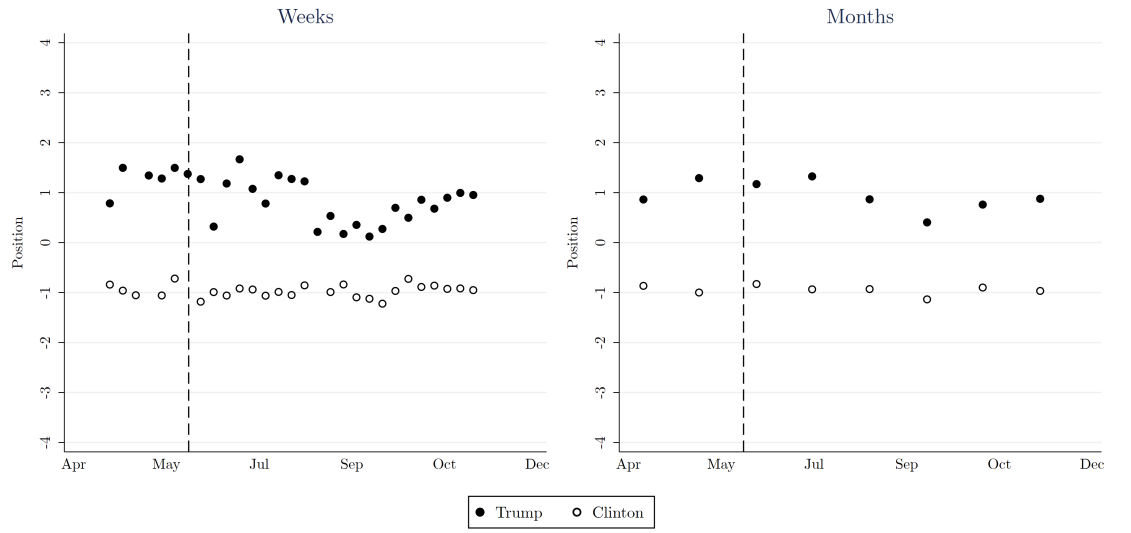

Figure C.1: Positions of speeches over time using Wordfish-based different time periods

	(1) Basic	(2) Weeks	(3) Months
D	-1.219***	-1.769***	-1.820***
	(0.0754)	(0.0989)	(0.158)
T	-1.251***	-0.506***	-0.261
	(0.223)	(0.140)	(0.194)
Interaction	1.291***	0.454***	0.185
	(0.226)	(0.155)	(0.204)
Constant	0.316***	0.843***	0.923***
	(0.0827)	(0.116)	(0.165)
Observations	258	54	16
Adjusted R^2	0.462	0.904	0.952

Standard errors (robust) in parentheses

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

Table C.3: Regression using Wordfish-based different intervals