

TSE

Energy & Climate Center

NEWSLETTER / June 2018

Sunspots that matter

Stefan Lamp

Could smog become a breath of fresh air for the climate?

Stefan Ambec

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EDITOR'S NOTE

The fight against climate change and the transition to new energy sources are among the greatest challenges facing policymakers in the 21st century. Building on the continued scientific excellence of energy and environmental economics in Toulouse, the urgency of such challenges has stimulated the creation of a new collaborative platform, TSE Energy & Climate Center, with the help of our partners EDF, Engie and Total.

This initiative brings together academic and industrial partners to build new analytical tools and exchange data and ideas on the economics of energy and climate change. The center aims at producing scientific publications and hosting conferences and seminars, and to facilitate the transfer of knowledge between researchers, practitioners and policymakers, and inform the public debate. It is organized around two thematic groups dedicated to the economics of energy industries and the economics of natural resources and the environment.

In this newsletter, we report on the latest activities of the **TSE Energy & Climate Center** initiative, including the Workshop on Energy Economics organized in January, that kicked off an exciting year for the center.

We also feature a snapshot of cutting-edge TSE research on energy and the environment. My paper co-authored with Jessica Coria from the University of Gothenburg 'Policy spillovers in the regulation of multiple pollutants', recently published in the Journal of Environmental Economics and Management, analyzes the complex interplay between policies that aim to reduce greenhouse gases and those that target local air pollution. Meanwhile, Stefan Lamp's working paper 'Sunspots that matter: the effect of weather on solar technology adoption' is the first to provide causal evidence for behavioral biases in the renewable energy investment context, where externalities lead to low take-up of otherwise profitable technologies.

Also in these pages, PhD students **Xavier Lambin** and **Nicolas Astier** report their recent academic visit to the University of California at Berkeley funded by the GEMCLIME research project.

Together with its partners, TSE is breaking new ground in this field, producing innovative economic responses to global challenges.

Stefan Ambec
Director, TSE Energy & Climate Center



SCIENTIFIC EVENT

Workshop on Energy Economics, January 9

03

The center's annual research discussion began with the Workshop on Energy Economics, attended by most of the center's researchers and associated members. The one-day event included presentations by Estelle Cantillon, Xavier Lambin, Giulia Pavan, Stefan Lamp, Bert Willems and Natalia Fabra, who discussed their latest research and other pressing issues, from environmental regulation to the effect of electricity taxation on firm competitiveness, which are at the core of the center's research agenda.

In her paper "Information aggregation in the European carbon market: The role of firm participation", **Estelle Cantillon** and her co-author Aurélie Slechten exploits recently released data from the first phase of the EU emissions trading scheme (EU ETS) to examine the process of market development during that phase.

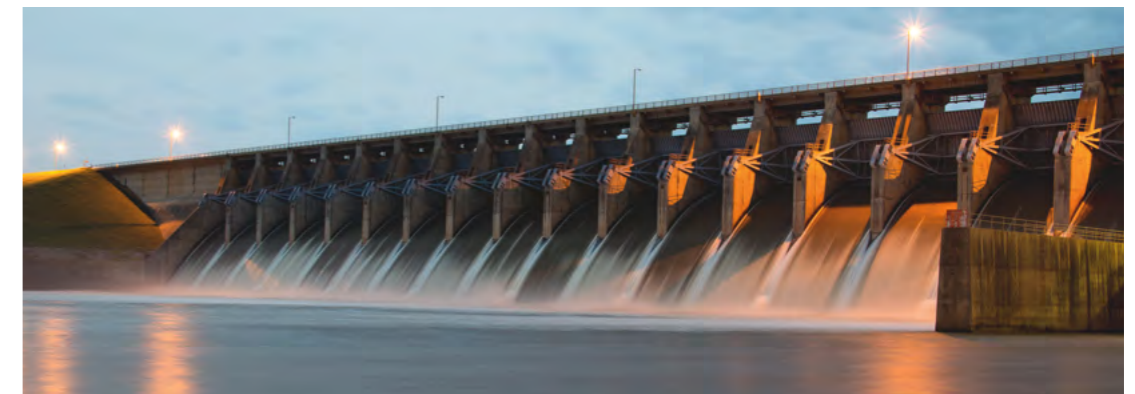
"We know who traded, when, with whom, on which platform if any, and at what price. These unusual data allow us to map for the first time the actual market structure that emerged. Participation was partial and the market was fragmented. We find evidence that the microstructure that arose is related to the observed price formation process."

The researchers plan to develop a microstructure-based model of emissions trading that captures the salient features observed in the data and allows them to explore the consequence of design choices such as the possibility to bank or 'grandfather' allowances.

In her paper "A Primer on Capacity Mechanisms", **Natalia Fabra** presents a simple model designed to capture the key drivers of investment and pricing incentives in electricity markets. She focuses on the interaction between market power and investment incentives, and the trade-off this produces when designing regulatory instruments.

"In contrast to the energy-only market paradigm that assumes perfect competition, our model demonstrates that in the presence of market power scarcity prices do not promote efficient investments, even among risk-neutral investors. Combining price caps and capacity payments allows us to disentangle the two-fold objective of inducing the right investment incentives while mitigating market power. Bundling capacity payments with financial obligations further mitigates market power as long as strike prices are set sufficiently close to marginal costs."

http://bit.ly/Workshop_energy2018



SUNSPOTS THAT MATTER

Stefan Lamp on salience
and projection bias



Installing rooftop solar energy is an expensive investment for most families, and one which requires them to form expectations on future returns. TSE postdoctoral researcher Stefan Lamp has investigated solar investment decisions by German households, and finds evidence that choices are overly influenced by the current state of sunshine in line with projection bias and salience. Evidence for projection bias and salience points to the importance of behavioral channels in explaining the low take-up of otherwise profitable renewable-energy technologies.

Projection bias and salience are well-established phenomena in the theoretical literature of behavioral economics, but it has proven difficult to identify them in empirical settings. Projection bias refers to people's tendency to overpredict how much future preferences will resemble current preferences. Salience, on the other hand, refers to the idea that consumers' attention may be systematically biased towards certain product attributes. When an attribute is very salient, it will have a disproportionately strong influence on consumers' purchase decisions.

Following the sun

Stefan's paper 'Sunspots that matter: the effect of weather on solar technology adoption' (2018) is the first to provide causal evidence for projection bias and salience in the renewable energy investment context, where externalities can be linked to low observed investment rates. This is especially relevant given the significant amount of public resources spent on incentivizing technology adoption. In line with the behavioral economics literature, Stefan provides empirical evidence that exogenous factors, such as weather, can impact individual investment decisions. Furthermore, looking at county heterogeneity, he shows that certain population groups are particularly affected, making them prominent candidates for targeting. If the objective of the policymaker is to reach fast product diffusion, it is important to consider these biases when designing adoption campaigns.

Empirical analysis in Germany

To test his hypotheses, Stefan uses administrative data on residential solar photovoltaic (PV) installations in Germany and high-resolution weather data. He focuses on Germany, the world-market leader in solar PV deployment until 2011, as its institutional features are particularly well-suited for this analysis. First, the design of feed-in tariffs, the main support mechanism for renewable energy deployment, guarantees comparable investment conditions for the time-period 2000 to 2011 in an otherwise quickly changing market environment. Second, given the long project horizon of 20 years, rational agents should not respond to short-term variations in weather as their average returns will not be affected. This is particularly true as there exists a time gap of approximately nine weeks between the decision to adopt solar and the time the installation is completed and starts to produce electricity. Third, the adoption of a rooftop solar PV system involves a large financial commitment, comparable to the purchase of a car, which allows Stefan to credibly exclude other behavioral mechanisms.

For his empirical analysis, Stefan recovers the long-term weather distribution for each county and defines a weather shock as a weather realization one standard deviation above the long-term mean. His empirical identification takes advantage of the randomness of local weather as well as the time gap between decision-making and completion of the installation. In his main specification, he regresses

solar PV market growth on current and lagged sunshine and other weather shocks, controlling for a rich set of county and time fixed-effects. In addition, he adds data on county demographics, solar PV prices, as well as news on 'solar PV' and 'climate change', to test for competing mechanisms and county heterogeneity. Finally, he performs an online survey with German solar PV installers to provide additional market insights, in particular regarding customer key decision variables, installation timing, and marketing outreach.

Key results

Stefan finds strong evidence that an exceptionally sunny month leads to additional solar PV installations with a two-month lag, in line with the average installation timing. A sunshine shock implies a 6.2% growth of the residential solar PV market in a county, increasing the average number of installations from approximately 10 to 10.6. He allows for non-linear effects of sunshine and finds that there exists a strong asymmetric response between positive and negative deviations from the long-term mean. Months with exceptionally low number of sunshine hours, lead to significantly fewer installations.

In line with these findings, Stefan shows that other weather variables such as rain and cloud cover lead to similar results. On the other hand, temperature does not seem to impact technology adoption decisions.

Finally, Stefan shows that 'green counties', with a large historic vote share for the green party, are particularly prone to additional adoptions induced by exceptional weather. Income and education, on the other hand, do not seem to play an important role in explaining the biases. These results suggest that political beliefs might play an important role in the response to policy interventions based on behavioral economic interventions.

While the data at hand does not allow to separately identify projection bias and salience, Stefan's analysis is able to rule out other possible mechanisms such as consumer myopia, biased weather beliefs, and learning about the weather.

Summing up

Stefan's paper provides evidence that an important household investment decision, the installation of solar PV panels, is affected by projection bias and salience. Furthermore, he shows that there is a strongly asymmetric response to positive and negative deviations from the long-term sunshine mean that can be explained by interactions of the two biases. He also shows that 'green counties', with a large historic share of green voters, are particularly affected by this sales effect.

In many similar energy contexts, we see low adoption rates for profitable investments due to the so-called energy-efficiency gap. Stefan's research suggests that targeted information campaigns could help to bridge this gap and increase product uptake. As solar investments are often profitable for households as well as beneficial for the society, these interventions can improve overall welfare.

FUTURE RESEARCH

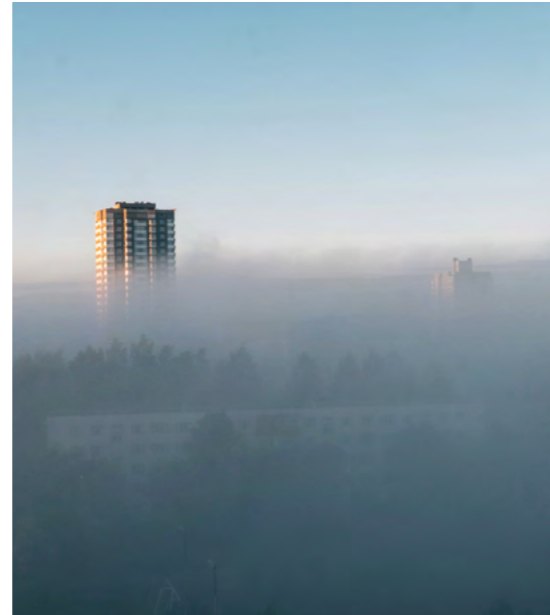


Stefan's results suggest that other important consumer decisions are also likely to be affected by projection bias, salience, and other behavioral biases. If consumers are prone to impulse purchases, a 'cooling-off period' combined with mandatory information disclosure is likely to increase consumer welfare. Yet, no clear recipe exists on how to de-bias consumers, which leaves an interesting field for future research. Randomized controlled trials aiming to disentangle distinct behavioral channels would also help improve the targeting of energy and environmental policies.

LATEST SCIENTIFIC STUDIES

COULD SMOG BECOME A BREATH OF FRESH AIR FOR THE CLIMATE?

Stefan Ambec on policy spillovers and multiple pollutants



Poor air quality in cities, particularly in developing countries, is often a greater spur to action for policymakers than the broader fight against climate change. Is this good news for the climate? In his paper 'Policy spillovers in the regulation of multiple pollutants', co-authored with Jessica Coria (University of Gothenburg) and recently published in the *Journal of Environmental Economics and Management*, Stefan Ambec (TSE) analyzes the interplay between policies aimed to control transboundary and local pollutants such as greenhouse gases and particulate matter. The complex picture that emerges offers crucial new insights for developing effective environmental policies.

Many local air pollutants and greenhouse gases (GHG) have common sources. For example, passenger vehicles and coal power plants emit nitrogen oxides (NOx) and carbon dioxide (CO2), which affect local air quality and the climate. Hence, regulations directed at local air pollutants affect GHG emissions, and vice versa. Policy spillovers occur when a policy aimed at one pollutant affects emissions of another. These spillovers can lead to ancillary benefits for the environment. For instance, climate policies that improve energy efficiency might reduce fossil fuel combustion and local air pollution. However, climate policies can also increase emissions of other pollutants. For example, greater use of biomass fuels may reduce GHG emissions but could increase emissions of NOx and particulate matters (PM).

Chinese priorities

Policy spillovers have implications for policy design and cost-benefit analysis, as they affect both the effectiveness and cost of specific policy measures. In China, climate change has suddenly become a high priority. The Chinese government now recognizes the need to reduce its dependency on coal to combat domestic air pollution, which could lead to significant ancillary benefits for climate change mitigation. Empirical studies have shown that the carbon-mitigation potential of the SO2 and NOx emission reduction targets proposed in the 12th Five-Year Plan corresponds to a 20% reduction of CO2 emissions, exceeding China's official target of 17%.

The spillover effect of local pollution policies on GHG emissions seems to be good news for the climate. Yet it is not always the case. First, reducing local pollution might increase the cost of mitigating GHG emissions. For instance, replacing a diesel car with a gasoline car reduces NOx and PM, but produces more CO2 per kilometer. Limiting emissions of SO2 and NOx by installing filters on more coal-fired power plants, uses more energy, leading to higher CO2 emissions. Second, the spillover effect might provide perverse incentives for guiding local environmental policy. A country might adjust its strategy on local air pollution to be in a better bargaining position during international negotiations on GHG emissions. Therefore, it is crucial to understand how policies can be designed to reduce local pollution and enhance global climate mitigation efforts.

The model

In their paper, Stefan and Jessica analyze the interplay between transboundary and local pollution regulations in the presence of policy spillovers. In particular, they analyze the question of how the choice of policy instrument affects the stringency of the policies and economic efficiency. The researchers assume that in each country there is a polluting firm that causes transboundary and local pollution.



Pollution abatement levels for both pollutants interact in the abatement cost function of firms through economies/diseconomies of scope. Abatement efforts are complements when reducing emissions from one pollutant decreases the cost of reducing emissions from the other pollutant, leading to economies of scope into abatement costs. Reversely, they are substitute if the cost increases, thereby implying diseconomies of scope. Regulators aim to maximize the social welfare of people exposed to pollution, using a variety of regulatory instruments (e.g., cost-efficient non-tradable quotas, emission taxes, and tradable emission permits). Inefficiency arises only from lack of coordination among regulators. Regulations can be designed either simultaneously or sequentially. In such a setting, each regulator's policy has the potential to affect the other regulator's welfare. However, as the researchers show, that depends on the type of policies chosen by the regulators.

Worse still, the regulation of local air pollution might lead to higher emissions on a global basis in net terms.

Ground-breaking research

Stefan and Jessica's study appears to be the first to analyze the effects of the choice of policy instruments under policy spillovers and regulation of multiple pollutants. Their paper builds on the literature on regulation of multiple pollutants when those pollutants interact in abatement costs or environmental damages. Most of such literature compares the efficiency of several instruments designed by one regulator. In contrast, Stefan and Jessica deal with two regulators, each of them in charge of a different pollutant.

Key results

Are policy spillovers between local air pollution and GHG emissions good news for the climate? Stefan and Jessica's analysis shows that the answer depends on several ingredients: (I) whether efforts to reduce local air pollution and GHG emissions are substitutes or complements in cost, (II) whether GHG emissions are regulated or not at the international level, (III) the choice of instrument used to implement an international agreement on GHG reduction, (IV) the regulatory timing, and (V) the marginal impact of countries on total GHG emissions.

The paper shows that in the absence of international obligations to cut greenhouse emissions, countries only do so when reductions in greenhouse emissions are complementary to efforts to reduce pollutants that damage the immediate environment (such as NOx). When local-pollutant abatement efforts are substitutes, however, countries have no self-interest in reducing their greenhouse-gas emissions. Worse still, the regulation of local air pollution might lead to higher emissions on a global basis in net terms.

This is why reducing greenhouse-gas emissions on a global basis requires international treaties. But the choice of policy instrument through which this is done matters if unintended consequences are to be avoided. In particular, the Paris agreement on emission reduction targets can be counter-productive for air quality. Countries that experience higher costs of curbing GHG emissions will obtain less stringent targets. By postponing investment in clean technology, sticking on coal power rather than moving to more wind or solar power, a country will be allowed to emit more. Such perverse incentives can be avoided with market-based instruments such as tradable emission allowances - like in the European Union Emissions Trading Scheme- or a tax on GHG emissions. Nevertheless those instruments should be properly designed to avoid any unintended consequence on local air pollution. In particular, the way emission allowances are allocated or the revenue from taxing GHG emissions is used matters.

Summing up

So is air pollution really good news for the climate? Well Stefan and Jessica conclude that it depends on the technology used for reducing pollution as well as the type of international agreement of GHG emissions. Let's be optimistic as many technologies adopted during our current energy transition to renewable sources are exhibiting economies of scope in pollution abatement: they manage to reduce many sources of air pollution (GHG, SO2, PM and NOx) at lower cost.

From their analysis, Stefan and Jessica conclude that a country's concern for local air pollution is good news for the climate in the absence of any international obligation on GHG emissions when there are economies of scope (or ancillary benefits) in abatement costs. Furthermore, the cost interaction between abatement of local and transboundary pollution matters for the choice of regulation instruments for GHG emissions.

NEWS

SCIENTIFIC NETWORKING



GEMCLIME
Global Exchange in Modelling
of Climate and Energy

Global Exchange in Modelling of Climate and Energy (GEMCLIME) is a European-funded research project that focuses on the economics of climate and energy. It follows an integrated approach to modelling the impacts of climate and energy policies.

To implement the research project, it coordinates the secondment of research staff to encourage scientific networking and the transfer of knowledge between the world's best research institutions. The project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 681228.

Two PhD students of TSE - **Nicolas Astier** and **Xavier Lambin** - enjoyed an academic stay at Berkeley thanks to this funding.

APPOINTMENTS



New TSE associate awarded ERC grant for energy research

TSE Energy & Climate member Natalia Fabra has been awarded a five-year grant from the European Research Council (ERC) for her project 'Current Tools and Policy Challenges in Electricity Markets'.

The project aims to analyze the design of regulatory instruments which minimize the costs of energy transition towards low-carbon economies. Natalia's team will combine theoretic modelling, simulations and big data analysis to address issues such as the design of contracts and bids for new investments in renewables, and the role of consumers in managing electricity demand.

"Achieving the necessary political and social support for energy transition depends on our capacity to reduce costs and boost its benefits. Lowering emissions is not only a must, it is also a unique opportunity to modernize our economy," says Natalia, who is Professor of Economics at Universidad Carlos III de Madrid and TSE associate. In 2014, she was awarded the Sabadell-Herrero Prize for Best Young Spanish Economist.



Gilles Lafforgues appointed member of France's commission on the social value of carbon

In line with the commitments made by France during the signing of the Paris Agreement, the July 2017 Climate Plan set the objective of achieving carbon neutrality by 2050. To achieve this objective and to guide the investment choices of all economic actors, giving a value to greenhouse gas emissions is essential.

With the support of France Stratégie, the French Prime Minister Gérard Philippe has entrusted to economist Alain Quinet with a mission to propose a new trajectory of the social cost of carbon that is consistent with France's climate goals, and to formulate recommendations.

To help define the cost path, a commission composed of experts, representatives of the social partners, and NGOs will meet throughout the first semester, drawing on the results of macroeconomic and techno-economic models for energy transition. The commission's proposals will be integrated into the national low-carbon strategy.

OUTREACH

TSE Debate is a portal that gathers the opinions and analysis of TSE researchers on topics of public interest such as electric cars, the European carbon market, and renewable energy. Members of the center regularly publish blog posts that can be consulted in TSE Debate's "Energy" section.

Here we feature some of the recent posts



The European Commission's green resolutions

January 11

Stefan Ambec and Claude Crampes

"The European Commission (EC) provided its contribution to the One Planet Summit in Paris on 12 December 2017 by publishing its "Ten Initiatives for a Modern and Clean Economy". Like the 12 international commitments made by Paris on the evening of 12 December, the EC's contribution talks a lot about the billions of euros that need to be found to finance the transition to a carbon-free economy. But it also discusses buildings and mobility, young people and Africa, islands, urbanization and technology."

<https://www.tse-fr.eu/european-commissions-green-resolutions>



The European Project needs a new long-term vision

February 2

Jean Tirole

"The EU is at a crossroads with two main options: improving the Maastricht Treaty, designed to ensure fiscal discipline for a common currency; or federalism, requiring greater risk-sharing. Either way, we will have to cede a little more sovereignty and rehabilitate the European ideal."

<https://www.tse-fr.eu/european-project-needs-new-long-term-vision>

OUTREACH



PUBLIC DEBATE

TSE's Nicolas Treich joined Carole Delga, President of the Occitanie Region, in a public debate organized by TSE in collaboration with La Tribune on February 8. This debate focused on the evaluation of regional public policy. Held at the Meeting Lab, Toulouse, and attended by decision-makers, TSE partners and students, this event also featured on TSE's social networks, allowing many others to follow the discussions from afar.

http://bit.ly/lamatinale_treich



TSE WORKSHOP

Environmental regulation and industrial performance

17-18 May, Toulouse

The threat of climate change has increased the number of environmental regulations that might impact economic growth. In May, TSE will host a 2-day workshop to advance our understanding and quantify the impact of environmental regulation on firms' choices and market outcomes. In particular, it will draw on both theoretical and empirical contributions that deal with the impact of climate policy on market structure, firm performance, and innovation.

<http://bit.ly/Env-regulation-workshop-may2018>



Organizers: Stefan Lamp and Giulia Pavan

WHAT'S NEXT

28 sept 2018

TSE
ENERGY & CLIMATE FORUM

AXA FRANCE,
23 AVENUE DE MATIGNON, PARIS
8H30 - 13H30

Inscription sur tse-fr.eu/forum

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