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Energy Research

Intermediate/Annual report from 03.12.2018

Expectation formation in energy markets and its impact on the success of future energy policies

Project Overview

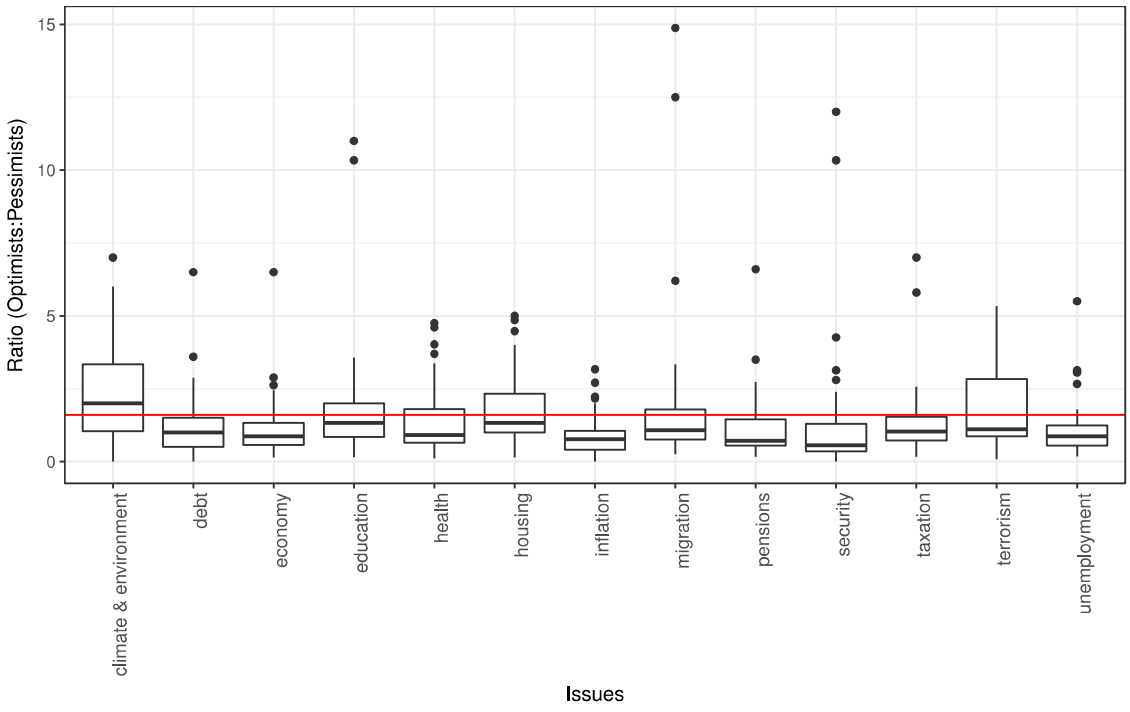

Figure 1: Relationship between environmental awareness and economic expectations in 33 European countries. The plot shows the ratio of number of optimists to number of pessimists for each named issue area

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Summary

The project builds on the hypothesis that current research and policy debates put a too strong emphasis on the historic evolution of economy, technology, and energy systems. As a matter of fact, most of the literature in energy and macroeconomics deals with purely history-dependent equilibria. We argue that the formation of expectations and the coordination of expectations by appropriate policies are crucial for the success of future energy policies. The influence of positive expectations about the economy runs against the above mentioned widespread belief that environmental policies hamper the economic performance. Everything else equal, a less ecological society imposing lower taxes on pollution may perform worse compared to a more ecological society imposing stricter policies if the latter is more optimistic with respect to future economic perspectives and thus more willing to invest (a phenomenon known as self-fulfilling prophecy).

In the past year the first part of the project - focusing on the macro perspective - was made. We use an OLG model with multiple steady states to analyse the impact of endogenous environmental policies on the relevance of history and expectations for the equilibrium selection. In a polluting regime environmental preferences cause an increasing energy tax which decreases the total factor productivity and thus raises the risk that the economy transits to the inferior equilibrium under pessimistic expectations. However, higher environmental preferences imply an earlier switch to the clean energy regime. Then, the conflict between production and environmental preferences is resolved and the prospects to select the superior equilibrium improve, since positive expectations become more relevant.

In the second part of the project we want to empirically test the hypothesis that people with environmental preferences are more optimistic about the economic development. We expect that we can use these findings to analyse the steady state dynamics implying that agents with environmental preferences support higher energy taxes and switch faster to clean production. Due to their optimism, the likelihood to reach the superior stable steady state increases. We will in the coming year empirically analyse the change of behaviour connected to expectations about future policies on the micro-level. The idea is to experimentally manipulate expectations about future environmental policies and test the effect on consumption decisions today. Preliminary results show that people who consider the information about policies important would rather change (to a more environmental-friendly choice) on a statistically significant level. The early behaviour change due to expectations can be described as a (different) self-fulfilling prophecy phenomenon: if consumers expect a policy target to be achieved in future and thus related policy measurements, their early change of behaviour to be policy target-compatible contributes to the achievement of the policy-target without any measurement implemented yet.

Zusammenfassung

Das Projekt untersucht die Hypothese, dass die aktuelle Forschung die historische Entwicklung der Ökonomie, Technologie und Energiesystemen zu stark gewichtet. Tatsächlich verwendet die gängige Literatur der Energie- und Makroökonomie hauptsächlich vergangenheitsbasierte Gleichgewichtsmodelle. Wir argumentieren hingegen, dass die Erwartungen bezüglich zukünftiger Politiken einen bedeutenden Anteil am Erfolg der tatsächlich implementierten Energiepolitiken haben. Die positiven Erwartungen führen dazu, dass der allgemein beschriebene negative Effekt von Umweltpolitiken auf die wirtschaftliche Entwicklung aufgehoben werden kann. Unter sonst gleichen Voraussetzungen, kann die wirtschaftlichen Entwicklung mit laschen Umweltpolitiken in einer pessimistischen Gesellschaft schlechter ausfallen, als in einer positiven Gesellschaft, die trotz strikten Umweltpolitiken mehr Investitionen tätigt (ein Phänomen bekannt als selbsterfüllende Prophezeiung).

Im vergangenen Jahr wurde der erste Projektteil – mit Fokus auf die Makroperspektive – durchgeführt. Wir verwenden ein OLG Modell mit multiplen Gleichgewichten, um den Einfluss der Erwartungen auf die Realisation des Gleichgewichts zu analysieren. Je grösser die Umweltbelastungen im Ausgangspunkt und je stärker die Gewichtung einer intakten Umwelt in der Gesellschaft, desto höher die implementierte Umweltsteuer. Diese wiederum erhöht das Risiko in einem inferioren Gleichgewicht zu landen. Eine höhere Gewichtung der intakten Umwelt führt jedoch zu einem rascheren Wechsel hin zu sauberen Produktionstechnologien. In diesem Fall wird der Konflikt zwischen Produktion und Umweltverschmutzung gelöst und die Wahrscheinlichkeit in einem superioren Gleichgewicht zu enden steigt.

Im zweiten Teil des Projekts soll die Hypothese, dass ein positiver Zusammenhang zwischen der Gewichtung von Umweltanliegen und der Einschätzung der ökonomischen Entwicklung besteht getestet werden. Wir erwarten, dass wir diese Resultate verwenden können, um die Dynamiken im und um ein Gleichgewicht zu analysieren und erwarten, dass Agenten mit einer höheren Präferenz für eine intakte Umwelt die Einführung höherer Umweltsteuern unterstützen und rascher zu sauberen Produktionstechnologien wechseln. Aufgrund ihres Optimismus steigt die Wahrscheinlichkeit in ein superiores Gleichgewicht zu gelangen. Im kommenden Jahr werden wir empirisch untersuchen, wie sich das Verhalten einzelner Akteure verändert, wenn die Erwartungen um zukünftige Umweltpolitiken ändern. In einem Experiment werden die Erwartungen manipuliert und wir testen den Einfluss auf das aktuelle Konsumverhalten. Erste Resultate weisen darauf hin, dass die Akteure, die Informationen über Umweltpolitiken als wichtig beschreiben, eher bereit sind, ihren heutigen Konsum - hin zu einem umweltbewusstem Verhalten - anzupassen. Diese vorzeitige Verhaltensänderung - induziert durch die erwartete strikte Umweltpolitik – kann als eine weitere Art der selbsterfüllenden Prophezeiung beschrieben werden. Wenn die Konsumenten nämlich erwarten, dass ein Umweltziel erreicht werden soll und die damit verbundenen Politiken antizipieren, kann dies dazu führen, dass sie vorzeitig ihr Verhalten anpassen.

Contents

List of abbreviations

ICE	Internal Combustion Engine
OLG	Overlapping Generations Model
SFOE	Swiss Federal Office of Energy
SHEDS	Swiss Household Energy Demand Survey
TFP	Total Factor Productivity

1 Introduction

Current research and policy debates put a too strong emphasis on the historic evolution of economy, technology, and energy systems. As a matter of fact, most of the literature in energy and macroeconomics deals with purely history-dependent equilibria: given the initial conditions (e.g. for capital and knowledge stocks), market participants optimize over a certain time horizon determining unique paths for future consumption, energy use, and investments (Acemoglu et al. 2012). Policy can modify the market equilibrium by changing restrictions and relative prices but there is no specific role for expectations. We argue that the formation of expectations and the coordination of expectations by appropriate policies are crucial for the success of future energy policies. If expectations for a regime switch are favourable we expect positive momentum effects and speeding moments reducing the costs of energy policy substantially. In this project we thus seek to shed light on the question, whether and how appropriate policy can help avoiding unfavourable income effects during the energy transition.

2 Context

2.1 Background

Starting with the seminal paper of Krugman (1991) there are a few contributions, which distinguish between history and expectations as the determinants of an equilibrium selection process. This has an important effect on policy. If past development ("history") determines the transition to a long-run equilibrium, a shift to a new steady state requires significant and potentially expensive policy interventions, which might be hard to get approved by the political process. But if the equilibrium is determined by "expectations" of a cleaner future production, policy has only to be active in an initial phase. After that, induced investments may create major network, momentum, and scale effects. Hence, expectation-driven equilibria can support initial policy and lower the costs of the transformation of energy systems significantly.

2.2 Goals

The project builds on the theoretical foundation of Bretschger and Schäfer (2017), which develops a multiple steady-state framework with economic policy affecting the relevance of expectations against history for the equilibrium selection process. While the paper provides a general analytic foundation the project aims at a thorough understanding of the detailed process of expectation formation in the current Swiss energy context. Specifically, we want to find out in concrete terms when and why market participants expect a new technology or a new energy system to be successful. Moreover, we seek to derive how exactly specific policies affect the coordination of expectation in a market and thus the interplay between history and expectations. To provide answers to these research questions we expand and adapt the theory, gather relevant data (existing and additional) and integrate the information into a quantitative setup.

3 Research Projects

3.1 Overview of the work performed during the past year

Project 1: Macro perspective: How do green preferences affect the economic performance and a regime switch, if expectations and history matter?

- DGE model where history and expectations matter
- Empirical analysis: relationship between economic optimism and green preferences
- Self-fulfilling prophecy with respect to steady state achievement

Project 2: Micro perspective: How does consumer behavior change if expectations matter?

- In macroeconomic models agents' expectations influence capital accumulation of firms
- Now: agents are consumers and choose between different products. The announcement of policy changes alters their choice
- Self-fulfilling prophecy with respect to policy target achievement

3.2 Detail Concepts for Projects 1 and 2

Project 1: The impact of green preferences on the relevance of history versus expectations
Authors: Andreas Schäfer & Anna Stünzi

Idea:

- In the absence of technological alternatives, societies with higher ecological preferences support stricter measures to protect the environment. Although this trade-off between pollution and production may be solved in a welfare-maximizing manner, the economic performance in such societies may be constrained by stronger regulations and higher taxes.
- This view is contrasted by our findings that individuals caring a lot about the environment tend to have more optimistic expectations about future economic perspectives. Such influence of positive expectations about the economy runs against the above-mentioned widespread belief that environmental policies hamper the economic performance. Everything else equal, a less ecological society imposing lower taxes on pollution may perform worse compared to a more ecological society imposing higher taxes if the latter is more optimistic with respect to future economic perspectives and thus more willing to invest (a phenomenon known as "self-fulfilling prophecy").
- Conceptually, this argument underlines the necessity to analyse the joint interaction between environmental policies and the relevance of expectations for the future economic performance, a feature that has been largely ignored by the existing literature on climate change and the energy transition.

Approach:

- Extend existing model (Bretschger & Schäfer, 2017) with endogenous policies and regime shift
- Use results from an empirical data analysis to discuss steady state dynamics

Data: Selects, pre-election survey 2015 (panel, wave 1), Switzerland

Status:

- Presented at IWECCS 2018 (Bologna), SURED 2018 (Ascona), WCERE 2018 (Gothenburg) as well as in internal seminars at the University of Bath, ETH Zurich, and the University of Göttingen
- Submitted to Environment and Development Economics in August 2018

Project 2: Is there a role for self-fulfilling prophecies when announcing environmental policies addressing consumers?
Author: Anna Stünzi

Idea:

- Expectations usually integrated on the market side -> expectations shape investment decisions
- Managing expectations usually known as policy instrument from central banks/monetary policy
- However, also consumers are informed actors and include expectations about future policies
- The announcement of policies might induce change of behavior

Approach:

- Experimentally test consumer choice behavior depending on different policy announcements
- Treatment: inform about policies worldwide that aim to increase the share of electric vehicles. The policy catalogue includes instruments that affect the consumers directly (such as fossil-fuel vehicle ban in city centers or restrictive number plate use). Inform that the Swiss government wants to achieve a target by 2023.
    - Treatment 1: inform that government has not decided yet which instruments are going to be implemented to achieve the target
    - Treatment 2: inform that the government has already decided to use instrument directly targeting the consumers from 2020 onwards

Data: SHEDS 2018

Status: Preliminary results from SHEDS 2018, Switzerland

3.3 Timeline

	Content Elaboration	**Peer review**	**Submission**	**Publication**
Project 1	Nov 17 – March 18	March 18 – July 18	August 18 (Journal: Environment and Development Economics)	
Project 2	June 18 – Dec 18 (potentially a second round of data gathering with SHEDS 2019)	Jan 19 – July 19		

Table 1: Timeline for two projects

4 Results

4.1 Project 1

(1) How do green preferences affect the economic performance, if expectations and history matter?

- Higher environmental preferences increase tau and reduce TFP
- Lower TFP reduces the prospects to transit to a superior steady state
- "Irrelevance of optimistic expectations"

(2) How do green preferences and optimistic expectations affect a regime switch from dirty to clean production?

- Green preferences induce an earlier regime switch
- No conflict between preferences and technology! TFP is constant
- Empirical analysis allows for some optimism: the relation between green preferences and positive expectations makes the transition to the superior equilibrium more likely

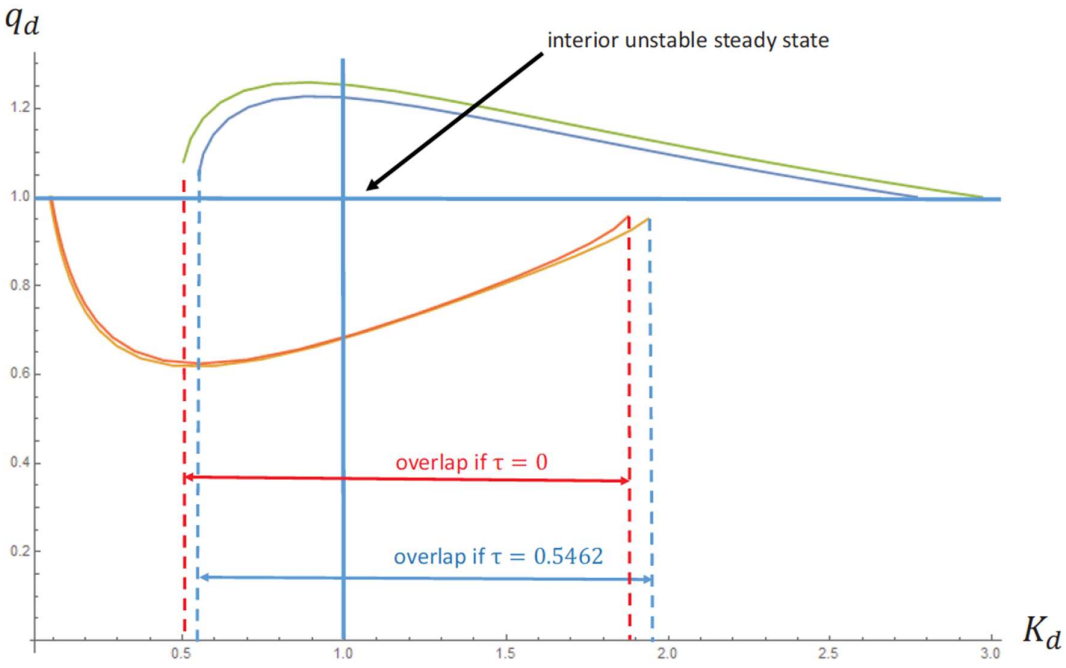

Figure 2: Equilibrium trajectories to the superior/inferior steady state for different energy taxes (_ = 0 and _ = 0:5462). The interior unstable equilibrium has been normalized to 1.

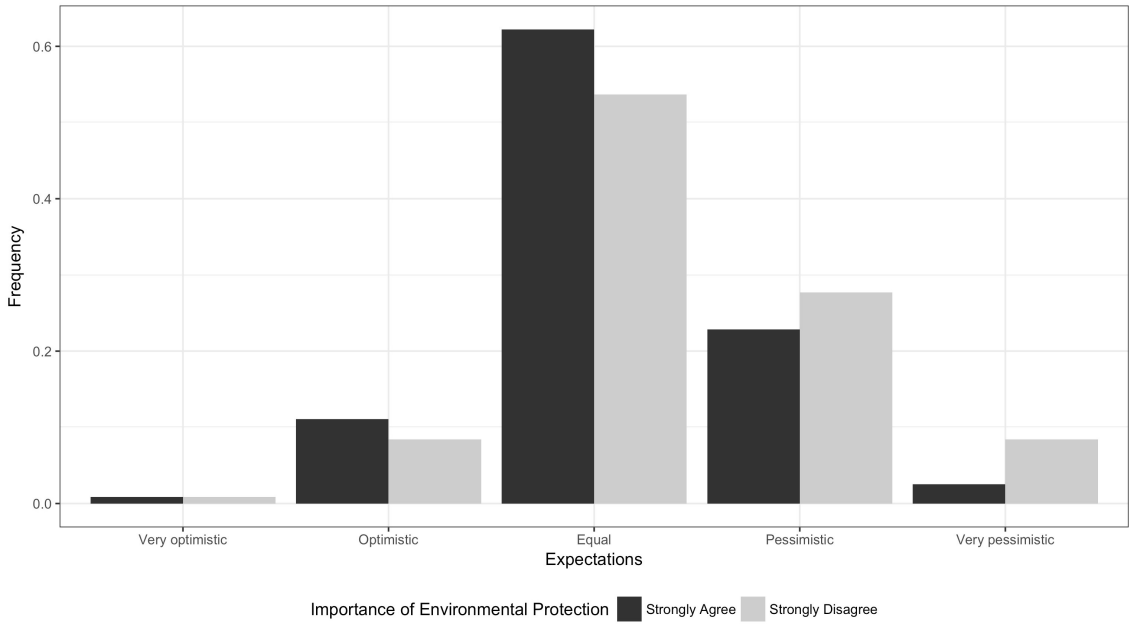

Figure 3: Relationship between attitudes on environmental protection and economic expectations.

	Decrease in positive economic expectations:		
	(1)	(2)	(3)
Disagreement to environmental protection	0.088*** (0.021)	0.077*** (0.023)	0.077*** (0.023)
Sex	✓	✓	✓
Age	✓	✓	✓
Household income group	✓	✓	✓
Education level	✓	✓	✓
Canton	✓	✓	✓
Most important problem (summarised to 9 problem areas)		✓	✓
Party choice (out of main 7 parties)		✓	✓
Preferred political party is going to win			✓
AIC	21'178.59	20'291.56	20'285.91
Observations	10,891	10'507	10'507
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 2: Multinomial ordinal logit regression. The coefficient indicating that a participant disagrees to more environmental protection (compared to the baseline of strong agreement) signi_cantly increases the log odds of choosing a more pessimistic answer option regarding expectations about economic development.

4.2 Project 2 (preliminary results)

- Participants with treatments are more likely to not choose an ICE, given they say that the information was important
- Participants who originally said, that they would not buy an electric car, are more likely to switch and buy an electric car when they had treatment 2

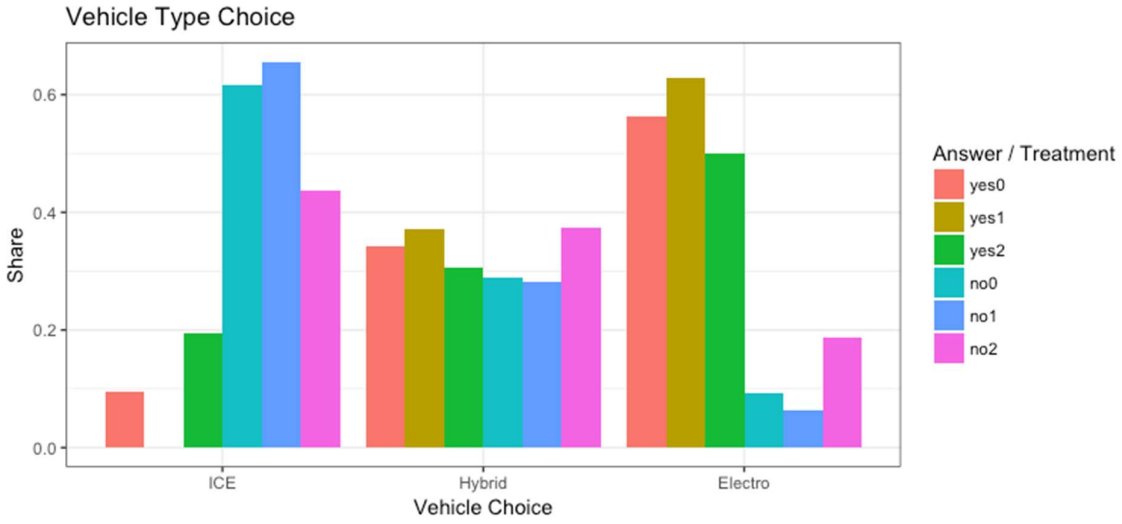

Figure 4: Share of vehicle choice depending on treatment (0, 1, or 2) and whether participants said that they would consider to buy an electric car (before the treatment)

5 Discussion of results

5.1 Project 1

We have shown that a switch from dirty to clean production depends on the productivity of both technologies, on the level of pollution and on the preferences of the households for environmental quality. With an endogenous energy tax, the size of the overlap is time varying. An early increase in the tax (due to strong environmental preferences) decreases the factor productivity gap between the two technologies. A switch to clean production occurs earlier and decreases the trade-off between environmental preferences and total factor productivity. Thus, higher preferences for the protection of the environment imply an earlier switch to the clean energy regime. In this regime, the conflict between production and environmental preferences is not only resolved, but the prospects to select the superior equilibrium have increased, since this regime gives more space to expectations compared to history, given that the productivity of the clean technology is sufficiently high. In an empirical data analysis from a large election survey in Switzerland we find that people with strong environmental preferences are more likely to also have more optimistic expectations about the economic development. The observation of a relationship between pro-environmental attitudes and optimistic expectations (and vice versa) implies that a) if societies with higher ecological concerns tend to implement higher energy taxes, the overlap region where optimistic expectations are supportive for the selection of the superior equilibrium is reduced and increased in a region where pessimistic expectations are influential. Nevertheless, their high degree of optimism may prevent these economies to converge to the inferior steady state. b) If societies with higher ecological concerns assume an earlier regime switch, their high degree of optimism likely drives a transition to the superior steady state.
These findings have important implications for the steady state analysis of our model: in a policy scenario without switching possibilities, the likelihood to reach the inferior stable steady state is low,

due to the generally optimistic expectations (despite that the area where positive expectations matter becomes smaller). For societies with strong environmental preferences the switch to a clean production happens faster, because they will support higher energy taxes, which makes an early switch more attractive. Thanks to their optimistic expectations the likelihood to reach the superior steady state increases.

5.2 Project 2

The results are only preliminary and the analysis of the first empirical results is work to be done.

6 Evaluation of 2018 and outlook for 2019

The journal submission of a paper (project 1) indicates that we moved forward quickly. Both, the content elaboration as well as the peer review process at conferences went very smooth. The results from the SHEDS experiment (project 2) are also quite promising. We aim to place a second experiment with a similar focus on policy expectations in the next SHEDS wave in 2019. Discussions with the SHEDS team are ongoing.

The results of the first part of the project and the start of the second part of the project indicate the potential of self-fulfilling prophecies for the energy transition. While project 1 analyses the effect of (positive) expectations on the aggregate economy, project 2 will in a next step test whether expectations can be shaped on a micro-level and how they then change the behavior of individuals. The first impression is that they imply that policy announcements can significantly influence buying decisions of customers. As such the announcements can profit of a self-fulfilling policy phenomenon: if customers change their behavior in expectance of a policy to achieve a target, the actual policy measure may not have to be implemented at all or at a lower cost; since a substantial share of customers has already changed behavior and thus contributed to the achievement of the target.

The idea is then – in a third part – to include the learnings of the first and the second part into a suitable model approach to answer the question of how governmental action affects and alleviates the coordination of investors' expectations when it comes to the implementation of new energy technologies. The set-up can be started with, when the results from the second part have been tested and verified. We expect this to be in the beginning of 2019.

7 Publications [within the project]

No paper has been published yet. Working paper for project 1 is in the appendix.

8 References

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9 Appendix

9.1 Appendix 1: Working Paper Project 1