ETH zürich

Institute of Science, Technology and Policy

Colloquium Science, Technology and Policy Spring Semester 2022

A Collection of Reports
Written by MSc STP Students

ISTP

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This collection contains reports about the ISTP Colloquia talks in the Spring Semester 2022 authored by our Master's students. Find out more about the ISTP Colloquia series: ***www.istp.ethz.ch/events/colloquia***

1

The effect of climate litigation on environmental policy

by Sverrir Arnórsson and Drífa Atladóttir
based on an ISTP Colloquium talk by Prof. Dr. Joesphine van Zeben

In the first colloquium of the semester, Prof. Dr Josephine van Zeben spoke about the effect of climate litigation on environmental policy. She is Professor and Chair of the LAW group at Wageningen University (WUR, the Netherlands). Her research focuses on the regulation of (transboundary) environmental issues by public and private actors. In the lecture, Prof. Josephine van Zeben talked about the basics of climate litigation, what it is, why we see a rise in the number of such cases, and how they are constructed. Then, she looked at two cases that exhibit interesting tactics. Finally, Prof. van Zeben touched on some challenges regarding the climate litigation scene.

Introduction to climate litigation

Climate litigation is defined as cases where climate change mitigation, adaptation, or climate science were determinative to the case's outcome. The number of climate litigation cases have increased significantly in the 21st century after only a handful in the century before. There are two main reasons for this rise. Firstly, the increase of awareness of anthropogenic climate change has led people to become frustrated with the insufficient action towards decreasing carbon emissions. Secondly, some corporate entities want to undermine the regulatory efforts of organizations that try to enforce climate restrictions and turn to courts for that purpose.

The plaintiffs, i.e. the parties who initiate a lawsuit, tend to be individuals acting through class actions or governmental actors. The defendants can either be public actors, like governments, or private actors, such as corporations. These lawsuits are either brought on in national or international courts. This distinction is fundamental as the intricacies are different, and the result of the case will highly depend on where the plaintiffs seek action. The strongest of the two is the national courts, as international courts generally do not allow individuals to bring lawsuits. On the other hand, it can be hard to bring cases against nations within their own national courts as some countries cannot be held

responsible in tort, and parties can find it difficult to have 'standing' or access to courts, especially NGOs. However, these two things are possible in the Netherlands, making climate litigation more viable there.

The Urgenda case

In 2015 the Urgenda Foundation, a Dutch environmental group, along with Dutch citizens, sued the Dutch government, arguing that it was not doing enough to tackle climate change in hopes to require it to do more to prevent a further environmental crisis. In this case, the plaintiffs used Dutch tort law, along with Articles 2 and 8 in the European Court of Human Rights (ECHR), to argue their case and ultimately won. They did this by arguing that the government's current policy statements were not in line with their actions. Although the Dutch government appealed twice, both courts decided in favour of Urgenda. If the government had discarded the ruling, this would have undermined the legal system. Instead, they adopted a new climate accord.

The Shell case

In the second example that Prof. van Zeben covered, seven environmental NGOs, led by Milieudefensie, and around 17,000 Dutch citizens brought a case against Royal Dutch Shell (RDS). Milieudefensie claimed that RDS violated the duty of care towards plaintiffs to prevent dangerous climate change, also based on tort. The District Court of The Hague ruled in favour of the plaintiffs and decided that RDS must reduce emissions inside the Netherlands and decrease indirect emissions from all subsidiaries globally. Notably, the court considered the UN Guiding Principles in the ruling and their construction of Shell's obligations, even though these principles are not legally binding.

Conclusion

In conclusion, Prof. van Zeben pointed out two commonalities in climate litigation cases in the EU. Firstly, the trend indicates that the European Convention of Human Rights is often used to support climate litigation cases rather than the EU Charter of fundamental rights. Even though the EU Charter of fundamental rights has a dedicated article on environmental protection in article nr. 37, which provides a stronger basis for building a case than the ECHR.

Secondly, the cases' outcome only applies to the parties involved in the litigation and does not examine external affected parties. As environmental effects know no borders, many groups can be affected, and it is often underrepresented groups that are most severely impacted. Therefore, many argue that these cases should be considered a global human rights issue rather than a national tort matter.

Changing the view of climate litigation cases raises challenges, such as identifying and measuring the impacts of actors' actions. Furthermore, it raises the question of the role of the government and the court in these cases; courts cannot be expected to look at climate effects in the same way that the scientific community does.

It was interesting to hear about how climate change influences the courts, and we thank Prof. van Zeben for her insight into this matter.

2

The Socioeconomic impact of High-Speed rail network to cities: Evidence from China

by Milena Bojovic and Josep Perna Montane
based on an ISTP Colloquium talk by Dr. Zheng Chang

High-speed rail has had a substantial impact in the development of the countries that have adopted it since its inception. The series of papers by Prof. Dr. Zheng Chang shows the causal impact of high-speed rail networks to economy, urbanization, and demographic changes in the context of China.

Introduction

In 2008 China inaugurated their first high-speed railway (HSR) line. By 2020 China had already built 38'000 km of HSR which amount to 70% of the entire HSR network worldwide. In this Colloquium Prof. Dr. Zheng Chang explains the socioeconomic impact of the HSR network on the cities all around China. The overarching topics of the talk were to demonstrate how one research idea is built on another and how data analytics can be used to justify causal inference. The talk focused on seven different papers by Prof. Dr. Zheng Chang that cover essential findings on HSR. The speaker started by acknowledging the importance of the 2021 Nobel prize winners, highlighting their methodological contribution to the analysis of causal relationships in cases where RCTs (Randomised Control Trials) cannot be used. This research serves as a basis for the papers that Prof. Dr. Zheng Chang presented in the talk.

The development of HSR in China

High speed rail was first developed in Japan in the 1960s and by the 1990s was adopted in Europe. It was not until 2008 that HSR reached China but with different intentions than in the countries it had been adopted previously. While in Europe and Japan HSR was seen as a tool to connect existing metropolises, in China it was used as an essential tool to foster the development of new cities. The financing of these HSR lines mainly through debt financing by China railway, as prefectural and provincial authorities financed about 10% of the overall development cost, are further proof of this.

The objective of the Chinese government is to connect all cities with a population of more than 500.000 people with HSR, with travel time between adjacent megacities being less than 4h. Furthermore, 19 city clusters were created within which travel time should not exceed 1-2h.

Socioeconomic impact of HSR

A Difference in Difference experiment design using nighttime satellite imagery was used to infer the impact of HSR stations on nearby districts. The treatment group was districts within a 4 km radius of the HSR station and the control group was districts within a 4-8 km radius of the HSR stations. It was found that light intensity in the treatment group areas was 27% higher.

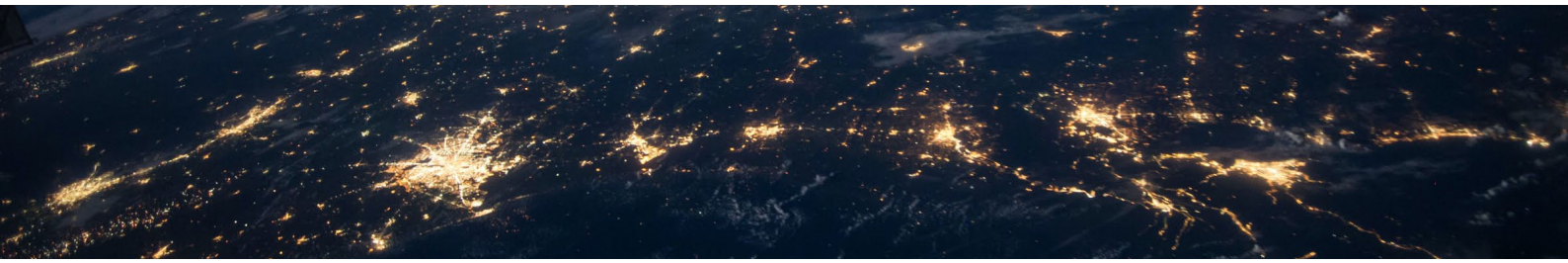
Strikingly, it is found that HSR decreases by 6% the number of companies in the cities it reaches. The main cause of this is that building a new HSR station creates a magnet effect that brings new residents from the suburbs into the city. This causes an increase in land prices which crowds out manufacturing firms, leading to an overall decrease in the number of firms. On the contrary, service-oriented firms thrive in this environment as they benefit more from the agglomeration economy. Further analysis found that due to the decentralization of manufacturing caused by HSR, the concentration PM2.5 particles was reduced by 2.74% on average. Moreover, Prof. Dr. Zheng Chang's research suggests that the overall GDP of China between the years 2007 and 2016 would be 7% lower if HSR had not been built.

In conclusion, we see that in China HSR is used to promote the development of new urban areas. The land revenue of these new urban areas is collected by local governments which can reinvest it in further infrastructure improvements, thus perpetuating the cycle and creating the necessity of further urban development.

3

The Benefits and Costs of Historical Energy Transitions

by Anshuman Mishra and Chao Zhang
based on an ISTP Colloquium talk by Prof. Dr. Roger Fouquet



In this talk Professor Roger Fouquet presented his works on historical energy transitions in the U.K., where he first discussed the evolution of energy consumption itself, then the related market indicators and the societal implications from changing energy consumption patterns. Finally, he gave his thoughts on the relevant policy implications.

Introduction

Since the commencement of the industrial revolution in the U.K. at the end of the 18th century, energy consumption has increased by several orders of magnitude. This increase in energy consumption has been divided across several sectors (lighting, heating, transport and communication were addressed in this talk) and has been augmented by shifts in energy sources over time. Prof. Fouquet mainly utilizes historical data of energy efficiency, use, consumption, market prices and demand from the last few centuries, as well as derived quantities including energy service price, energy service use, income and price elasticities of demand and consumer surplus, to evaluate the change in net welfare. He also incorporated external costs related to pollution and climate change resulting from historical energy development. Throughout the talk, Prof. Fouquet used graphics from his work to demonstrate his ideas.

Evolution of energy consumption over time

Prof. Fouquet first gave a broad picture of how global energy consumption evolved. The change in energy consumption over time was driven by the change in energy sources, where the introduction of coal to the global energy economy accompanied a 10,000% increase in energy consumption, which was further augmented by the later introduction of oil and natural gas. After that, energy consumption boomed at an unprecedented rate for the next 70 years, and the rate of increase has yet to slow. In the U.K. specifically, industrial heating has formed the foremost component of energy consumption for the past

two centuries, although after World War II the energy consumption of passenger transport has increased dramatically. While energy consumption was dramatically affected historically at the end of World War I and the commencement of the Great Depression, it proved much more resistant to fluctuation later in the 20th century.

The market of energy consumption

Prof. Fouquet then turned to the market and societal effects of historical energy development, with an emphasis on the demand side. He illustrated the correlation between the historical development of the market for energy consumption and energy efficiency with the example of lighting, where mainly due to the wider application of electric lighting, lighting efficiency increased 14-fold from 1800 to 1900 and 70-fold from 1900 to 2000. Alongside the improvement in the energy efficiency of lighting, its service price fell dramatically. He went on to show that for the other three sectors studied, on average the price of energy service also fell as the energy service efficiency increased, and vice versa. He also pointed out that as railways replaced horses and as telegraphs and telephones replaced railroad communication, there were drops in the energy service efficiencies and in turn increases in the prices.

Subsequently, in the U.K. the consumption of energy services in the four sectors exhibited exponential increase from 1700 to 2000, but the corresponding income and price elasticities of transport, domestic heating, and communication plateaued in the 1990s while communication exhibited U-shape trends at that time due to the advancement of Internet. Over the last two centuries the market demand curves for energy consumption in the four sectors shifted steadily outwards from the origin. Moreover, the demand curves exhibited very strong diminishing marginal utility.

Prof. Fouquet then presented the evolution of consumer surplus of the four sectors as well as the contributions from technologies within each of them, calculated from the area surrounded by the empirical supply and demand curves, as a percentage of GDP. He showed that the sum of consumer surplus of the four sectors as a percentage of GDP increased from 1830 to 2010, which means that the contribution of energy consumption to the overall societal welfare in the U.K. increased during that time period.

Lastly, to analyze the net welfare brought by the historical development of energy consumption, external costs related to the above energy consumption were also included in the analysis. The net benefits of the four sectors as percentages of GDP were positive and also increased over time. Prof. Fouquet also singled out the marginal benefit and marginal cost curves of heating and passenger transport in 1900 and 2000 to demonstrate that the overall marginal benefits were higher than marginal costs.

Implications for the current energy transition

At the end of the presentation Prof. Fouquet pointed out that the marginal net benefits of various forms of energy consumption in the U.K. are in decline primarily due to the saturation of energy technologies. Together with the observed length of time required for the benefits of energy technology to be fully realized (several decades), this may result in a situation where marginal costs of current energy consumption exceed marginal benefits (due to climate change). The current energy transition may also incur increased marginal costs due to the environmental impacts of mining rare earth elements. Future policy decisions relating to the energy transition must account for these considerations.

We would like to thank Professor Fouquet for his excellent presentation.

4

Citizen Participation and Government Accountability: National-Scale Experiment Evidence from Pollution Appeals in China

by Shijie Hu and Sam Mattern
based on an ISTP Colloquium talk by Prof. Dr. Mark T. Buntaine

Environmental regulations are undermined by widespread non-compliance by firms and enterprises. To understand this issue, Prof. Mark T. Buntaine and his team did a national-scale experiment in China. The results show that public appeals significantly decrease non-compliance incidents and that remarkable environmental benefits could arise from citizen participation in environmental governance.

The Non-compliance Problem and the Chinese Case

Billions of people around the world live under extreme pollution, which has serious negative effects on public health, productivity, and well-being, to name just a few examples. Despite this, countries are not meeting the targets needed to reduce their pollution to the levels they have set for themselves, because of widespread non-compliance with the environmental standards. For this reason, many countries have begun to disclose corporate pollution in the hope that this will encourage their participation in environmental management. However, there is not much evidence on how or when such participation suffice meeting the pollution standards.

Professor Mark T. Buntaine and his team focused on China because it is one of the world's largest polluters and a country with abundant industrial activities. There are many violations of emission standards in China, averaging 3% violation rate per day. Although there is public pressure from citizens which is an important factor in regulating pollution, a lack of evidence remains on the types and channels of public engagement that drive

government accountability. Therefore, this work by Prof. Dr. Mark T. Buntaine tries to explain how citizen participation affects government responsibility for enforcing environmental regulations in China.

A National-scale Experiment in China

To investigate this, a national-scale experiment was conducted with China's Continuous Emission Monitoring System (CEMS). This system detects pollution violations in real-time and covers more than 25000 heavy polluters in the country. The CEMS is applied to smoke pipes and water pipes, allowing the acquisition of data that tracks the flows and concentrations of key pollutants. There are also protocols to ensure the quality of the data, such as monitors, CCTVs, and algorithms to help detect anomalies in the data, and to take placebo samples with random timing. Governments are required to publish this data hourly, so people can see the allowed and emitted amounts for each company, and specifically determine if a company was out of compliance.

The study consisted of three main groups: the control group, the private appeals group, and the public appeals group. The control group did not undergo treatment. The results of the study showed that the private appeals, which were made by filing a complaint to the government and the firm through private channels, allowed for only a small improvement in environmental outcomes. The public appeals, which were made by posting on the Chinese public social platform Weibo, contributed significantly to the improvement in the environmental pollution of the companies studied. Violations from the latter were found to have decreased by as much as 40%, and air and water pollution by 13% and 14%, respectively.

Public Pollution Appeals Notably Facilitated Compliance

While private appeals only appeared to have marginal effects, public appeals have improved the situation significantly. Remarkable reductions from various pollution indexes were observed with public appeals. This study also found that, when the public appeals have more “likes” and “forward”, the regulator is more likely to give formal and detailed response as well as conduct on-site investigations. This could be explained by the hypothesis that publicity incentivizes the government to enforce regulations better. Additionally, this study also examined the possible spillover effect that appeals may crowd out government's regulatory efforts on other firms, and found no evidence for such an effect.

Overall, the national-scale study in China found that public appeals improves the enforcement of environmental regulations effectively, and significant environmental benefits could arise from citizen participation in environmental governance.

We would like to sincerely thank Professor Mark T. Buntaine for coming to ISTP and sharing this interesting study.

5

Using natural language processing to measure political preferences on climate policies.

by Emily Robitschek and Lukas Schlatter
based on an ISTP Colloquium talk by Dr. Sebastian Levi

Based on polling and survey research, political scientists have collected abundant data on public attitudes towards issues intersecting society and the environment. For instance, in the case of climate change, it is known that society is broadly aware of and concerned about the problem. However, there is much less short term and longitudinal public opinion data regarding specific public policies to tackle climate change (e.g. carbon taxes), beyond the unpopularity of "push" policies that restrict climate harmful activities. This in turn makes it difficult to know what specific policy designs the public would support and to conduct retrospective analyses of how societal views have changed over time concerning specific policies.

Sebastian Levi, a political scientist at the Hertie School in Berlin, Germany, focuses on the investigation of climate change politics and public attitudes. He is currently working on a research project that aims to generate scientific advice to guide the German government's response to the global climate crisis. As a guest in the ISTP colloquium on 13. April 2022, S. Levi presented how he is applying natural language processing (NLP) to measure dynamic political preferences for different climate policies.

Motivation for the work

Some theories argue that there are several modes for increasing support for stricter climate policies, e.g., via increased awareness (e.g. protest), making being climate friendly convenient/cool (e.g. electric cars), and monetary incentives/cost saving policies. It is imperative for society to quickly reach net zero emissions to avert global irreversible climate disaster, but how can politicians pass the policies that speed the energy transition and achieve that goal, especially when some of the policies could be

unpopular with their constituents? Being able to extract views on particular policies would facilitate an assessment of their political feasibility and the incorporation of that element into policy designs to pass the most effective policies for reaching climate goals.

Applying natural language processing (NLP) to policy problem areas: Methodology and Challenges

Parliamentary speeches, interviews, social media, and other political texts are publicly available potential sources of insight on political attitudes. But tapping into their potential wealth of information presents the challenge of sifting through them for relevant material. To help researchers identify political stances on specific climate policies in a time efficient manner, they applied NLP methods, a class of machine learning approaches dealing with text to develop a model for political stance detection analysis tested on specific climate-relevant policies in German parliament speeches.

However, certain challenges had to be addressed for a reasonable approach to be defined, including the fact that traditional methods would need to be adapted for the question and data source. For instance, the speeches mention many different topics unrelated to those of interest, and so a keyword search mechanism was used to select relevant windows of text from speeches that spoke about the relevant policies (e.g. "carbon tax").

In addition, the researchers found that it was difficult to assess degrees of political support with out-of-the-box traditional NLP methods like sentiment models, because while such models assess positive and negative valence, this does not translate/directly imply a political stance as stances can be complex and caveated and political language is quite nuanced and indirect. In addition, the decision of what to label as the "policy" is non-trivial as someone can be against a policy at a national level, but in favor of local ones, and there can be a stance in favor of the policy goals but against the policy instruments for achieving the goals. To make the task even more challenging, certain contextual statements about beliefs about the world like "it's impossible that electric cars would be feasible" can be paired with support or against views e.g., "but we need to make it work" or "so focusing on this is pointless." To deal with these challenges, the researchers developed a novel, more substantive classification typology and applied free text labeling and active learning approaches to the problem of classifying political stance on coal exit, electrification of road transport, and carbon taxes in the speeches. The typology elaborated in this work conceptualizes four stances according to relative positions towards newly proposed policy changes and the status quo. First, opposed indicates a position against a particular policy and its general goal. Second, status-quo indicates support for the policy goal but not of the design of the policy (i.e. they feel it is too harsh, strict, fast, or unimplementable). Third, support reflects a view in favor of both the policy goal and the particular policy design. Finally, even more implies support for the general policy goal but not the policy design because the policy does not go far enough to accomplish the goal in a given timeframe.

Results

The findings were structured into two sections: The first depicting the political stance of the German Bundestag (parliament) towards carbon pricing, and the second describing the degrees of support for electrifying road transport of important interest groups and stakeholders such as ADAC (the German Automobile Club), Greenpeace or Volkswagen.

For the first analysis, Levi et. al. coded 6,300 statements from German parliament speeches, covering different climate policies such as carbon pricing, support of electric vehicles, coal exit or renewable energy subsidies. The first results presented show the stances towards carbon pricing. During the period from 2014—2019, the political support towards the suggested carbon pricing policy peaked between 2014—2015 during which time only a few were against the policy or claimed that the carbon pricing

should be stricter. In 2016, the number of statements requesting an even stricter policy peaked, surpassing those that simply supported the policy or were against it, whereas in 2017, the members of parliament demanding a stronger policy declined and the share of members of parliament opposing the policy peaked. By the end of the period assessed (early 2019) the general support again overtook the share of opposing stances. Taken together, this analysis illustrates the rapid fluctuations of political support for carbon pricing policies over the five-year period.

The second analysis examined the changing stances of different interest groups like the ADAC, Greenpeace, BDEW (German Association of Energy and Water Industries) and the car manufacturer Volkswagen. In this case, fewer statements were observed, and the stances fluctuated less. However, general trends in stances were observable. As an example, the support for electrifying road transport almost tripled for Volkswagen, whereas the initial support of the BDEW heavily dropped in 2021. The trend for Volkswagen makes substantive sense in that the company has invested heavily in electric vehicles over the past few years so logically they would be increasingly in favor of climate policies favoring the electric vehicle industry. Greenpeace did not give that many statements about mobility in comparison to the business-related interest groups such as ADAC or BDEW. This is perhaps because the global campaigning network has a much broader focus beyond electric cars to "expose global environmental problems and develop solutions for a green and peaceful future."

Further research and limitations

Since the goal was to assess the stance towards different climate policies of the general population one can doubt whether the NLP of parliament speeches accurately represents the opinion of average citizens. Assuming a well-functioning democracy this might be the case. We suggest there should be further research complimenting the results of the work presented by S. Levi addressing this issue.

The Institute of Science, Technology and Policy at ETH Zurich thanks Sebastian Levi for presenting his important work and progress in this crucial area at the interface of machine learning and political science.

6

Bottled or tap? Determinants of water consumption in Germany

by Fabian Bättig and Anna Ingwersen
based on an ISTP Colloquium talk by Prof. Dr. Jale Tosun

Apparently, the average person in the EU consumes up to 106 litres of bottled water per year even though it is much more expensive than tap water and leads to higher amounts of plastic waste and greenhouse gas emissions. Coherently, Jale poses the question "Why do people purchase water? Why don't they drink tap water?" in her research. Germany ranks top in terms of market share of bottled water - a market that is still growing and considered unsaturated. And this even though Germany has very high tap water quality. Bottled water is relatively heavy compared to soft drinks, where only the syrup needs to be transported, which increases the carbon footprint of bottled water. Thus, we see that drinking bottled water is not only more expensive but also not very environmentally friendly. Therefore, it makes sense that Jale asks why people choose the more expensive one out of the two perfect substitutes.

Not everywhere in Europe does the issue have the same relevance. In Iceland, for example, there are no recycling systems for PET-bottles, so more bottles end up in regular waste streams. Also, drinking water habits differ geographically in Europe.

The regional distribution of water quality in Germany ranges from high to very high. This is different in Italy, where the quality of tap water varies much more. Therefore, the results in Italy are not as surprising as in Germany. The German situation is puzzling from an economic perspective, too: a litre of tap water costs about 0.2 cents in Germany, while the cheapest bottled water Jale could find costs about 17 cents per litre. Apparently, even though consumers generally know that tap water is cheaper, they still drink more bottled water than tap water in Germany.

Understanding Water Drinking Behavior

To understand the German water drinking behaviour, Jale researched several potential underlying causes through a

survey. The underlying causes she investigated were the perception of quality and security, taste preferences, knowledge, lifestyle choices (i.e., how we consume), political attitudes and environmental concerns.

The survey was balanced in most aspects – age, gender, education and in terms of population of the different federal states. One aspect, in which the survey was not balanced, was political orientation. This could be explained by the fact that the topic likely attracted people with high environmental interest and concern more. This hypothesis was reflected in the party affiliation distribution of the respondents – mainly the Greens and the SPD.

The Three Hypotheses

Scientific literature is clear: water drinking habits are caused by different factors, many of which date back to early childhood. In the survey, parents and family were mentioned as the main influence on peoples' water drinking habits. Building up on literature, three hypotheses were formed:

1. Left-leaning individuals have a higher likelihood of mostly drinking tap water at home than right-leaning individuals. This comes partly also from a tendency to have more environmental concerns as a left-leaning individual.

2. Individuals who support the Green Party have a higher likelihood of mostly drinking water at home, due to a pro-environment orientation.

3. Individuals who support the Left have a higher likelihood of mostly drinking tap water at home, due to an anti-capitalistic orientation.

Results

Interestingly, the results of the survey, only support the second hypothesis: respondents that vote for the Green party are more likely to drink tap water. These findings show a relationship between pro-environmental behaviour and a preference for drinking tap water compared to bottled water. Voting for the Left is only correlated with a slight, non-significant preference for tap water. The Lefts' consumer behaviour is influenced by an anti-capitalistic world-view – namely, the conviction that water is a public good and not a company's property to be sold.

The first hypothesis was also not supported by Jale's findings. Although left-leaning respondents were more likely to drink tap water, there was no statistical significance. Other factors that significantly affected respondents' water drinking behaviour were gender, education, and the belief in climate change.

Conclusion

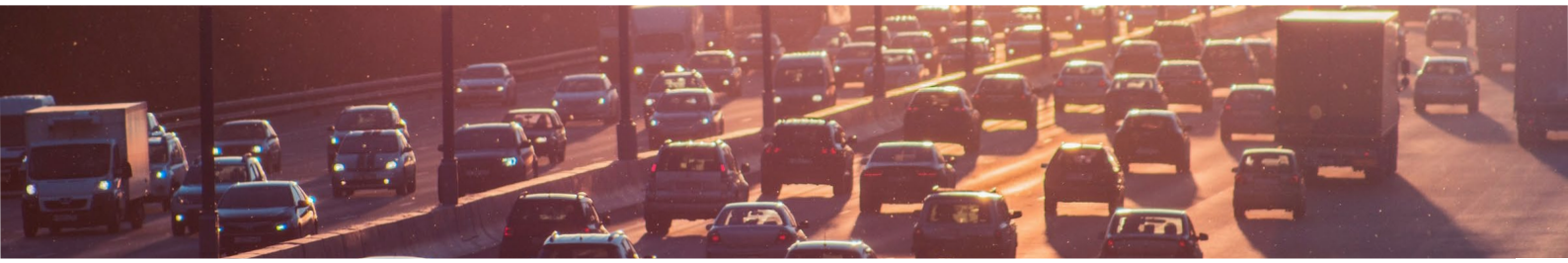
There exists a tap-water related puzzle in Germany – a lot of people buy more expensive bottled water, although the tap water is of high quality and is easily accessible. This is problematic from an environmental perspective, as bottled water has higher impacts on the environment than tap water. Only one of the three hypotheses described can be supported by the available data: people who support the green party are more likely to drink tap water, mainly because of environmental concerns. Generally, the connection between political orientation and consumer behaviour is an interesting one that could be subject to further research.

We would like to thank Prof. Dr. Jale Tosun for her insightful presentation.

7

Tradable performance standards (TPS) – insights from real-world applications in the transportation sector

by Cyril Heim and Victoria Herbig
based on an ISTP Colloquium talk by Prof. Dr. Sonia Yeh



We had the pleasure to welcome Prof. Dr. Sonia Yeh, one of the contributing authors of the sixth Intergovernmental Panel on Climate Change (IPCC) Assessment Report, who presented recent research findings around Tradable Performance Standards (TPS). TPS have evolved as a successful policy tool to decrease GHG emissions.

A performance standard defines a limit of a technology performance but leaves the choice of how to reach these goals to the producers. When implementing performance standards they start out somewhere close to the current "dirty" technology, such as gasoline. Providers whose emissions exceed the standard are subject to a penalty, whereas companies that are below the standard generate credits which they can trade. Over time the standard decreases, so that the penalty for "dirty" technologies, i.e. those above the standard, increases and "clean" technologies possibly become subject to penalties.

Performance standards have a long history in environmental policy. Adding the "tradable" property opens up new possibilities. It allows producers to trade their credits, which they obtained by using favorable performance characteristics below the defined performance standard.

Real-world tradable performance standards

TPS are predominantly implemented in Californian policies, aimed at the fuel economy - also due to the lack of a carbon tax. In particular, electric vehicle and biofuel, as well as the fuels' GHG emission intensity are targeted.

According to Prof. Yeh, how car companies reacted to TPS are a prime example. Tesla's business model, for example, is to sell electric cars to strive for a more sustainable transportation sector. In the early stages, TPS system, then called ZEV credits, were a crucial financial contributor for Tesla. In 2012, credit sales equaled 135% of Tesla's gross profit.

It was emphasized that when establishing new TPS, policy makers have to consider the influence between different standards as they may cancel each other out or allow for synergies.

TPS vs. Cap and Trade

In financial volume TPS are very small compared to Cap and Trade. Note that credit prices are not directly comparable with a price on carbon because they have a different purpose. The primary objective of TPS is to encourage innovation and system transition. The important difference between TPS and Cap and Trade is that under TPS companies are not paying the full price for their emissions, but only pay for the marginal emissions above the performance standards. Once the standard is reduced to zero, TPS corresponds to a carbon price.

It was emphasized that it is politically speaking challenging to implement sufficiently high carbon prices. This is where TPS comes in as a market-based approach. The idea is that companies have an incentive to innovate. Nonetheless, TPS systems may lead to unintended consequences such as a rebound effect, where improved efficiency or lower fuel costs would increase the consumptions and with it the GHG emissions. On the path to net-zero emissions, both the supply and demand side have to change. According to this presentation only addressing demand, e.g. through carbon prices, will not produce the required innovations but combining TPS and a carbon tax may prove to be successful to decrease GHG emissions and promote a transition in the transportation sector.

We sincerely thank Prof. Dr. Sonia Yeh for her excellent and insightful presentation of the latest research results.

8

Assessing climate policy instrument mix pathways: An application to the German light duty vehicle sector

by Yilin Huang and Thomas Mendoza
based on an ISTP Colloquium talk by Prof. Dr. Christian Flachsland

To achieve its 2030 climate target, Germany has adopted the Climate Action Programme 2030, of which a shift to green transport is a major component. To achieve these targets, it is paramount that realistic and effective policies are implemented. We were incredibly fortunate to have Prof. Christian Flachsland to break down the policy instrument mix and methods for assessing them in the application of light duty vehicles. As the director of the Hertie School's Center for Sustainability (Berlin) and a Research Fellow at the Mercator Research Institute, Prof. Flachsland had many first-hand insights on the findings. We sincerely thank Prof. Flachsland for his time and engaging talk.

Project Context

In ensuring a smooth and well-adopted transition to electric vehicles, it is paramount that policies implemented are well-informed and feasible. The Ariadne Project, funded by the German Federal Ministry of Education and Research (BMBF), aims to provide decision-makers with scientific advice on German/EU policy design. The project itself has projects that range from energy to buildings, however, today's talk focuses on the topic of transportation, and more specifically the transition of light duty vehicles from internal combustion engine (ICE) vehicles to battery electric vehicles (BEVs). There is a great demand for a framework to discuss and assess the mix of climate policy pathways ex ante that bridge the interface of science, policy, and society. In this project, attention is particularly paid to dynamic interactions and policy feedbacks.

General Policy pathways

Before diving into the domain of BEVs it's important to first understand the different stages in technological

transitions since each of these transitions require unique policy mixes to be successful. The first of these phases is the Emergence phase, where we see political opposition, infrastructure network externalities, and consumer myopia. This is followed by the Diffusion phase, where there is still consumer myopia, but there is learning from the externalities that lead to a slow phasing out of the previous technology (in this case, a phasing out of ICEs). The final stage is the Saturation phase, where there is wider-scale adoption of the new technology and elimination of the previous one. It is important that climate policy changes over time to match the needs of each of these unique phases.

Current BEV situation in Germany

To dive into the topic at hand, an understanding of the current BEV situation in Germany helps set the stage for understanding proposed climate policies. There has been a recent growth in Germany, where BEVs made up 14% of total sales in 2021. There are, however, large uncertainties regarding the cost estimates of BEVs for parity with ICEs. These uncertainties mostly stem from uncertainties of battery costs, minerals, and chips. In relation to the previously described policy pathways, Prof. Flachsland states that Light Duty Vehicles (LDVs) are at an early stage of diffusion in the transition from ICEs to BEVs.

As with any transition, there are also significant challenges to this transition. Notable challenges include the environmental effectiveness, cost-effectiveness, political feasibility, and fiscal burden to the state. Each of these have key indicators that can be tracked to determine the status of acceptance and advancement of the transition.

Policy instrument mix

In his presentation, Prof. Flachsland presents three different policy instrument mixes for Light Duty Vehicle adoption in Germany, namely a fuel focussed carbon pricing scheme, a stock focussed carbon pricing scheme and a mix of the latter two.

First of all, Prof. Flachsland presents the baseline policy mix, which includes current policies such as carbon fuel pricing, performance standards and BEV purchase subsidies. The development of the stringency of each of these policies can be seen in the figure policy as usual with “Fit for 55” package. While most policy instruments can be well forecasted, the carbon pricing trajectory shows large variation, depending on the future development of carbon pricing in Germany or Europe (i.e. the currently discussed ETS-2 in the Fit-for-55 package).

A pure fuel focussed carbon pricing approach would correspond to a phase-out of all other types of instruments (i.e. on infrastructure or subsidies-level). This approach would imply a strong increase in the fuel pricing mechanism, however, the model shows a large variation in the stringency of fuel pricing (see figure fuel focused carbon pricing). Prof. Flachsland points out that, in the current situation, the political (and societal) feasibility of such an approach is a major drawback.

In the second policy instrument mix, the stock focussed carbon pricing scheme, a focus lies on the stock turnover dynamics, i.e. supporting the removal of ICEs and their replacement by BEVs. This policy mix includes both different forms of subsidies as well as malus mechanisms. While the instrument stringency varies a lot across the single policy tools (see figure stock focussed carbon pricing), the drawbacks are to lay in the early phase environmental effectiveness and the low static cost effectiveness due to the limited use of fuel carbon pricing.

Lastly, a mixed pathway is presented, including sequentially combining elements of each of the previous scenarios: in the early phase, a focus lies on the stock turnover support, while later on fuel carbon pricing would be slowly ramped up. This approach is anticipated to achieve a higher societal acceptance due to the only slow increase in fuel pricing (the carbon pricing curve includes only the current German CO2 pricing scheme). The stringency of each single policy instrument can be found in the figure mixed sequential carbon pricing.

Policy comparison & Conclusions

From this policy mix, it is important to then assess the optimal policy mix. Notably, first, there are calibration challenges, finding the right pathway between over-subsidizing and under-subsidizing BEVs makes up a large challenge in itself. The current policy comparison work is done at a high-level glance, to understand general trends and issues, however, individual analyses will need to be conducted at a more deep-dive level before implementation.

Overall, as students studying technology policy, it was highly relevant and engaging to see how policy concepts are applied in the real world. We would like to thank Prof. Flachsland for the very interesting and insightful presentation!

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