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Exploring voter dynamics in Swiss climate policies (2021-2023): Reasons for a reversal

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Abstract

This paper compares the positions taken by Swiss municipalities regarding the rejection of the CO_2 Act in 2021 and the acceptance of the Climate and Innovation Act in 2023. I use detailed statistical analysis to explore the electoral behaviour of municipalities according to socio-demographic and energy-related factors. The results show that municipalities with a higher proportion of young people, residents active in the primary sector and supporters of right-wing political parties, as well as those that have adopted renewable energy as the main energy source for buildings, were more likely to switch from a 'no' vote in 2021 to a 'yes' vote in 2023. These findings provide additional insight into the determinants of voting results and enrich the understanding of political dynamics related to climate issues in Switzerland.

Contents

List of Figures

List of Tables

1 Introduction

Since the beginning of the 21^{st} century, Switzerland has introduced new legislation to align with its commitments under the Kyoto Protocol and, later, the Paris Agreement. In May 2023, the counter-proposal to the glacier initiative was adopted, following several stalled projects. While the new law represents a step forward in Swiss climate policy, it has faced substantial criticism for its perceived lack of ambition and concrete implementation mechanisms, raising concerns about its alignment with the goals of the Paris Agreement. One tangible and effective measure, widely recommended by economists, is the taxation of carbon emissions. The Pigouvian tax is designed to address the negative externality arising from human pollution. It provides society with a double dividend: pollution reduction, and use of the revenues generated by the tax. However, as evidenced by the rejection of some legislative proposals, this solution has not received public approval. The Swiss population seems reluctant to bear the costs of addressing climate change. This poses a significant challenge for climate policy: devising measures that people are willing to accept. The key question is how to implement more effective measures, make taxes more attractive, and allocate tax revenues in the most appropriate manner. In order to better understand public preferences, the legislative proposals that have been rejected should be meticulously analysed and refined.

Given the local and recent context of my study, which centres on the latest popular votes in Switzerland, only a few studies have been carried out to date. Through my analysis, I intend to uncover the voting patterns among Swiss citizens regarding the 2021 and 2023 climate laws. By comparing these two legislative votes, I aim to unravel the reasons behind the rejection of one and the approval of the other. Furthermore, I will explore the demographic composition of the population to identify the groups more inclined to oppose the law. In this manner, I hope to highlight avenues for improving the public acceptance of Switzerland's forthcoming climate policies.

2 Context and Literature review

2.1 International Environmental Policy and the Paris Agreement

The consequences of human-induced environmental degradation transcend geographical boundaries. The inaugural Stockholm environmental conference in 1972 emphasized the urgent need for global cooperation in addressing environmental issues. During this conference, the United Nations Environment Programme (UNEP, 2018) was established, and a series of conventions followed, paving the way for international environmental agreements. Among them, the adoption of the Montreal Protocol in 1987 marked a turning point in environmental governance, regulating nearly a hundred synthetic chemicals known to deplete the ozone layer (Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection, nd).

In 1992, the inaugural international "Earth summit" was held in Rio de Janeiro, focusing on climate change, biodiversity, and desertification. These negotiations allowed the establishment of the United Nations Framework Convention on Climate Change (UNFCCC, ndb), aiming to stabilize human-induced Greenhouse Gas (GHG) emissions. Subsequently, the Conference of the Parties (COP1) in Berlin in 1995, aimed to ensure effective implementation of the Convention's objectives. At the third COP in December 1997, the legally binding Kyoto Protocol was officially adopted and came into force in 2005. Nowadays, it is ratified by 192 Parties, including 191 nations and the European Union (UNFCCC, 2006). The Protocol obliged developed countries to commit to GHG emissions reduction targets, seeking an average five percent decrease compared to 1990 levels during the first commitment period (2008 to 2012). In the consecutive commitment period (2013 to 2020) under the Doha Agreement, they aimed for an 18 percent decrease in emissions (UNFCCC, ndb).

At the close of 2015, a major agreement was achieved within the UNFCCC framework: the Paris Agreement. Coming into effect on October 5, 2016, at the UN Climate Change Conference (COP21), it aimed to contain global warming to well below 2°C, ideally targeting a limit of 1.5°C above pre-industrial levels. Unlike previous agreements, the Paris Agreement has achieved near-universal participation, requiring each country to submit Nationally Determined Contributions (NDCs)[1]. It is important to underline that this near-universal participation has been made at the expense of enforcement measures such as punishments. Indeed, NDCs are set by each country but there is no consequences of not respecting its commitment. Often, in international agreement, there is a trade-off between enforcement and participation. Contrary to Paris, Kyoto's protocol had enforcement measures but which led to a small participation. Moreover, the Paris Agreement mandates countries to establish an Enhanced Transparency Framework (ETF) to ensure transparency in reporting their actions. In addition, developed nations are tasked with providing financial, technical and capacity building support to vulnerable countries (UNFCCC, nda).

Following the adoption of the Paris Agreement, awareness of climate change issues has increased, leading to more public debate and activism. The Paris Agreement encourages countries to implement Long-Term Low GHG Emissions Development Strategies (LT-LEDS) to align with the targets. These strategies include a transition to carbon neutrality, a target being considered by a growing number of countries (UNFCCC, nda).

2.2 Environmental Policy in Switzerland

2.2.1 Changes in the Federal CO_2 and Climate Legislation since 1999

Before delving into the background of Swiss climate policy, it is crucial to understand the Swiss legal system. The system is founded upon the Federal Constitution,

[1]NDCs outline specific measures and commitments for reducing GHG emissions and adapting to climate change. While national circumstances are considered when determining the NDCs, actions specified in these contributions have to become increasingly ambitious over time. (UNFCCC, nda)

the highest authority governing all legal acts. Proposed amendments to the Constitution can go through Parliament, consisting of two chambers: the National Council and the Council of States, elected by the population. To enact changes, approval from both the people and the cantons through a mandatory referendum is required. Additionally, any citizen can propose modifications by submitting a popular initiative, necessitating once again a double majority for adoption (Parlement suisse, nd). Federal laws derive from the Constitution and are enacted by the Parliament without the need for approval by the people and the cantons. However, citizens may challenge the introduction of a new law by launching an optional referendum. If they collect sufficient signatures within the prescribed time frame, the law is subject to a popular vote. Unlike the popular initiative, the optional referendum only requires a majority vote from the population for the law to take effect. This system is a distinctive feature of Switzerland and is known as direct democracy (Parlement suisse, nd).

This legal framework provided the basis for Switzerland to take significant steps in addressing climate change. The Kyoto Agreement was signed in 1998, and two years later, the first Federal Act on the Reduction of GHG Emissions (CO_2 Act) came into effect, laying the groundwork for emission reduction measures (Conseil fédéral suisse, 2002). The Federal Office for the Environment (FOEN, 2023b) claims that a concrete step was taken in 2008 with the introduction of an incentive tax on fossil fuels, including heating oil and natural gas. The FOEN (2023b) indicates that one third of tax revenue is allocated to the Buildings Program, which aims at improving the energy efficiency of the real estate sector. The remaining funds are distributed equitably among the public through the Swiss compulsory health insurance system and to employers, who receive an amount proportional to the payroll they have declared to their Old-Age and Survivors' Insurance (AHV) compensation fund[2]. On December 23, 2011, the CO_2 law was revised to require a 20% reduction in Switzerland's GHG emissions by 2020 compared to 1990 levels, along with a further 1.5% reduction by the following year (Assemblée fédérale de la

[2]AHV: Alters- und Hinterlassenenversicherung

Confédération suisse, 2011). In 2015, the Green Liberal Party (GLP), advocating green tax reform, launched an initiative to replace the current Value-Added Tax (VAT) with an energy tax. This initiative was massively rejected by the Swiss population (Carattini et al., 2017).

In June 2017, the Swiss parliament ratified the Paris Climate Agreement, as did the majority of states. According to the FOEN (2023c), Switzerland committed to halve its GHG emissions by 2030. On November 27, 2019, the popular glacier initiative "For a healthy climate" was submitted by a group of society campaigners. It demanded that from 2050 onwards, Switzerland should no longer emit any GHGs that cannot be offset by local carbon sinks (Confédération suisse, 2020). So, had the proposition been accepted, the distribution and use of combustibles and fossil fuels in Switzerland would no longer have been possible, with a few exceptions. The Federal Council and Parliament (Confédération suisse, 2020) argued that the initiative went too far. Nevertheless, it has rekindled the climate change debate in Switzerland[3]. Around a year later, a revision of the CO_2 law was drafted, with the aim of reducing GHG emissions by at least 50% by 2030, compared to 1990 levels. This corresponds to an amount that does not exceed the absorption capacity of carbon sinks. A referendum was initiated by the Swiss People's Party (SVP), economic interest groups, and the climate strike movement for various reasons. As a result, on June 13, 2021, Swiss citizens participated in a vote on the proposed amendment to the CO_2 law and rejected it by 51.6% (Confédération suisse, 2020; Gfs.bern, 2021).

After the rejection of the proposed revision, the Environment, Spatial Planning and Energy Committees of the National Council (ESPEC-N, 2022) drew up a counter-project that indirectly responded to some of the demands contained in the earlier initiative and referendum. This project took up the core objective of the glacier initiative, i.e. achieving zero net emissions by 2050. The report of the ESPEC-N (2022) indicates that rather than imposing an absolute ban on fossil

[3] Around the same time, Switzerland presented its Energy Strategy 2050, which aims to progressively phase-out nuclear energy (Baranzini and Carattini, 2017).

fuels, the project advocated a progressive reduction in oil and gas consumption. It also provided additional support for special circumstances, such as mountainous regions and remote areas with limited access to public transport. Subsequently, a referendum was submitted. It was partly influenced by concerns over a possible electricity shortage, and potentially further intensified by the ongoing conflict in Ukraine. On June 18, 2023, the Swiss population cast their votes on the Federal Act on Climate Protection Targets, Innovation and Strengthening Energy Security, also known as the Climate and Innovation Act (CIA). Unlike previous unsuccessful climate initiatives, the law was approved by 59.1% and is now Switzerland's main legislative framework on climate change (Conseil fédéral suisse, 2023; Gfs.bern, 2023).

2.2.2 Amendments to the Laws of 13 June 2021 and 18 June 2023

This section examines the legislative amendments that were briefly introduced in the preceding discussion of CO_2 and climate legislation changes. These laws are at the centre of my analysis, with one being rejected and the other approved. A detailed examination of these proposals enables the identification of the possible reasons for the different outcomes of the two votes.

To achieve the reduction of GHG emissions, the proposed amendments to the CO_2 Act of June 13, 2021, allowed for an increase in the tax per ton of CO_2, rising from CHF 120 to a maximum of CHF 210 (FOEN, 2021). Additionally, it introduced a new incentive tax on airline tickets, ranging from CHF 30 and to CHF 120. A portion of the tax revenues would be redistributed to benefit the population and the economy, while the remainder would be allocated to a Climate Fund. Furthermore, the FOEN (2021) specifies that measures would be imposed on vehicle and fuel importers. These proposed measures included the promotion of more energy-efficient vehicles to reduce petrol and diesel consumption and implementing climate protection projects to offset carbon emissions from fuels. Regarding buildings, the proposed legislation emphasised the promotion of renewable energy sources. When replacing heating systems in existing buildings, a maximum allowable level of carbon emissions should be observed. However, the FOEN (2021) points out that companies could be released from the CO_2 tax by investing in climate protection initiatives for their infrastructure or by participating in the Emissions Trading Scheme (cf. 3.2.3).

In response to public concerns about taxation, the amendments proposed in the indirect counter-project of June 18, 2023 sought to avoid the introduction of new taxes. Instead, the measures consisted of incentives to encourage positive behaviours. These included support for building owners transitioning from polluting heating systems or inefficient electric heating to clean energy sources such as heat pumps or wood, as well as for any building insulation improvements. The FOEN (2023a) provided that a yearly amount of up to CHF 200 million would be granted in financial support. The same amount is granted for firms modifying their production methods, as well as for firms investing in innovative technologies.[4]
Furthermore, the FOEN (2023a) reports that the law also aims to reduce Switzerland's dependence on foreign countries. Indeed, Switzerland imports three-quarters of its energy, especially as all its fossil fuels come from abroad. Lastly, the FOEN (2023a) points out the necessity of the Confederation and cantons to set an example and take measures to adapt to climate change.

2.3 VOX Analysis for the Laws of 13 June 2021 and 18 June 2023

Since 1977, the VOX project (Gfs.bern, nd) has been dedicated to analysing voting decisions on behalf of the Federal Chancellery. After each federal vote, the gfs.bern research institute conducts a representative survey, involving approximately 3,000 randomly selected anonymous voters. This survey focuses on voter turnout, voting decisions, and the key arguments at play. Socio-demographic and political

[4]This includes companies using high-temperature heat pumps or technologies for offsetting GHG emissions that cannot be fully eliminated in specific sectors, like agriculture and waste incineration facilities. One potential approach involves the capture and long-term storage of CO_2 emissions from industrial chimneys and the atmosphere (FOEN, 2023a).

parameters are also collected as they significantly shape voting behaviour. Gfs.bern conducted VOX analysis for both climate laws (Gfs.bern, 2021, 2023), yielding valuable insights into voting behaviour that will serve as a basis for comparison with my own analysis.

Table 1: Summary table of the two objects

				Yes voting rate	
	Title	Number of other objects	Turnout	% People	Number of Cantons
June 13, 2021	CO_2 Act	4	59.5%	48.4%	4 1/2
June 18, 2023	CIA*	2	42%	59.1%	18 1/2

*Climate and Innovation Act

Retrieved from Gfs.bern (2021, 2023)

2.3.1 June 13, 2021

On June 13, 2021, the Swiss population was asked to vote on five different legislative proposals, including the popular initiatives “for clean drinking water” and ”for a Switzerland free of synthetic pesticides”. The voter turnout was relatively high, standing at approximately 60%, with the highest participation observed among individuals leaning towards the far-right of the political spectrum (Gfs.bern, 2021). Gfs.bern (2021) analysis revealed that the strong mobilization of rural residents not only led to the rejection of the two agricultural initiatives but also influenced the rejection of the CO_2 Act, with only 48.4% in favour. At the cantonal level, only Basel-City, Geneva, Neuchâtel, Vaud, and Zurich voted in favour of this law.

Concerning voting behaviour, socio-demographic parameters had a limited effect. However, the study of Gfs.bern (2021) indicated that young people, women, or individuals with completed university studies were more likely to support the measures. Political parameters played a more decisive role, with a majority of ’yes’ votes coming from individuals self-identifying as left-wing, fully left-wing, or supporters of the Green party (GPS), the GLP, or the Socialist Party (SP). Trust in environmental associations and climate research also played a significant role, with higher trust levels correlating with greater support (Gfs.bern, 2021). Personal values were influential, as respondents were confronted with a dilemma: “A Switzerland where environmental protection is more important than economic prosperity, or a Switzerland where economic prosperity is more important than environmental protection” (Gfs.bern, 2021, p. 50). Predictably, individuals who placed a higher value on economic prosperity tended to vote 'no' (Gfs.bern, 2021). To uncover voter motivations, respondents were surveyed with an open-ended question. The predominant motivation for casting a 'yes' vote was interest towards environmental protection due to climate change and the perceived urgency of the situation. Meanwhile, the majority of 'no' voters were primarily driven by economic concerns, including cost-effectiveness, concerns about rising gasoline prices, and opposition to redistribution (Gfs.bern, 2021).

Finally, various pro and con arguments were presented to respondents by Gfs.bern (2021). Almost all pro arguments received majority approval, particularly those addressing the challenges of climate change. Surprisingly, the con arguments received less favour, with the argument pertaining to rising energy prices and the potential impact on small and medium-sized enterprises (SMEs) being the most accepted.

2.3.2 June 18, 2023

On June 18, 2023, the Swiss population was once again asked to voice their opinions in a popular vote, particularly on the Climate and Innovation Act. Gfs.bern (2023) argues that the voter turnout was lower compared to the 2021 vote, hovering at approximately 42%. Furthermore, fewer participants from the right or far-right of the political spectrum and rural residents were mobilized.

Regarding voting behaviour, the Gfs.bern (2023) study showed that most socio-demographic categories supported the CIA. Only individuals with no post-compulsory education and those with basic vocational training did not vote in favour. There was a slightly different voting pattern within sub-groups between the 2021 and the 2023 Act. The proportion of young people in favour dropped by 2%, while those over 70 showed even stronger support, with a 19% increase in 'yes' vote. The wealthiest individuals were the most favourable (70%), whereas they were mostly against the CO_2 Act (49%).

In terms of political parameters, the poll results revealed a widening gap between different ideologies and political parties. The 'yes' share among those on the left exceeded 90% (between 82% and 87% in 2021), while the share among those on the extreme right was only 13% (16% in 2021). The most significant differences in the final vote concerned individuals classifying themselves politically in the Centre (a 23% increase in 'yes' votes) and the Liberals (FDP) sympathizers, whose support surged from 37% to 66%. Compared to 2021, the 'yes' share also exhibited a clear correlation with trust in various actors and environmental institutions. Finally, in terms of personal values, the number of votes in favour of environmental protection was higher than in 2021 (a 15% increase), and the number of mixed opinions also increased (a 12% increase). Gfs.bern (2023) attributed this difference to the significantly greater representation of the environmental protection component in this vote compared to the one in 2021.

As in 2021, in the 2023 vote, respondents were questioned with an open-ended survey to uncover their voting motives. The primary reason for voting 'yes' overwhelmingly centred on the pressing need for environmental protection, with an even stronger perceived urgency of the situation. Conversely, the reasons for opposition were partially linked to cost issues (showing a 9% decrease compared to 2021) and political challenges, including concerns about policy direction, opposition to prohibitions stemming from policy, or the belief that current legislation was sufficient (Gfs.bern, 2023).

Finally, an analysis of respondent attitudes towards the arguments presented was conducted by Gfs.bern (2023). All pro arguments received majority approval, with notable support for a secure long-term energy supply and the phased reduction of fossil fuels. In contrast, no con argument garnered majority approval, with the argument regarding rising electricity prices being the most accepted at 45%.

In summary, the two Gfs.bern (2021, 2023) VOX analyses provide valuable insights into voting behaviour and enable key distinctions to be made between the two votes. By moving forward into the next chapter, we will build upon the findings of this literature review to gain a deeper understanding of the theoretical concepts in environmental policy, which will contribute to my alternative research approach.

3 Conceptual Framework

3.1 Command-and-Control vs Incentive-based Instruments

In the mid-20th century, the earliest command-and-control measures were implemented. These measures were taken in response to major pollution incidents that highlighted their devastating effects on human health and the environment (Tietenberg, 1990). For instance, the UK's Clean Air Act was established after the Great Smog in London in 1952 which caused the deaths of thousands of people due to the use of coal (Ben Amar, 2021). Simultaneously, the discovery of Minamata disease in Japan in 1956 which was the result of seawater contamination by industrial waste led to the development of other anti-pollution measures (Environmental Health and Safety Division, Environmental Health Department, Ministry of the Environment, Japan, 2013). This traditional regulatory or command-and-control approach consists of a benefit-cost comparison of regulation in setting specific standards to limit pollution (Tietenberg, 1990).[5]

However, the command-and-control approach has been criticised for being based on static efficiency only. This has a negative effect on innovation, the measures being similar for all industries, and providing no incentive for companies to improve their behaviour (Palmer et al., 1995). Progressively, new incentive-based carbon pricing instruments were suggested by economists to address the negative externality of pollution. Baranzini and Carattini (2017) point out that as early as the late 1970s, there was discussion about the quality of the cost effectiveness of different tax policies (e.g. Baumol and Oates, 1971) and Palmer et al. (1995) underline that incentive-based regulation stimulates technological progress.

[5] Environmental standards specify the acceptable level of pollutants such as carbon monoxide to control air quality. Emission standards control pollution directly at its source by imposing a maximum quantity of pollutants that can be emitted. The control authority can also impose technology standards by specifying techniques which polluters must adopt to ensure environmental sustainability (Tietenberg, 1990).

Over the past few years, a growing number of countries have implemented carbon pricing instruments, and more sectors are being affected to tackle environmental challenges. In Europe, in 2020, the Swiss and European Union Emission Trading Schemes (ETS) were interconnected, allowing companies covered by either ETS to trade permits for compliance purposes. In April 2023, the World Bank (2023) reported 73 carbon pricing initiatives implemented, consisting of CO_2 taxes and ETS, covering approximately 23% of global GHG emissions. Nearly 40% of the revenues from these pricing instruments are earmarked for climate-friendly investments, and 10% are redistributed to the population (World Bank, 2023).

Another pricing mechanism used is carbon credits that are voluntarily purchased by companies to offset their emissions surplus. Compared to 2021, the World Bank (2023) specifies that fewer carbon credits were issued and withdrawn in 2023. Current high inflation and energy crisis reveals a trade-off between adapting carbon pricing to reduce the price of energy and the importance of carbon pricing in promoting energy independence. In practice, the current macroeconomic global situation is pushing countries towards aid measures, making government debt even worse (World Bank, 2023). However, this effect is partially mitigated since high inflation is pushing down government debt in real terms.

3.2 Carbon pricing: Principles and Instruments

3.2.1 The Polluter-Pays Principle

The Polluter-Pays Principle (PPP), as defined by the Organisation for Economic Co-operation and Development (OECD, 1992), suggests that the entity responsible for pollution should bear the costs associated with it, ensuring an acceptable environmental quality. In other words, this environmental policy principle provides incentives to internalize the negative externalities associated with pollution. In practice, according to a report by the OECD (1992), polluters must cover expenses aimed at preventing pollution such as investing in technologies to reduce pollutants emissions and at controlling pollution. The report specifies that the PPP was adopted in 1972 as part of the OECD's environmental policy and in 1990, it was adopted as a norm of international environmental law.

According to the OECD (1992), in most cases, polluters should not receive assistance such as grants, or tax deductions to fulfill their obligations in controlling pollution. Despite these guidelines, implementing measures including subsidies are contained in the 2023 Swiss CIA. However, assistance is provided to incentives pro-climate actions that go beyond the requirements set by public authorities. The OECD (1992) highlights that such efforts are not prohibited and are commonly employed nowadays, aligning with the statement made by the World Bank (2023). Carattini et al. (2017) point out that the main problem with these 'soft policies' which involve subsidies, is their high cost.

Since its global implementation in 1990, the PPP has been significantly improved, aiming for complete internalisation of costs by increasing polluters' liability.[6] However, the OECD (1992) specifies that determining the party accountable for pollution is not always straightforward. Depending on the context, responsibility might fall on the producer, the consumer, or even the government.

To apply the principle on a global scale, the High-level Commission on Carbon Prices (HCCP, 2017) argues that carbon pricing is an effective and cost-efficient strategy for addressing market failures and reducing CO_2 emissions.[7] The Commission indicates that pricing carbon pushes the economy towards low-cost abatement solutions, equalizes marginal abatement costs across sectors (cost-efficiency), and enables a shift to less carbon-intensive goods by incentivizing producers to reduce the carbon intensity of their products. Furthermore, the HCCP (2017) states that carbon pricing drives innovation and the adoption of cleaner technologies to lower

[6] In practice, according to the OECD (1992), full internalization is rarely achieved, as polluters typically bear the cost of compensating victims at best, excluding those who are not awarded compensation. The social cost of damage is therefore higher than the compensation paid by the polluter.

[7] The carbon price corresponds to the price per ton of CO_2 equivalent over a specific time period (HCCP, 2017).

carbon emissions. A carbon price can be introduced through a Pigouvian tax or a cap-and-trade system.

3.2.2 The Pigouvian Tax

Pigou (1920) as cited in Manta et al. (2023) argues that a tax allows offsetting the negative externalities of the production process by integrating them into the private marginal cost (MC_p). Therefore, adjusting the price of goods to reflect the social marginal cost (MC_s) would lead to a more optimal allocation of resources by the private sector. In the following simplified model, the blue curve represents the marginal benefit of consuming the good (MB). The introduction of the tax leads from private equilibrium (O_p), where $MB = MC_p$, to social equilibrium (O_s), where $MB = MC_s$, thus fully internalizing negative externalities. The orange triangle illustrates the net gain for society resulting from the implementation of the environmental tax.

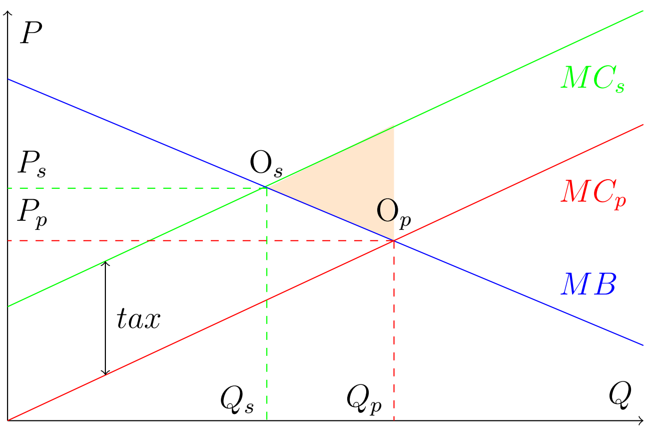

Figure 1: Quantity of CO_2 emitted by the good as a function of its price

The HCCP (2017) argues that environmental taxes are relatively easy to implement, as they can be applied on existing taxes, such as fuel taxes. However, the commission points out that the tax effectiveness in achieving CO_2 emission reductions is uncertain and depends on how agents respond to the price signal. If economic agents find more efficient and less costly ways of reducing their emissions, the tax may not ensure an annual reduction in emissions. Hence the importance of setting a long-term cumulative emissions target instead to allow more flexibility

(HCCP, 2017). If the carbon tax is not set correctly to meet targets, policymakers can adjust it over time.

Although carbon taxes increase environmental quality and social well-being, they also come with limitations. Particularly noteworthy are their regressive effects, as they tend to hit poorer households more heavily (cf. 3.3.3), and they are unpopular (cf. 3.3.4).

3.2.3 The Cap-and-Trade System

Another approach of carbon pricing involves the introduction of a cap-and-trade system, such as the European Union Emissions Trading Schemes (ETS). These systems limit the total volume of emissions allowed over a given period (emissions cap) and allow economic agents to buy and sell their emission rights freely (HCCP, 2017). According to Tietenberg (1990), ETS based on the flexible cap-and-trade principle enable the automatic and efficient allocation of emission rights.

Unlike a tax, the HCCP (2017) argues that a cap-and-trade system provides full control over annual emissions reductions, but the price at which allowances are traded is uncertain. To reduce carbon price variability, policymakers can adjust the cap over time (e.g. in the event of a sharp rise in prices), or by setting a floor price for emission rights that are auctioned. The HCCP (2017) indicates that the latter measure has proven effective in the UK. With the additional cost of emissions, UK power plants have received an economic incentive to invest in cleaner technologies and adopt more environmentally-friendly practices to reduce their emissions.

3.3 Determinants of Climate-related Votes

This section begins with the Cost-Benefit Analysis (CBA), frequently used to select an environmental measure among several alternatives. However, this analysis does not consider how specific measures are perceived or will be received by the public. Therefore, the following sub-sections present the other determinants of voting while considering voters' concerns.

3.3.1 Cost-Benefit Analysis

In 2005, the Nairobi work program was established by the Parties to the UNFCCC, with the aim of assisting countries to adapt to climate change. One of its key mandates involved selecting adaptation options by comparing their costs and benefits, considering the trade-off between climate change risks, and costly measures (UNFCCC, 2010).

The Fourth Assessment Report (AR4) of the Intergovernmental Panel on Climate Change (IPCC) defines adaptation costs as expenses linked to implementing adaptation measures, and benefits as the avoided costs of damages (UNFCCC, 2010). Various approaches exist in practice, with Cost-Benefit Analysis being a commonly employed method. According to UNFCCC (2010), CBA sets a single adaptation objective and quantifies costs and benefits in monetary terms, enabling comparisons across different aspects using a common metric. It compares a baseline scenario, estimating the situation without adaptation, to a projected scenario reflecting successful adaptation. Since costs precede benefits, discount rates are utilized to estimate the present value of future benefits. Planners may consider positive net present values (NPV), benefit-cost ratios (BCR) greater that one, or the highest internal rates of return (IRR) to select the most efficient options.

UNFCCC (2010) indicates that CBA provides a consistent framework for determining the economic attractiveness of policy instruments, but it also has its limitations. It encounters challenges related to uncertainty (e.g. how to choose the appropriate discount rate), valuation of non-market costs, and the unequal distribution of costs across the population. This can act as a brake on the acceptance of specific measures by the population or specific groups in society (cf. 3.4).

Therefore, in practical application, the UNFCCC (2010) advises not to rely solely on the CBA but to explore alternative approaches such as Cost-Effectiveness Analysis, Multi-Criteria Analysis, or risk assessment, and supplement policies with support measures to mitigate inequalities.

3.3.2 Asymmetric Information

This section refers to the asymmetric information between experts and the public. The HCCP (2017) states that individuals may prefer to rely on their observations and own experiences rather than processing the available information. Consequently, because of imperfect information, carbon pricing with a Pigouvian tax may not automatically achieve the optimal reduction in emissions and should be complemented with other measures.

According to Carattini et al. (2017), imperfect information is a major reason for carbon tax aversion. People tend to underestimate the taxes' effectiveness and perceive revenues as an excuse to boost government incomes. As carbon taxes are, in fact, effective, informing the public about their functioning, their impacts and how revenues are allocated helps reduce their unpopularity (Carattini et al., 2017; Dresner et al., 2006; Maestre-Andrés et al., 2021)[8]. More generally, according to the HCCP (2017), making efforts to disclose information leads individuals to align their behaviour with social norms. Therefore, ensuring transparency among the population can bridge the gap between people's preferences and economists' recommendations. Nevertheless, this result should be nuanced, as Maestre-Andrés et al. (2021) assert that people who perceive themselves as uninformed about carbon taxes are not willing to learn more about the subject.

As well as enhancing the acceptability of the tax (cf. 3.3.4), Palmer et al. (1995) argue that providing information will help new technologies to develop, such as the EPA's Green Lights program in 1991 which assisted organizations in using energy-efficient lighting to prevent pollution (Oates and Portney, 2001).

[8]For the Carattini et al. (2017) discrete choice experiment, respondents were given detailed information on how taxes work and on the consequences of each of the tax models such as fossil fuels price, reduction in CO_2 emissions, or purchasing power of average and low-income households.

3.3.3 Impact on Inequality

As outlined in subsection 3.3.1, costs and benefits are not distributed equally among the population.

Grainger and Kolstad (2010) argue that numerous studies have shown that carbon pricing instruments, such as taxes and tradable emissions permits, are regressive.[9] Grainger and Kolstad (2010) set out to determine the extent to which carbon pricing in the United States is regressive. They found that while high-income households pay more in absolute terms, low-income households bear a greater share of the burden relative to their incomes. Similarly, Maestre-Andrés et al. (2021) indicates that low-income households devote a greater share of their earnings to covering tax-related expenses.

However, according to Grainger and Kolstad (2010), the regressive nature of costs is not clear-cut and may depend on various factors such as the price elasticity of demand for carbon-intensive goods, sectorial impact (some sectors may be exempted from the policy and not have to reduce emissions), and revenue recycling. Furthermore, the HCCP (2017) claims that an energy tax may be progressive in developing countries, as the share of energy in household budgets generally increases with income.

To mitigate the distributional impact of carbon pricing, part of its revenues could be redistributed equally among the population. This mechanism would help to make carbon pricing a progressive instrument, with high-income households contributing more in absolute terms (HCCP, 2017).

Moreover, Grainger and Kolstad (2010) point out that the distribution of the benefits of a policy should also be considered. Indeed, the regressive effect may be worsened or mitigated depending on which groups benefit most from the policy.

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[9] A regressive policy levies a larger share of the wealth or income of poorer people than of richer people (Grainger and Kolstad, 2010).

3.3.4 Taxes' Acceptability

This section reviews the main findings from the literature concerning the acceptability of cost-effective climate policies in real voting contexts.

The acceptability is mainly influenced by the purpose for which tax revenues are allocated. According to Carattini et al. (2017), most studies suggest higher acceptability when revenues are earmarked to climate projects or social cushioning, and lower acceptability if they are used to offset other taxes to benefit from a double dividend. The discrete choice experiment by Carattini et al. (2017) aimed to gauge tax acceptability after the 2015 initiative - which proposed replacing the VAT with an energy tax - was rejected. This involved confronting informed respondents to realistic carbon tax alternatives, each with different tax rates and revenue recycling methods. The study revealed a preference for a progressive revenue model, favouring lump-sum redistribution and social cushioning, rather than the allocation of tax revenues to environmental projects. As we saw in section 3.3.2, this could be due to the specific context of the choice experiment, where respondents were informed about the tax' effectiveness. According to Maestre-Andrés et al. (2021), the carbon tax also raises redistribution concerns due to its regressive effects (section 3.3.3). Therefore, using tax revenues to compensate economically disadvantaged households can increase the tax's acceptability.

More recently, another discrete choice experiment was performed by Ott et al. (2020) prior to the rejection of the CO_2 Act in 2021.[10] The analysis revealed that individual characteristics can lead to diverse preferences regarding policy attributes. As a result, two distinct citizen profiles were identified based on their responses and attitudes: Environmentalists and Neutrals. Environmentalists are in favour of higher tax rates and allocating revenues to assist low-income households, while Neutrals prefer lower tax rates and equal transfers. Considering these heterogeneous preferences could help design more favourable measures (Ott et al., 2020).

[10] At the time of Ott et al. (2020) research project, it was uncertain whether the CO_2 Act, passed by Parliament, would face a popular referendum. Therefore, its rejection was not yet known.

3.3.5 Lobbying

Meng and Rode (2019) define lobbying as the interaction between elected politicians and organized interest groups. According to Oates and Portney (2001), if all agents are represented by an interest group that accurately reflect the interests of its members, then it will lead to a socially optimal political equilibrium, where externalities are effectively internalized. Oates and Portney (2001) argue that policymakers will opt for the most effective policy instrument and the most appropriate level of regulation, being the Pigouvian tax. In practice, however, only a few efficient climate policies are being implemented. The authors claim that this must be due to the under-representation of certain interests. For instance, research suggests that even if pollution reduction efforts are less efficient under command-and-control regulations, such regulations may be favoured by certain important interest groups because of perceived lower costs than those associated with environmental taxes (Oates and Portney, 2001). In particular, future generations are not present to defend their interests and would advocate for stringer regulations as they will endorse most of the climate change costs.

To better understand the impact of lobbying on the limited implementation of climate change regulations in the United States, Meng and Rode (2019) focused on the role of lobbying activities in reducing the likelihood of the Waxman-Markey bill being implemented.[11] They examined and compared lobbying efforts of companies expecting gains and losses from climate policy, and observed that lobbying by losing companies was more effective in reducing the chances of policy adoption than lobbying by winning companies in increasing them. Thus, Meng and Rode (2019) found that distributing more emissions permits to losers than to winners (i.e. an unequal distribution of costs) may have increased support for the policy.

Another study by De Bruycker and Colli (2023) aimed to identify what en-

[11] The United States Waxman-Markey bill was proposed in 2009 and rejected by the Senate by the end of 2010. Its main measure involved the introduction of a cap-and-trade system for climate regulation (Meng and Rode, 2019).

ables interest groups to achieve their political objectives within the framework of European Union climate policy. They argue that this depends not only on an interest group's economic resources, but also on its alignment with public opinion. The role of public opinion in explaining the success of lobbying is particularly relevant in the field of climate policy, as public attention to climate issues has increased in recent years (De Bruycker and Colli, 2023).

Having reviewed the determinants of climate-related votes, this analysis will now focus on understanding what led to the success or failure of Switzerland's two recent climate policies by examining voting dynamics and voter concerns. We know that the Pigouvian tax is strongly recommended in environmental economics (Oates and Portney, 2001), but its acceptability is limited due to its potential impact on inequalities, the lack of public information on its effectiveness and the incomplete representation of interest groups. By taking these factors into account, I seek to propose new avenues for developing more effective climate policies. The ultimate goal is to win broader support for these policies among the Swiss population, so that Switzerland can meet its commitments to the Paris Agreement targets.

3.4 Hypotheses

The hypotheses are mainly formulated based on the VOX analysis conducted by Gfs.bern (2021, 2023). The goal here is to compare the surveys' findings, and to complement them with my aggregated analysis. A first identical set of assumptions (H1-H3) for the 2021 and the 2023 votes are formulated to verify whether these assumptions apply for both. The second set of hypotheses (H4-H6) focuses on potential differences between municipalities that rejected the 2021 CO_2 Act but supported the 2023 CIA, and those that maintained the same voting stance.

H1: Municipalities with higher populations, a greater share of young residents, women, middle-to-high average net income, social assistance, and workforce employed in the tertiary sector show a positive tendency to support the law.

H2: Municipalities further to the left of the political spectrum, and more specifically supporting the GPS, the SP, or the GLP show a positive tendency to support the law.

H3: Municipalities favouring renewable energies for their buildings show a positive tendency to support the law.

H4: Municipalities with smaller populations, a greater share of middle-aged to elderly residents, middle-to-high average net income, less social assistance, and a larger primary sector workforce have a positive effect on the change from refusal in 2021 to acceptance of the CIA in 2023.

H5: Municipalities where FDP and the Centre party support is greater have a positive effect on the change from refusal in 2021 to acceptance in 2023, while the opposite is true for municipalities with greater support from left-wing parties.

H6: Municipalities favouring renewable energies for their buildings have a positive effect on the change from refusal in 2021 to acceptance in 2023.

4 Methodology

4.1 Data / Variables

Most of the data was gathered from the Swiss Federal Statistical Office (FSO)'s website (2021; 2022b; 2022a; nd; 2022c), which serves as the primary source for Swiss public administration data.

My analysis revolves around two key data tables: the results of the popular vote on the CO_2 Act of June 13, 2021, and the outcomes of the popular vote on the Climate and Innovation Act of June 18, 2023. For each municipality, I collected aggregated voting outcomes for the years 2021 and 2023, resulting in 2164 and 2132 observations for the respective years. The quantitative and dependent variable is the 'yes' voting rate, expressed as a percentage.

In addition to the results data, I collected various explanatory variables at the municipal level that could have an influence on voting behaviour for a climate bill. I included variables similar to those used in the Gfs.bern (2021, 2023) VOX analysis and supplemented them with additional variables. According to Dunlap (1975), several studies have identified a significant correlation between socio-demographic characteristics and awareness of environmental issues. Therefore, I included variables such as age, sex, average net revenue, average household size, social assistance, and employment in each economic sectors. Furthermore, I collected energy-related variables such as the number of new vehicles by energy source, and the main energy source for buildings, and I gathered political parameters, which encompass the share of voters for each party in National Council votes.

One challenge in data processing involved addressing the numerous municipality mergers that occurred between the creation of certain databases and vote date. To rectify this, I used the official directory of Swiss municipalities, which tracks all municipal changes from 1848 to 2023, ensuring the data sets align with the 2023 results table. I also checked which municipalities had no polling stations (those with communal ballot boxes), in order to match the results tables with the tables of explanatory variables.

Another issue concerned the handling of missing values. Several variables contained missing data: employment in each economic sector (90 missing values), National Council votes (party-dependent missing values), and social assistance (459 missing values). For employment data, municipalities with unknown values in one or more sectors were excluded when computing percentages to prevent distorting the data. For instance, having only employment data for the primary sector in certain municipalities does not imply that the entire active population works exclusively in this sector.

4.2 Descriptive Statistics

I conducted a descriptive analysis, computing key statistics for each variable. These included the number of observations, minimum and maximum values, average and standard deviation. Missing data were excluded from these computations. The average for each variable was determined using a weighted average based on municipal population size.

In 2021, the average 'yes' voting rate was approximately 49.39%, ranging from 8.10% to 77.50%. In contrast, the average 'yes' voting rate in 2023 stood at around 59.40%, ranging from 7.50% to 82.35%. It should be noted that the variability (standard deviation) of the 2023 vote exceeded that of the 2021 vote. For a more detailed overview of the explanatory variables, refer to Appendix A.3.

Before conducting any regression analysis, I computed correlation coefficients to examine the relationships between all pairs of variables. I performed the correlations in R with a significance level of 99% (*), handling missing values using pairwise complete observations. The majority of correlations were statistically significant, and it is notable that the correlations between the two voting rates and each explanatory variable consistently share the same sign (cf. Appendix A.4).

4.3 Empirical Specifications

This section outlines the methodology applied to analyse Swiss voting behavior based on the independent variables from the previous section. The analysis is structured in three parts. The first corresponds to an initial exploratory analysis prioritizing the predictive accuracy, involving various Ordinary Least Squares (OLS) regression models. This step allowed me to select a first set of significant variables used for the rest of the analysis, based on Leamer (1985) and Sala-I-Martin (1997) Extreme Bound Analysis (EBA). Four different dependent variables (and therefore four different models) were considered: 'yes' voting rate in 2021, 'yes' voting rate in 2023, differences between the 2023 and 2021 'yes' voting rate, and a binary variable (logistic model) focusing on the change in municipal voting between 2021 and 2023. For the second part of the analysis, a naive EBA was performed to determine a subset of variables according to Leamer's (1985) criterion, which are systematically included in each model specification. For the third part, a more refined EBA was conducted to identify all robust variables according to Sala-I-Martin's (1997) criterion.

4.3.1 Preliminary Analysis

For the initial phase, a stepwise regression procedure was employed, gradually adding variables to improve the model's performance. To address multicollinearity, each categorical variable omitted one variable inferred from the others, such as one of the six age groups. The trade-off between model complexity and goodness of fit was evaluated using various metrics. Adjusted R-squared to measure overall model fit and F-statistic to test model significance, while Bayesian Information Criterion (BIC) and Akaike Information Criterion (AIC) were employed to evaluate the model while avoiding over-fitting. Residual analysis identified potential data outliers, i.e. observations which significantly deviate from the majority of data points (Temple, 2000). To ensure a more robust model fit, only municipalities with populations exceeding five hundred inhabitants were retained. Consequently, the number of municipalities considered was reduced to 1786 from the original 2132.

After assessing various models, the explanatory variables influencing the 2021 and 2023 'yes' voting rate included 23 variables out of 33 potential variables: total population, proportion of women, age groups, support for political parties, social assistance, log-transformed average net revenue, economic sectors, and main energy sources for buildings. Variables relating to the fuel type of new vehicles lack significance and have therefore been excluded from the analysis.

4.3.2 EBA Framework

Four dependent variables are considered, and explanatory or independent variables remain the same for each of these analyses. The first set of analyses focus on the two votes, independently of each other. The dependent variable is the 'yes' voting rate for the 2021 vote, and the 'yes' voting rate for the 2023 vote. The second set of analyses focus on the relationship between the two votes. I first studied the differences in population structure between the voting results in the 2 ballots. The dependent variable being the 2023 outcome minus the 2021 outcome, aiming to emphasize population structure variations. This analysis was then compared to a logistic regression model. The logit model is suitable for binary classification, considering dummy variables for the dependent variable. Parameter estimates correspond to the change in the log odds of the dependent variable. The dummy variable being equal to 1 for municipalities who changed their vote from refusal in 2021 to acceptance in 2023, and equal to 0 for those whose outcome remained unchanged.

For each of these four dependent variables, sensitivity tests employing Extreme Bound Analysis by Leamer (1985) and Sala-I-Martin (1997) were performed.[12] The core concept involves running a large number of regression models, by combining variables in many possible ways. This method allows to examine variable sensitivity across various models. Temple (2000) as cited in Hartwig and Sturm (2012) argues that it is rare for one model to dominate the others in every aspect, and EBA is considered a valuable method for addressing model uncertainty. Leamer's (1985) approach categorizes variables as either robust or

[12] Model regressions have been performed using R's package `ExtremeBounds` Hlavac (2016).

fragile based on their estimates' consistency across models. A variable is robust if its coefficients' upper and lower bounds (i.e. maximum and minimum values) have the same sign across each model. In contrast, Sala-I-Martin's (1997) approach allows more flexibility by considering the complete distribution of estimates. He evaluates the cumulative distribution function (CDF) at zero, determining the proportion of regressions where coefficients significantly differ from zero. A variable is considered more robust when a greater proportion of its estimates lie on one side of zero. In my analysis, I refer to the latter concept and only report variables for which the cumulative distribution exceeds the 95% threshold above or below zero.

The following general equation has been estimated to assess variables' impact on the 'yes' voting rate :

$$\mathbf{Y} = \alpha_j + \beta_j \mathbf{F} + \gamma_j \mathbf{X} + \epsilon \tag{1}$$

Where $\mathbf{Y}$ is the dependent variable; j represents various regression models; $\mathbf{F}$ are the free or explanatory variables included in every regression model; $\mathbf{X}$ is a subset of up to k additional explanatory variables; and ϵ is the error term.

4.3.3 Naive EBA

McAleer et al.'s (1985) methodology as suggested by Hlavac (2016) is separated into two parts: performing a so-called naive EBA before conducting a more refined EBA. Hlavac (2016) argues this step is useful for selecting robust variables according to Leamer (1985), which will be included in all model specifications in the more refined EBA. Therefore, there are no free variables $\mathbf{F}$ in a naive EBA, but only explanatory variables $\mathbf{X}$. In R, I specified that combinations of up to three variables $\mathbf{X}$ have to be included in each model. I followed this methodology for the four different analyses.

4.3.4 Refined EBA

A more refined EBA was then conducted, leveraging Hlavac's (2016) approach, by incorporating free variables **F** that were identified as robust in Leamer's (1985) naive EBA. In addition to the free variables, I specified that combinations of up to three variables **X** have to be included in each model. I set a maximum variance inflation factor (VIF) to address multicollinearity issues, and I used heteroscedasticity-robust standard errors of coefficients in the OLS regression, following White's (1980) method based on Hlavac's (2016) function.[13]

[13]Heteroscedasticity-robust standard errors of coefficients have been conducted using R's package `sandwich` (Zeileis, 2006)

5 Results

5.1 Extreme Bound Analysis: Climate Policy Voting Drivers

This section presents the results of four different analyses. First, I introduce variables identified as robust by the naive EBA, serving as free variables **F** in each of the four models. For the 2021 'yes' voting rate, these variables include: population in thousand inhabitants, proportion of women, log-transformed average net revenue, tertiary sector engagement, share of voters for the SVP, the GLP, and the GPS, as well as gas as the main energy source for buildings. Regarding the 2023 vote, the same variables were considered robust, except for net revenue. For the difference in voting rates, robust variables encompass the proportion of people aged 18 to 29 years, share of voters for the SVP and the GLP, and solar thermal energy as the main energy source for buildings. Lastly, in the logistic model, robust variables were the share of voters for the SP and the SVP, along with solar energy as the main energy source for buildings.

Table 2, 3, 4, and 5 summarize various information on the estimates: their value, standard errors, lower and upper bound according to Leamer (1985), and their CDF.

5.1.1 Separate yearly Estimates (Hypotheses H1-H3)

Concerning the first hypothesis linked to socio-demographic parameters, most coefficients in Table 2 align with expectations: they are negative for people aged 40 to 49 and primary sector engagement, and positive for total population, proportion of women, and tertiary sector engagement. It is important to note that a 1% increase in log-transformed average net revenue leads to an increase of around 3.8% in the 2021 'yes' voting rate, holding other variables constant. An exception contrasting with the findings of Gfs.bern (2021) VOX analysis, concerns individuals aged over 70, exhibiting a positive relationship with the dependent variable.

The second hypothesis finds support with positive estimates for left-leaning parties and negative estimates for right-leaning parties. Specially, the GLP party displays a significantly high positive coefficient.

There are limited significant coefficients for energy-related variables. District heating exhibits a positive coefficient but solar thermal energy and renewable energy show counterintuitive negative coefficients.[14]

Table 2: EBA Regression results: 2021 vote

	β	Std. Errors	Lower Bound	Upper Bound	CDF*
Population (1K)	0.060	0.021	0.011	0.118	99.800
Women	0.791	0.104	0.312	1.232	100.000
Age 40-49	-0.294	0.066	-0.665	0.130	97.761
Age above 70	0.310	0.038	0.174	0.478	100.000
Log of net revenue	3.840	0.586	1.799	7.140	100.000
Primary sector	-0.041	0.013	-0.105	0.009	99.418
Tertiary sector	0.052	0.009	0.017	0.083	100.000
FDP	-0.164	0.024	-0.245	-0.020	99.998
SP	0.148	0.030	0.024	0.358	99.990
SVP	-0.337	0.016	-0.457	-0.164	100.000
GLP	1.013	0.037	0.845	1.202	100.000
GPS	0.315	0.031	0.158	0.558	100.000
Solar thermal	-0.270	0.064	-0.558	0.044	99.834
District heating	0.064	0.018	-0.002	0.132	99.919
Groups					
Left-leaning parties	0.330	0.023	0.230	0.498	100.000
Right-leaning parties	0.088	0.024	0.017	0.163	99.966
Renewable energies	-0.156	0.028	-0.238	-0.062	100.000

FDP: The Liberals, SP: Socialist Party, SVP: Swiss People's Party, GLP: Green Liberal Party, GPS: Green Party. Left-leaning parties include the SP, the GLP, and the GPS. Right-leaning parties include the FDP and the Centre party. Renewable energies include air, water, geothermal, and solar thermal as main energy sources for buildings. *Given that histograms on R reveal non-normal coefficient distribution, I considered CDF estimates which don't assume a specific coefficient distribution.

[14] District heating exploits different energy sources and can be considered an environmentally-friendly method of heating buildings, since it uses renewable energies (SFOE, nd).

For the 2023 EBA, similar to Gfs.bern (2023) VOX analysis, Table 3 shows that municipalities with a higher proportion of young residents tended to support the law more than older residents. Consistent with the findings presented in Table 2, positive coefficients are observed for total population, proportion of women, log-transformed average net revenue, and tertiary sector engagement, confirming the first hypothesis. A surprising result is the positive effect of the workforce employed in the primary sector on the climate vote outcome, despite its negative correlation. This reversal effect could occur because of multicollinearity issues (Bobbitt, 2019) and the positive coefficient could suggest that players in the primary sector, initially opposed to the 2021 Act because of their heavy dependence on road transport and the high share of taxes they would have had to bear, were attracted by the 2023 Act, which is less restrictive (Gfs.bern, 2021, 2023).

Regarding the political spectrum, the signs of coefficients shows the same trend as the results of the VOX analysis, thus aligning with the second hypothesis. The proportion of left-leaning parties and right-leaning parties reveal a positive relationship with the 2023 'yes' voting rate, while the SVP's share notably opposes the outcome.

Except for solar thermal energy as the primary energy source for buildings exhibiting a relatively high positive coefficient (but representing only 1.7% of Swiss building energy cf. Appendix A.3), most energy-related variables display relatively minor positive effects (gas and district heating), or lack statistical significance.

Table 3: EBA Regression results: 2023 vote

	β	Std. Errors	Lower Bound	Upper Bound	CDF*
Population (1K)	0.021	0.010	-0.007	0.061	97.733
Women	0.660	0.112	0.238	0.999	100.000
Age 18-29	0.242	0.057	-0.110	0.641	97.578
Age 50-59	-0.199	0.068	-0.492	0.098	98.876
Age 60-69	-0.416	0.068	-0.655	-0.130	100.000
Log of net revenue	2.271	0.532	0.606	4.603	99.993
Primary sector	0.048	0.014	-0.002	0.105	99.822
Tertiary sector	0.027	0.009	-0.007	0.066	99.514
SP	0.186	0.028	0.084	0.351	100.000
SVP	-0.530	0.017	-0.618	-0.401	100.000
GLP	0.827	0.034	0.648	1.013	100.000
GPS	0.422	0.034	0.260	0.689	100.000
Solar thermal	0.327	0.058	0.068	0.593	100.000
Gas	0.025	0.009	-0.031	0.069	97.479
District heating	0.057	0.018	-0.007	0.130	99.609
Groups					
Left-leaning parties	0.355	0.023	0.253	0.518	100.000
Right-leaning parties	0.128	0.025	0.064	0.206	100.000

SP: Socialist Party, SVP: Swiss People's Party, GLP: Green Liberal Party, GPS: Green Party.
Left-leaning parties include the SP, the GLP, and the GPS. Right-leaning parties include the FDP and the Centre party.
*Given that histograms on R reveal non-normal coefficient distribution, I considered CDF estimates which don't assume a specific coefficient distribution.

5.1.2 Vote differential (Hypotheses H4-H6)

The graph below summarizes the 'yes' voting rates for the two ballots in municipalities with more than 500 inhabitants. Of particular interest are the green municipalities in the graph, which rejected the CO_2 Act in 2021 and accepted the CIA in 2023. The first regression model links population structure to the difference in voting between 2023 and 2021, while the second model focuses on the population structure of municipalities that changed their vote between the two ballots.

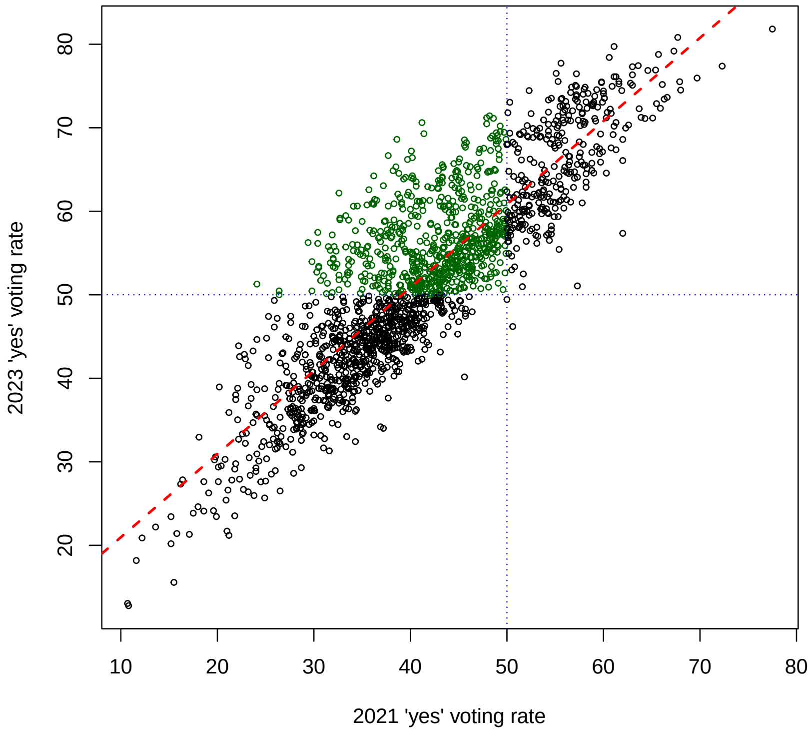

Figure 2: 'Yes' voting rates in municipalities over 500 inhabitants

For the analysis regarding the difference between the 2023 and 2021 voting rates, we can observe that coefficients align with my prior analysis of the individual 2021 and 2023 EBA, but the interpretation differs. Given the consistent pattern of higher 'yes' voting rates in 2023 compared to 2021 (except for two municipalities), positive estimates indicate a greater voting difference between 2023 and 2021 than negative estimates. When observing negative estimates for the 2021 Act in Table 2 and positive estimates for the 2023 Act in Table 3, we expect positive estimates for the difference in 'yes' voting rates in Table 4, and vice versa. For instance, this is reflected by solar thermal as the main energy source for buildings in Table 4.

The coefficients for population per thousand inhabitants, the proportion of individuals aged over sixty, average log-transformed net income and the tertiary sector are negative, suggesting that municipalities with a greater representation of these variables tend to prefer the 2021 Act to that of 2023, compared to other municipalities. In contrast, the coefficients associated with the proportion of young or middle-aged individuals and the primary sector are positive. These results are consistent with the fourth hypothesis, except for the young and elderly age groups, as well as the average net income variables, for which the observed trend is opposite to that predicted.

Regarding the fifth hypothesis, the coefficients indicate a positive influence of higher support for the FDP on the change in voting behaviour. Conversely, the Centre party's support reveals a negative impact. When combining the rates of both parties, estimates suggest that a one-percentage point increase in support for the right-leaning parties' within municipalities corresponds to a 0.097 percentage point increase in the difference between the two rates, all else constant. This aligns with the hypothesized direction. The support share for the GLP exhibits a negative impact on the differences in voting rates, however, this does not apply to the SP. By grouping left-wing parties together, the results obtained do not achieve significance at the 95% level (Sala-I-Martin, 1997). Hence, The overall effect on the left-wing parties remains ambiguous. The SVP shows a negative coefficient, which aligns with Gfs.bern (2023) VOX analysis arguing that the SVP support was even lower for the 2023 vote compared to 2021.

Additionally, the renewable energies variable has a positive coefficient, while gas as the main energy source for buildings has a negative coefficient. These observations are consistent with the sixth hypothesis.

Table 4: EBA Regression results: Differences in voting rates

	β	Std. Errors	Lower Bound	Upper Bound	CDF*
Population (1K)	-0.037	0.013	-0.082	-0.006	99.763
Age 18-29	0.370	0.049	-0.136	0.610	99.737
Age 40-49	0.357	0.060	-0.096	0.596	99.878
Age 60-69	-0.244	0.062	-0.482	0.114	97.652
Age above 70	-0.205	0.038	-0.390	0.051	99.743
Log of net revenue	-1.092	0.400	-3.422	0.565	98.336
Primary sector	0.092	0.011	0.045	0.156	100.000
Tertiary sector	-0.035	0.007	-0.063	0.005	99.701
FDP	0.082	0.019	-0.006	0.173	99.936
The Centre	-0.048	0.012	-0.106	0.070	98.975
SP	0.089	0.024	-0.047	0.185	99.411
SVP	-0.152	0.012	-0.247	-0.006	100.000
GLP	-0.271	0.030	-0.454	-0.095	100.000
Solar thermal	0.605	0.061	0.295	0.894	100.000
Air, geoth., water	0.117	0.021	0.035	0.217	100.000
Gas	-0.021	0.007	-0.071	0.018	96.335
Groups					
Right-leaning parties	0.097	0.010	-0.037	0.230	95.119
Renewable energies	0.183	0.023	0.099	0.300	100.000

FDP: The Liberals, SP: Socialist Party, SVP: Swiss People's Party, GLP: Green Liberal Party.
Right-leaning parties include the FDP and the Centre party. Renewable energies include air, water, geothermal, and solar thermal as main energy sources for buildings.
*Given that histograms on R reveal non-normal coefficient distribution, I considered CDF estimates which don't assume a specific coefficient distribution.

Contrasting outcomes from Table 4 with the logistic regression model of Table 5, enables an examination of the potential factors influencing municipalities that switched their vote from refusal in 2021 to acceptance in 2023.

Regarding age groups, a higher proportion of middle-aged individuals in municipalities is positively associated with the likelihood of these municipalities changing their vote from refusal to acceptance. Conversely, a negative correlation is observed for municipalities with a larger population, a higher proportion of people over seventy, a higher level of social assistance, and a higher average net revenue, all other factors being equal. All results in Table 5 are consistent with those in Table 4, and notably, the previously insignificant social assistance variable is significant here, confirming the fourth hypothesis.

In Table 5, the coefficients for both the FDP and the Centre parties lack statistical significance, even when considered collectively. Despite this, similar trends to the earlier examination involving the left-wing parties are observable. The SP exhibits a positive coefficient, making the change in voting behaviour more likely, while the opposite is observed for the GLP and the GPS. Similarly, the SVP displays a negative coefficient, aligning with the findings from the previous analysis in Table 4.

The results concerning energy-related variables, particularly solar thermal and gas as the main energy sources for buildings, exhibit coefficients with the same sign as in Table 4. In addition, the oil variable is significant and shows a positive coefficient.

Table 5: EBA Regression results: Logistic model

	β	Std. Errors	Lower Bound	Upper Bound	CDF*
Population (1K)	-0.003	0.001	-0.007	-0.001	99.908
Age 40-49	0.016	0.005	-0.020	0.037	99.228
Age above 70	-0.008	0.003	-0.024	0.005	97.744
Social assistance	-0.034	0.008	-0.068	-0.002	99.974
Log of net revenue	-0.153	0.042	-0.378	0.009	99.823
SP	0.010	0.002	0.000	0.021	99.990
SVP	-0.012	0.001	-0.020	-0.005	100.000
GLP	-0.008	0.003	-0.022	0.005	97.412
GPS	-0.009	0.003	-0.021	0.002	99.722
Oil	0.003	0.001	-0.003	0.007	97.619
Gas	-0.005	0.001	-0.008	-0.001	100.000
Solar thermal	0.024	0.006	0.001	0.051	99.964

SP: Socialist Party, SVP: Swiss People's Party, GLP: Green Liberal Party, GPS: Green Party.
*Given that histograms on R reveal non-normal coefficient distribution, I considered CDF estimates which don't assume a specific coefficient distribution.

Table 6 in Appendix A.2 uses the same independent variables as in Table 3, but adding the 2021 'yes' voting rate as a control variable. I examine how the other independent variables influence voting in 2023, while taking into account voting in 2021. I consider the tendency of individuals to maintain their previous opinions over time, so the 'yes' rate in 2021 is a starting point for the vote in 2023. Table 6 can be used as a robustness test, as it suggests that the impact of other variables on attitude change towards climate policy remains relatively stable even when the inertia of the previous vote is considered. Indeed, it can be observed that coefficients are similar for these three regression models (Table 4, 5 and 6). The only difference concerns the GLP and the GPS vote, which have positive estimates in Table 6. The following interpretation could be made: although their support for the 2023 Act is weaker than that expressed for the 2021 Act, by taking the 2021 vote as a reference point, we find that these parties still remain inclined to support the CIA.

5.2 Discussion

5.2.1 Results Overview and Answers to Research Questions

Despite the lack of significance of certain variables, the results are in line with most hypotheses and broadly align with Gfs.bern (2023) VOX analysis.

Indeed, regarding the first hypothesis, municipalities with greater share of young residents, women, higher average net income, and workforce employed in the tertiary sector show a positive tendency to support the CO_2 Act as well as the CIA. The only result contradicting the hypothesis is observed for individuals over seventy, who seem to support the CO_2 Act. For the second hypothesis, estimates reveal that municipalities further to the left of the political spectrum positively support the two laws. However, while the third hypothesis is valid for the CIA (at least as far as solar thermal energy is concerned), it is not for the CO_2 Act (cf. Table 2 and 3).

Concerning the fourth hypothesis, the coefficients for population per thousand inhabitants, individuals aged 40 to 49, level of social assistance, and the workforce engaged in primary and tertiary sectors are in line with my expectations (cf. Table 4 and 5). For the elderly population, it could be supposed that its negative coefficient is explained because older people may be less inclined to change their position regarding a climate law compared to younger people. Interestingly, municipalities with higher average net income display a lower likelihood of moving from a 'no' vote in 2021 to a 'yes' vote in 2023, which seems to be at odds with the findings of Gfs.bern (2021, 2023) study. This may be due to the way income levels were treated in the analysis, as the VOX study grouped incomes into categories, while my analysis used the log-transformed average net income of municipalities. The logarithmic transformation reduces the impact of extreme values as these are pulled closer to the center of the distribution. Another interesting difference between the two votes concerns engagement in the primary sector, which had a positive estimate for the CIA, and negative for the CO_2 law. This finding aligns with the context of the 2021 CO_2 law, wherein agricultural interest groups strongly opposed the proposition (Gfs.bern, 2021). Hence, it is reasonable to infer that the positive estimate of the primary sector on the CIA vote played a role in explaining the reasons for the reversal.

Regarding the fifth hypothesis, on the one hand, municipalities where right-wing party support is greater tend to support the CIA more than the CO_2 Act, but the result is nuanced, as the Centre party exhibits a negative coefficient. On the other hand, the negative coefficients for the GLP and the GPS indicate that municipalities with a higher share of people supporting these parties are less favourable to the CIA. This is consistent with the voting context, given the GLP initiative in launching the CO_2 Act. Moreover, the GLP may be reluctant to support a law that worsens the public budget, while the GPS may be disappointed by the project's lack of ambition, although these assertions are untested hypotheses. Furthermore, we can observe that the SP coefficient remained positive and the estimate for the left-wing parties combined is not significant (cf. Table 4 and 5).

Finally, concerning the last hypothesis (H6), results are consistent with my expectations (cf. Table 4 and 5). On the one hand, municipalities with a greater proportion of heating oil households might exhibit a higher tendency for voting behaviour changes, considering the less stringent law in 2023, which does not impose more heavy taxes on this type of housing (Ott et al., 2020). On the other hand, municipalities with a greater share of households using renewable energy as the principal energy source also are more likely to support the 2023 than the 2021 law. Nor is this result surprising, given that the law's main measures include financial support to encourage positive behaviours, like the use of clean energy sources (cf. 2.2.2).

5.2.2 Comparison with Previous Studies

A relevant previous study by Carattini et al. (2017), focuses on the 2015 proposed initiative to introduce an energy tax in Switzerland, which I have already featured in sections 3.3.2 and 3.3.4. The authors point out that increasing the tax rate reduces acceptability, and that people seem to regard subsidies as much more effective than taxes. Furthermore, they add that subsidies lead to voluntary behaviour change, which is clearly preferable to coercive measures. These two observations partly explain why the 2021 CO_2 Act was rejected, while the 2023 CIA was supported.

Concerning socio-demographic characteristics, previous studies such as those conducted by Carattini et al. (2017), Baranzini and Carattini (2017), and more recently Ott et al. (2020), confirm the observation that individuals with environmental consciousness and higher levels of education tend to support climate legislation involving environmental taxes (cf. 3.3.4). In particular, my study reveals that people employed in the tertiary sector, often associated with higher levels of education, display stronger support for the 2021 CO_2 Act compared to the primary sector. In addition, it is interesting to note that people working in the primary sector show a positive effect on the CIA in 2023, which does not include new taxes.

Regarding political factors, Dunlap (1975) observed a strong correlation between environmental concerns and political orientations in his US study. Dunlap (1975) notes that Democrats tend to be more supportive of environmental issues than Republicans, being sympathetic to business interests and more inclined to oppose state intervention. These results reinforce the findings of my study in Switzerland on left- and right-leaning parties.

6 Conclusion and Policy Implications

6.1 Limitations

I encountered several limitations in my research work, which is why the results of the analysis should be interpreted with caution.

First, the comparison involved two distinct votes, conducted at different periods and within different contexts. Additionally, there were variations in voter demographics between the two votes. Participants in the CO_2 bill differed from those in the Climate and Innovation bill as evidenced by the Gfs.bern (2021, 2023) VOX analyses, which revealed a lower turnout among right-wing or extreme right-wing voters and the rural population during the 2023 ballot. Consequently, these disparities impacted the comparison and interpretation of coefficients in the EBA. Second, considering the current nature of my study, specific data related to municipalities was not available at the time of this analysis. Therefore, all explanatory variables from 2021 were reused in the 2023 analysis to compare the two votes. This approach assumes that the population structure remained relatively unchanged between 2021 and 2023.

Another problematic aspect of the analysis concerns the psychological impact of the 2021 bill on the 2023 bill. Indeed, the fact that citizens were confronted with a stricter proposal in 2021 may have reinforced their acceptance of the less restrictive 2023 proposal. This observation can be extrapolated to the results of previous votes. Although the content of the laws are different, this does not rule out a potential psychological effect. This is illustrated by the 2015 proposal, which was widely rejected by the population at a 92% rate (Carattini et al., 2017), compared to the one in 2021, also rejected but with a lower percentage of negative votes (51.6% according to Gfs.bern (2021)).

Furthermore, considering the various municipalities enabled me to examine the Swiss population as a whole, but precluded the possibility of highlighting individual voting patterns. To achieve this, it would have been necessary to conduct a survey on a representative sample of the Swiss population similar to Gfs.bern (2021, 2023) VOX analyses.

Finally, regarding my empirical analysis, employing Leamer (1985)'s and Sala-I-Martin (1997)'s EBA was a reasonable approach, which Temple (2000) believes should not detract from the quality of modelling efforts. Nonetheless, Temple (2000) argues that EBA should still be used in parallel with other approaches such as diagnostic testing or Bayesian model averaging when confronting to model uncertainty. Furthermore, more recent techniques, such as cross-validation or bootstrapping, are commonly used to assess variable robustness.

6.2 Future Climate Policies

In conclusion, the HCCP (2017) report describes four changes necessary to mitigate climate change: decarbonization, increasing the use of electricity, improving efficiency, and landscape preservation. As part of its Energy Strategy 2050, Switzerland is facing the challenge of the energy transition towards a nuclear phase-out (Baranzini and Carattini, 2017). As nuclear energy represents a significant source of electricity production, compared to other countries, electricity produced in Switzerland has low carbon emissions and it is difficult to replace nuclear energy without increasing CO_2 emissions. Therefore, strategic energy policies with the development of renewable energy sources and the promotion of research and innovation in clean technologies is required. However, Baranzini and Carattini (2017) argue that to meet its commitments made ahead of the Conference of Parties in 2015, Switzerland must make greater efforts in terms of energy consumption.

The idea of setting a carbon price responds to this imperative. It offers crucial solutions to the challenges posed by climate change by remedying climate externality as a market failure (HCCP, 2017; Oates and Portney, 2001). To achieve the Paris Agreement's target, the HCCP (2017)'s report emphasizes the necessity of setting a sufficiently high price, tailored to national circumstances. It further highlights that carbon pricing alone is not sufficient and should be complemented by other policies.

Future climate policies in Switzerland should therefore include progressively more stringent incentive-based instruments, to mitigate the burden on the state budget and achieve the set objectives. A plausible approach would be to propose new measures in stages to avoid drastic changes for the population, giving them time to adapt. This raises however the question of the trade-off between gradual action and the urgent need to act quickly. In addition, maintaining financial support is essential to foster the acceptance of a new climate law by the public.

More specifically, recent studies in Switzerland by Carattini et al. (2017) and Ott et al. (2020) reveal the necessity of properly using tax revenues from CO_2 pricing to mitigate the regressive effects of the carbon tax, and improve its acceptability to the population. This can also be seen in both my study and in the analysis by Gfs.bern (2021, 2023). Poorer municipalities and those with a higher proportion of people employed in the primary sector are more strongly opposed to pricing measures, as evidenced by the response to the CO_2 law. This law proposed to use two-thirds of the income as equal redistribution and distribute the rest to a climate fund. According to my study and the literature, it might be more effective to allocate the remaining one-third as social cushioning, to compensate those most affected by the tax such as vulnerable and rural households that are less well-served by public transport. The adoption of reasonable tax rates is also essential to guarantee social acceptability while preserving the economic efficiency of the measure (Carattini et al., 2017).

In addition, a mass information campaign on the effectiveness of the carbon tax before the next bill would be a solution to boost the acceptability of tariff measures, as information asymmetry has been identified as a major cause of tax aversion (Carattini et al., 2017).

In order to meet these challenges, Switzerland must develop future climate policies that integrate not only economic and environmental considerations, but also social and equitable aspects. These policies must be designed to be environmentally effective while minimising costs to society and ensuring a successful energy transition to a sustainable future.

A Appendices

A.1 Data Description

This appendix provides a comprehensive overview of the databases used in this analysis.

For socio-demographic parameters, I accessed interactive STAT-TAB tables on the FSO Website to gather data for each municipality. This included information on the permanent resident population of Swiss citizens, categorized by sex and age in 2021 (Federal Statistical Office, 2022b). I created six age groups, and computed percentages for each one of them, as well as for the sex variables. Additional variables, such as employment in each economic sector, the percentage of people on social assistance, average household size, and the share of voters for National Council elections, were obtained from the "Portrait des communes 2021" database (Federal Statistical Office, 2021). Note that National Council election data contains missing values due to the fact that not all political parties are represented in every municipality.

To complete the explanatory variables at the municipal level, I incorporated data on the average taxable revenue per inhabitant in 2019, as well as a STAT-TAB table on new road vehicle registrations by energy source in 2022 (ba!joodoo, nd; Federal Statistical Office, 2022a). I also included data from the 2021 building and housing statistics, specifically the number of buildings in each municipality by the main energy source for heating and hot water (Federal Statistical Office, 2022c). Given the prevalence of missing data, the unknown category was excluded from the analysis, with percentages computed based on the available data. However, percentages of unknown data were also calculated to reflect this limitation.

To maintain consistency and clarity in the database, variable names were standardized to six characters.

A.2 Regression results EBA: 2023 vote with 2021 'yes' voting rate as control variable

Table 6: EBA Regression results: 2023 vote with 2021 'yes' voting rate

	β	Std. Errors	Lower Bound	Upper Bound	CDF*
2021 Yes rate	0.626	0.017	0.469	0.730	100.000
Population (1K)	-0.013	0.005	-0.048	0.010	97.748
Age 18-29	0.367	0.044	-0.040	0.595	99.984
Age 40-49	0.303	0.054	-0.143	0.578	99.201
Age 50-59	-0.156	0.053	-0.471	0.105	97.853
Age 60-69	-0.467	0.052	-0.691	-0.072	100.000
Age above 70	-0.185	0.031	-0.366	0.170	98.715
Primary sector	0.060	0.010	0.008	0.130	99.998
FDP	0.067	0.017	-0.054	0.178	98.277
The Centre	-0.057	0.012	-0.110	0.088	98.671
SP	0.133	0.021	0.031	0.230	100.000
SVP	-0.313	0.014	-0.430	-0.199	100.000
GLP	0.216	0.036	0.007	0.363	99.991
GPS	0.260	0.028	0.047	0.418	100.000
Solar thermal	0.513	0.053	0.285	0.740	100.000

FDP: The Liberals, SP: Socialist Party, SVP: Swiss People's Party, GLP: Green Liberal Party, GPS: Green Party.
*Given that histograms on R reveal non-normal coefficient distribution, I considered CDF estimates which don't assume a specific coefficient distribution.

A.3 Descriptive Statistics

Table 7: Descriptive statistics on municipalities

Variable	Abbrev.	Year	Unit	N	Min.	Max.	Mean	SD
Votes' results								
2021 'yes' vote	YesCOM1	2021	%	2132	8.1	77.5	49.4	9.9
2023 'yes' vote	YesCOM3	2023	%	2132	7.5	82.4	59.4	11.5
Total population	POPCOM	2019	Person	2132	32.0	420217.0	4036.2	12987.9
Total Swiss population	TOT_CH	2019	Person	2132	31.0	283821.0	3015.0	8610.4
Proportion Swiss men	SEXE_M	2022	%	2132	43.1	66.7	48.5	1.9
Proportion Swiss women	SEXE_W	2022	%	2132	33.3	57.0	51.5	1.9
Swiss aged 18-29	AGE_01	2022	%	2132	1.2	28.6	16.2	3.0
Swiss aged 30-39	AGE_02	2022	%	2132	0.00	26.67	14.66	2.9
Swiss aged 40-49	AGE_03	2022	%	2132	5.2	25.6	14.5	2.7
Swiss aged 50-59	AGE_04	2022	%	2132	10.3	34.1	18.0	2.5
Swiss aged 60-69	AGE_05	2022	%	2132	6.9	38.1	15.9	2.8
Swiss aged 70+	AGE_06	2022	%	2132	4.8	39.5	20.7	4.3
Average household size	SIZ_HH	2019	Person	2132	1.5	18.5	2.3	0.6
Social assistance	SOC_AS	2019	%	1673	0.0	11.2	3.3	1.6
Average net revenue	NET_RV	2019	CHF	2132	11176.0	452633.0	41357.5	18367.1
Primary sector employment	SECT_1	2018	%	2042	0.0	79.9	5.1	15.0
Secondary sector employment	SECT_2	2018	%	2042	0.0	95.5	22.9	15.2
Tertiary sector employment	SECT_3	2018	%	2042	3.9	98.8	70.7	18.3
National Council elections								
FDP votes	VO_FDP	2019	%	2094	0.0	69.7	15.4	9.0
The Centre votes	CENTRE	2019	%	2132	0.0	79.5	13.0	13.3
SP votes	VOT_SP	2019	%	2100	0.0	49.3	17.3	6.2
SVP votes	VO_SVP	2019	%	2128	2.9	84.1	25.0	13.3
GLP votes	VO_GLP	2019	%	2017	0.0	23.8	7.8	3.8
GPS votes	VO_GPS	2019	%	2070	0.0	38.4	13.6	5.9
New diesel vehicles	VE_DIE	2022	Vehicle	2132	0.0	1321.0	136.6	15.0
New electric vehicles	VE_ELE	2022	Vehicle	2132	0.0	1661.0	169.3	15.2
New gasoline vehicles	VE_GAS	2022	Vehicle	2132	0.0	2555.0	345.3	18.3
Buildings' energy source								
Air, geoth. and water	AIGEWA	2021	%	2132	0.0	47.2	2.8	5.2
Gas	HW_GAS	2021	%	2132	0.0	69.1	24.1	15.9
Heating oil	HW_OIL	2021	%	2132	0.0	99.2	40.6	14.0
Wood	HW_WOO	2021	%	2132	0.1	71.2	7.0	11.4
Electricity	HW_ELE	2021	%	2132	0.2	93.4	19.0	11.3
Solar thermal	HW_SOL	2021	%	2132	0.0	25.8	1.7	2.4
District heating	HW_DHE	2021	%	2132	0.0	74.6	4.8	5.3
Indefinite, other, no sources	HW_ION	2021	%	2132	0.0	53.3	11.8	7.9

A.4 Correlation Table

Table 8: Spearman correlation coefficients

Correlation	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1 YesCOM1	1																		
2 YesCOM3	0.82*	1																	
3 POPCOM	0.39*	0.24*	1																
4 TOT_CH	0.37*	0.22*	1*	1															
5 SEXE_M	-0.43*	-0.42*	-0.33*	-0.31*	1														
6 SEXE_W	0.43*	0.42*	0.33*	0.31*	-1*	1													
7 AGE_01	0.09*	0.26*	0.25*	0.23*	-0.1*	0.1*	1												
8 AGE_02	-0.18*	-0.06*	0.06*	0.07*	0.11*	-0.11*	0.24*	1											
9 AGE_03	0.03	0.08*	-0.01	0	0.08*	-0.08*	0.08*	0.23*	1										
10 AGE_04	-0.12*	-0.15*	-0.29*	-0.28*	0.2*	-0.2*	-0.12*	-0.29*	0.08*	1									
11 AGE_05	-0.2*	-0.33*	-0.23*	-0.22*	0.16*	-0.16*	-0.56*	-0.29*	-0.42*	0.01	1								
12 AGE_06	0.21*	0.08*	0.16*	0.16*	-0.25*	0.25*	-0.42*	-0.57*	-0.5*	-0.29*	0.21*	1							
13 SIZE_HH	-0.06	0.06*	-0.15*	-0.14*	0.15*	-0.15*	0.36*	0.21*	0.45*	0.26*	-0.3*	-0.6*	1						
14 SOC_AS	0.16*	0.21*	0.22*	0.2*	-0.27*	0.27*	0.16*	0.06*	-0.19*	-0.3*	-0.14*	0.18*	-0.27*	1					
15 NET_RV	0.47*	0.36*	0.14*	0.13*	-0.14*	0.14*	-0.13*	-0.14*	0.18*	0.21*	-0.05	-0.01	0.11*	-0.25*	1				
16 SECT_1	-0.48*	-0.35*	-0.69*	-0.66*	0.39*	-0.39*	-0.2*	0.07*	0.1*	0.27*	0.19*	-0.26*	0.29*	-0.34*	-0.21*	1			
17 SECT_2	-0.17*	-0.17*	0.16*	0.16*	0.03	-0.03	0.13*	0.1*	0.02	-0.06	-0.02	-0.08*	0.05	0.07*	-0.17*	-0.17*	1		

Correlation	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
18 SECT_3	0.48*	0.38*	0.44*	0.41*	-0.3*	0.3*	0.01	-0.14*	-0.07*	-0.12*	-0.1*	0.25*	-0.25*	0.1*	0.31*	-0.6*	-0.59*	1	
19 VO_FDP	0.33*	0.46*	0.16*	0.12*	-0.21*	0.21*	0.21*	-0.03	0.12*	-0.06*	-0.26*	-0.02	0.14*	-0.01	0.37*	-0.26*	-0.05	0.23*	1
20 CENTRE	-0.19*	-0.21*	0.07*	0.08*	0.17*	-0.17*	0	-0.06	-0.19*	-0.03	0.16*	0.09*	-0.1*	-0.26*	-0.21*	0.01	0.09*	-0.05	-0.25*
21 VOT_SP	0.43*	0.5*	0.22*	0.2*	-0.31*	0.31*	0.14*	0.02	-0.01	-0.21*	-0.14*	0.09*	-0.11*	0.33*	0.08*	-0.34*	0.04	0.22*	0.24*
22 VO_SVP	-0.59*	-0.75*	-0.17*	-0.14*	0.37*	-0.37*	-0.26*	0.13*	0.02	0.16*	0.24*	-0.13*	0.01	-0.16*	-0.19*	0.33*	0.11*	-0.31*	-0.53*
23 VO_GLP	0.47*	0.33*	0.24*	0.24*	-0.12*	0.12*	-0.01	0.05	0.23*	0.05	-0.13*	-0.09*	0.09*	0.01	0.45*	-0.2*	-0.07*	0.22*	0.06*
24 VO_GPS	0.54*	0.65*	0.05	0.03	-0.31*	0.31*	0.15*	-0.02	0.08*	-0.06*	-0.19*	-0.02	0.11*	0.25*	0.29*	-0.16*	-0.13*	0.2*	0.33*
25 VE_DIE	0.31*	0.18*	0.86*	0.85*	-0.28*	0.28*	0.22*	0.08*	-0.01	-0.26*	-0.23*	0.14*	-0.18*	0.19*	0.11*	-0.66*	0.15*	0.4*	0.16*
26 VE_ELE	0.44*	0.34*	0.89*	0.88*	-0.32*	0.32*	0.27*	0.08*	0.07*	-0.2*	-0.29*	0.07*	-0.05	0.13*	0.29*	-0.66*	0.1*	0.45*	0.26*
27 VE_GAS	0.43*	0.35*	0.91*	0.9*	-0.36*	0.36*	0.32*	0.09*	0.04	-0.26*	-0.31*	0.09*	-0.11*	0.23*	0.23*	-0.73*	0.13*	0.47*	0.29*
28 AIGEWA	-0.05	0.01	-0.03	-0.01	0.04	-0.04	0	0.13*	0.15*	0.06*	-0.02	-0.18*	0.17*	-0.05	0.04	0.11*	0.08*	-0.13*	-0.13*
29 HW_GAS	0.37*	0.42*	0.37*	0.34*	-0.32*	0.32*	0.3*	0.09*	0.02	-0.22*	-0.29*	0.02	-0.03	0.27*	0.15*	-0.44*	-0.01	0.3*	0.4*
30 HW_OIL	0.09*	0.07*	0.13*	0.12*	-0.11*	0.11*	0.01	-0.04	0.06*	0.05	-0.02	0.01	0.02	0.02	0.19*	-0.19*	0.09*	0.11*	0.07*
31 HW_WOO	-0.56*	-0.54*	-0.47*	-0.43*	0.44*	-0.44*	-0.25*	0.06*	-0.05	0.12*	0.3*	-0.09*	0.04	-0.26*	-0.42*	0.68*	0.02	-0.49*	-0.42*
32 HW_ELE	-0.22*	-0.28*	-0.23*	-0.22*	0.24*	-0.24*	-0.26*	-0.11*	-0.01	0.18*	0.26*	0	-0.07*	-0.29*	-0.11*	0.25*	-0.03	-0.09*	-0.22*
33 HW_SOL	0.19*	0.31*	-0.03	-0.04	-0.1*	0.1*	0.21*	0.1*	0.17*	-0.05	-0.2*	-0.15*	0.23*	-0.02	0.05	0.08*	-0.07*	0	0.25*
34 HW_DHE	0.11*	0.03	0.35*	0.36*	-0.05	0.05	0.05	0.07*	-0.01	-0.13*	-0.08*	0.06*	-0.06*	0.07*	0.01	-0.16*	0.09*	0.08*	-0.06
35 HW_ION	-0.07*	-0.18*	0.14*	0.15*	0.15*	-0.15*	-0.01	0.13*	0.24*	0.19*	0	-0.28*	0.22*	-0.36*	0.15*	0.02	0.12*	-0.03	-0.07*

Correlation	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
20 CENTRE	1															
21 VOT_SP	-0.25*	1														
22 VO_SVP	-0.09*	-0.45*	1													
23 VO_GLP	-0.4*	0.15*	0.05	1												
24 VO_GPS	-0.45*	0.44*	-0.53*	0.23*	1											
25 VE_DIE	0.09*	0.18*	-0.14*	0.17*	-0.01	1										
26 VE_ELE	0	0.26*	-0.25*	0.29*	0.14*	0.8*	1									
27 VE_GAS	0.01	0.3*	-0.3*	0.23*	0.16*	0.83*	0.89*	1								
28 AIGEWA	0.05	0.14*	0.05	0.06*	0.1*	-0.05	0.01	-0.02	1							
29 HW_GAS	-0.21*	0.29*	-0.38*	0.13*	0.34*	0.34*	0.42*	0.44*	-0.15*	1						
30 HW_OIL	0.03	0.05	-0.07*	0.14*	0.02	0.13*	0.14*	0.19*	0.06*	-0.23*	1					
31 HW_WOO	0.17*	-0.43*	0.48*	-0.25*	-0.37*	-0.43*	-0.55*	-0.6*	-0.03	-0.52*	-0.26*	1				
32 HW_ELE	0.25*	-0.14*	0.16*	-0.14*	-0.33*	-0.19*	-0.23*	-0.26*	-0.06*	-0.41*	-0.15*	0.33*	1			
33 HW_SOL	-0.22*	0.05	-0.25*	0.09*	0.28*	-0.04	0.04	0.03	0	0.27*	-0.1*	-0.06*	-0.13*	1		
34 HW_DHE	0.02	-0.01	0.06*	0.08*	-0.01	0.31*	0.28*	0.27*	0.04	-0.05	-0.06*	-0.01	-0.12*	-0.08*	1	
35 HW_ION	0.26*	-0.12*	0.18*	0.13*	-0.32*	0.14*	0.18*	0.13*	0.06*	-0.25*	0.32*	0.06*	0.35*	-0.08*	0	1

A.5 Abbreviation List

AHV	Old-Age and Survivors' Insurance (Alters- und Hinterlassenenversicherung)
AIC	Akaike Information Criterion
BCR	Benefit-Cost Ratio
BIC	Bayesian Information Criterion
CBA	Cost-Benefit Analysis
CDF	Cumulative Distribution Function
CIA	Climate and Innovation Act
COP	Conference of the Parties
EBA	Extreme Bound Analysis
ESPEC-N	Environment, Spatial Planning and Energy Committees of the National Council
ETF	Enhanced Transparency Framework
ETS	Emissions Trading Schemes
FDP	The Liberals (Freisinnig-Demokratische Partei)
FOEN	Federal Office for the Environment
FSO	Federal Statistical Office
GHG	Greenhouse Gas
GLP	Green Liberal Party (Grünliberale Partei)
GPS	Green Party (Grüne Partei der Schweiz)
HCCP	High-level Commission on Carbon Prices
IPCC AR4	Intergovernmental Panel on Climate Change's Fourth Assessment Report
IRR	Internal Rate of Return
LT-LEDS	Long-Term Low GHG Emissions Development Strategies
NDC	Nationally Determined Contributions
NPV	Net Present Values
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Squares
PPP	Polluter-Pays Principle
SFOE	Swiss Federal Office of Energy
SMEs	Small and Medium-sized Enterprises
SP	Socialist Party (Sozialdemokratische Partei)
SVP	Swiss People's Party (Schweizerische Volkspartei)
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
VAT	Value-Added Tax
VIF	Variance Inflation Factor

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