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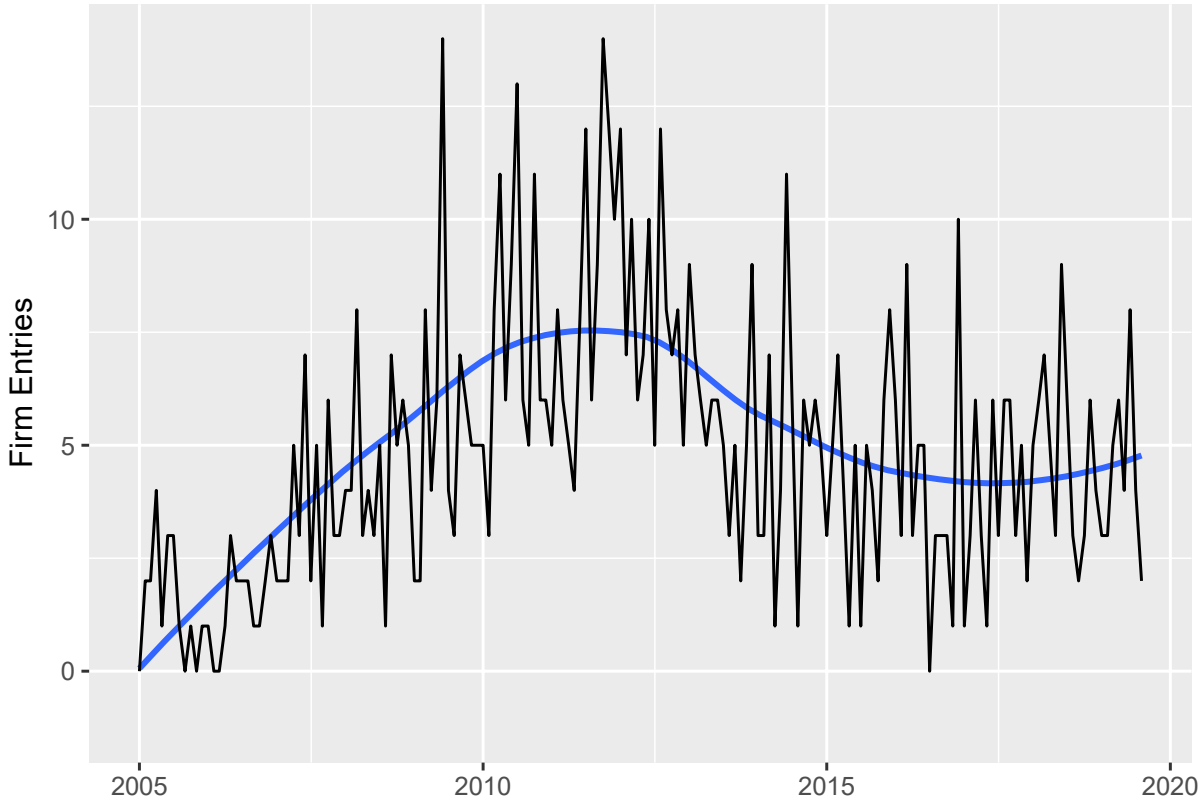
Interim report dated 15 11 2019

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



Source: Author's calculations. Number of firm entries in the solar energy business. Data. SHAB Switzerland

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Zusammenfassung

Das Projekt zielt auf ein tieferes Verständnis des Erwartungsbildung-Prozesses ab im aktuellen Schweizer Energiekontext. Dazu erweitern und adaptieren wir die bestehende Theorie, sammeln relevante Daten und integrieren diese Informationen in einem quantitativen Modell. Im Laufe des zweiten Projektjahres haben wir eine Publikation veröffentlicht, in welcher wir theoretische und empirische Erkenntnisse über die Rolle von Erwartungen mit endogener Politikgestaltung kombinierten. Darüber hinaus haben wir die Ergebnisse von zwei Experimenten der Schweizerischen Haushalt- und Energiebedarfserhebung (SHEDS) analysiert, bei denen wir die Manipulation von Erwartungen auf der Ebene der Einzelpersonen testen. Wir haben zudem damit begonnen, Erwartungen auf der Ebene einzelner Unternehmen zu analysieren, um diese Erkenntnisse zu nutzen für die Modellierung der Transition von einer fossilen zur grünen Produktionsweise. Schließlich haben wir begonnen, die Rolle von Erwartungen in das CITE-Modell zu integrieren, um die direkten Auswirkungen energiepolitischer Massnahmen auf die Schweizer Wirtschaft zu untersuchen.

Résumé

Le projet vise à mieux comprendre le processus de formation des perspectives économiques dans le secteur actuel de l'énergie en Suisse. Pour ce faire, nous élargissons et adaptons la théorie existante, recueillons les données pertinentes et nous intégrons ces informations dans un modèle quantitatif. Au cours de la deuxième année du projet, nous avons publié un article dans lequel nous combinons des résultats théoriques et empiriques sur le rôle des perspectives économiques et de l'élaboration de politiques publiques émergentes de ces perspectives. En outre, nous avons analysé les résultats de deux expériences de l'Enquête Suisse sur les ménages et la demande d'énergie (SHEDS), dans lesquelles nous testons la manipulation des perspectives au niveau individuel. Nous avons également commencé à analyser la formation des perspectives économiques au niveau des entreprises afin d'utiliser nos résultats pour modéliser la transition d'une production utilisant les énergies fossiles, vers une production dite "verte". Enfin, nous espérons intégrer le rôle de ces perspectives économiques dans le modèle CITE pour examiner l'impact direct des politiques énergétiques sur l'économie Suisse.

Summary

The project aims at a thorough understanding of the detailed process of expectation formation in the current Swiss energy context. To provide answers we expand and adapt the theory, gather relevant data (existing and additional) and integrate the information into a quantitative setup. Throughout this second year of the project we have published on paper, combining theory and empirical findings on the role of expectations with endogenous policy-making. We have furthermore analysed the results from two experiments in the Swiss Household and Energy Demand Survey (SHEDS) where we test expectations on the level of individuals. We have also started working on analysing expectations on the firm-level, aiming to use these insights for modelling the transition from dirty to green production. An finally, we have started to integrate the role of expectations in the CITE model in order to study the effects of the direct implementation of energy policies on the Swiss economy.

Contents

Abbreviations

QOL	Quality of Life
SHAB	Schweizer Handelsblatt
SHEDS	Swiss Household Energy Demand Survey

1 Introduction

1.1 Background information and current situation

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. Based on Krugman (1991) 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.

1.2 Purpose of the project

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.

1.3 Objectives

The project aims to answer the following research questions:

1) How do realistic energy policies affect the interplay between history and expectations?

2) What are the differences between taxes and subsidies in this context?

3) How can the government coordinate expectations?

4) How do the costs of energy policies change with expectations?

5) What are the specific issues and results for the Swiss economy and policy?

The milestones are:

(1) Development of a holistic theoretical model framing the role for expectations in a dynamic macroeconomic context.

(2) Implementation of a government into the set-up developed in 1) which is able to align and coordinate expectations.

(3) Empirical research on the impact of expectations and attitudes on consumer and firm behaviour.

(4) Implementation of results into a large-scale dynamic computable general equilibrium model calibrated for the Swiss economy with the aim to simulate policy experiments.

2 Description of facility

Not applicable

3 Procedures and methodology

The research questions are answered along different sub-projects. The aim is to develop the theory, discuss it along empirical findings and finally use these insights for the dynamic CGE model to illustrate the Swiss case.

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 with endogenous policy-making based on green preferences of households
- Empirical analysis: relationship between economic optimism and green preferences; Data from Selects, Switzerland

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 durable consumer goods. The announcement of policy changes alters their choice
- Experiment: analysis of behavior change in light of early policy information; Data from Swiss Household Energy Demand Survey (SHEDS) 2018 and 2019
- 3 different sub-analyses; two with focus mobility, one with focus buildings

Project 3: Optimistic expectations and firm entries: modeling the energy transition on the micro-level

- The existing papers and attempts model a switch from a dirty to a green regime. Now: 1) model a transition where both sectors (green and dirty) can be active. 2) include signalling from the government to coordinate transition via expectations
- DGE model as in Project 1
- Empirical analysis: impact of government signalling (future policies) on the number of firm entries; Data from SHAB Switzerland

Project 4: Integrating previously presented insights into the Computable Induced Technical change and Energy (CITE)

- Extension of the CITE (Dynamic CGE) model and scenario analysis

4 Activities and results

4.1 Project 1: The impact of green preferences on the relevance of history versus expectations

Authors: Andreas Schaefer and Anna Stünzi

For details see annual report 2017.

Status: Paper is now published in *Environment and Development Economics*.

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

4.2.1 Project 2.1: Smart policy-making to reduce stranded assets for individuals the potential of long-term policy announcements

Author: Anna Stünzi

For details see annual report 2017.

Status: Paper presented at conferences in St Petersburg, Beijing and Manchester. Working paper version is available on request.

4.2.2 Project 2.2: "What are the factors and needs promoting Mobility-as-a-Service? Findings from the Swiss Household Energy Demand Survey (SHEDS)"

Authors: Raphael Hörler, Anna Stünzi et al. Lead author is Raphael Hörler (ZHAW)

Approach: using the same data from SHEDS 2018 as in 2.1 (see annual report 2017) to analyse the willingness to use Mobility-as-a-Service (MaaS) solutions.

Results: informing people about future policies (as in 2.1) significantly increases the likelihood to try MaaS services.

Status: under review at *European Transport Research Review*.

4.2.3 Project 2.3: The willingness to do renovations and sufficiency measures in tenants and owners and the expected change in Quality of Life (QOL)

Authors: Anna Stünzi and Iljana Schubert

Approach: The aim of this project is to analyse how expectations about potential political measurements in future in the housing/building area change decision-making of individuals today, how this affects their perceived quality of life and whether they would accept alternative behavioral measurements (sufficiency) to "adapt" to those future potential policies.

To do so we set up an experiment in the new wave of SHEDS 2019. With two separated tracks for tenants and owners we asked about their willingness to renovate (owners) / acceptance of a renovation (tenants) in near future and the accepted rent increase in the latter case. We informed two treatment groups about future policies with respect to buildings (either extension of the building program or replacement with strict standards) and test a) whether the informed participants want to change their opinion in light of this additional information and b) the general preference for these policies compared to the control group. We then also ask participants if they would change their (daily) behavior (such as temperature of washing machine, reducing short-term flights) instead or in addition

to the retrofitting measures and we ask them about the perceived change in quality of life for all of such changes. Finally we let them allocate the expected savings thanks to the retrofitting and behavioral changes (lower energy bills) to different spending options (savings, trips, food, etc.) in order to estimate the indirect rebound effect of the energy savings.

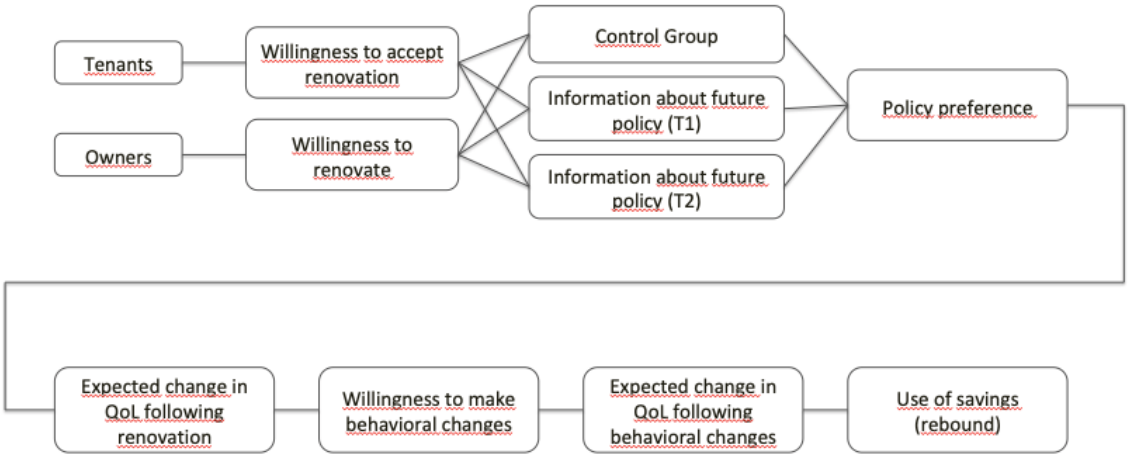

Figure 1: Experimental Setup

Results: The results are still preliminary and to be verified. We found that, in general, people are positive towards having renovations done. Tenants are more likely to say that they agree to have a renovation and also agree to pay a higher rent, even more than the expected savings. In particular, more than 90% of the tenants said that they would accept a renovation in the near future. More than 50% of the tenants also said that they would accept rent increases exceeding the provisional 40 CHF savings in energy bills every month.

With respect to the acceptance of policies, the expansion of the building programme is generally preferred to strict building standards. This pattern is mostly driven by the preferences of the owners, who strongly prefer the buildings programme.

Status: poster presentation at CREST conference 2019

4.3 Project 3: Optimistic Expectations and Firm Entries: Modeling the Energy Transition on the Micro-Level

Authors: Andreas Schaefer and Anna Stünzi

Approach: In this paper we model the transition from a fossil (dirty) to a green (clean) regime based on firms' decision to adopt green technologies. We build on seminal contributions to the literature on appropriate technologies (e.g. Atkinson and Stieglitz, 1969; Acemoglu and Zilibotti, 2001) to allow for the coexistence of green and polluting technologies. Higher market entry of green energy providers increases the share of adopted green technologies in the economy. Related to the entry decisions of green or dirty energy service providers, we analyse how expectations can be shaped via credible signaling of the government. Based on these theoretical considerations we seek to empirically analyse the relevance of the effect of governmental policy announcements on the number of firm entries in the area of green energy services: we test whether credible government announcements actually influence the number of firm entries. To do so, we use a new dataset that is manually retrieved from

the Swiss commercial register and analyse the number of firm entries (thus new firm registrations) related to clean energy services. In addition to that, we identify key decisions in the Swiss parliament with respect to the support of green energy use and test whether the number of firm registration changes following such major decisions. For the analysis we proceed somewhat similarly to an event study analysis, a method being used to test the impact of specific events or announcements on the stock market value of companies. In our case we look at the impact of a specific parliamentary decision on the number of firm entries.

Results: Overall the model yields three interesting insights with respect to the change of the ratio between green and fossil-based intermediate producers: first, the number of green energy service providers increases relative to polluting providers, more firms switch from polluting to green energy. Second, this ratio is sensitive to economic policy. Finally, and in view of Bretschger and Schaefer (2017) and Schaefer and Stünzi (2019), an increase in the ratio of clean energy providers increases the role of expectations relative to history in the economy.

On the empirical side we have some preliminary (yet to be confirmed) results. We can show that there is no linear trend and considerable seasonal variation. Overall, there was a substantial increase from 2005 until 2012, a decrease between 2012 and 2015 and a stabilization since 2015. Thus, despite the price of photovoltaic modules decreased steadily from 2005 until 2017, the number of new firms in that sector stalled in 2012. The trend for new firms in the green energy sector also differs from the general firm entry trend in Switzerland (Statista, 2019). Controlling for all these factors we find a significant relationship between future policy announcements in the early years and firm entries.

Status: presented at SAEE workshop 2019 in Zurich, submitted for NBER conference in Cambridge, Massachusetts, 2020

4.4 Project 4: CGE model

Authors: Alena Miftakhova and Clément Renoir

Approach: We use the dynamic computable general equilibrium model CITE to study the effects of the direct implementation of energy policies on the Swiss economy. The goals for these policies will derive from the conclusions of the projects presented above. Our theoretical approach—for example, a “switch” from “dirty” to “clean” energy—corresponds to gradually forcing fossil fuels out of the economy via public policies. The examined policies will be aligned with those announced by the Swiss government (i.e., CO2 neutrality by 2050) and correspond to the time horizon specified for these policies.

The literature suggests that carbon pricing policies prove more effective when complemented by direct R&D investments—the latter facilitates sectoral growth and thereby alleviate the effects on welfare (Bretschger et al., 2011; Bretschger and Schaefer, 2017). Our study will explore this mechanism for the Swiss economy in light of the abovementioned policies. It will compare the implications of the conventional lump-sum redistribution of the tax revenues, to the reinvestment of these revenues into the economic growth.

Moreover, inefficiencies may arise in the Swiss economy because in a liberal economy with monopoly markups, producers under-use capital inputs (machines). As a part of an energy policy, subsidies to capital inputs given to producers in “clean” sectors, by reducing the markup of these sectors, would also increase the growth rate and the share of clean energy use compared to fossil fuels.

Following the theoretical framework outlined above, we consider the present value of an additional unit of capital as a proxy for expectations. In a regular (optimization) formulation, this value would refer to the shadow price of capital. The way CITE is formulated—as a mixed complementarity problem—

includes the price for capital explicitly and thus gives us an opportunity to track and influence this variable. Given the size and complexity of the model, tracking the transition paths to equilibria step-wise à la Bretschger and Schaefer (2017) and Schaefer and Stünzi (2019) indeed deems challenging. As a first step, we therefore take a reverse approach and explore how various energy policies influence capital price—and thereby the expectations—in the economy.

The results of the study, first of all, will include the effects of the energy policies on: welfare, overall and sectoral growth, and income distribution, for various choices of policy instruments. The analysis will suggest the attributes of the optimal policy that would minimize the induced welfare loss for consumers and the growth slowdown for the economy.

Method: Scenario analysis.

Status: various experiments are being conducted, with the first indications of policies' impacts. For example, with the current calibration of CITE, cutting the emissions from the "dirty" energy by 80%—from their 2010 level—by 2050 is expected to cost the economy 6% of the welfare.

5 Evaluation of results to date

The (provisional) empirical analyses indicate that both, consumers and firms actively take into account signals from the government with respect to future policies. This calls for an active role of the government in shaping such expectations. Thanks to early information, individuals and firms can adjust their decision-making process and thereby save costs. From theory we can see then that on the macro-level such signalling induces positive expectations increasing the likelihood to achieve a superior equilibrium path.

The publication of the paper from the first sub-project and the broad acceptance and good feedback of the sub-projects 2 and 3 at the conferences indicate that we address an important topic with a plausible approach.

Thanks to using data from a representative survey in Switzerland (sub-project 1) and setting up our own experiment (in sub-project 2) we can control for a lot of socioeconomic variables and external factors, making the analyses more robust. The empirical method from sub-project 3 is new and has to be tested for robustness first. If the results hold, the method and data collection might be useful for multiple other analyses addressing expectations of small companies not listed at the stock markets (where expectations can be estimated from the asset prices).

The combination of theoretical modelling and empirical analyses (projects 1 and 3) allows us to discuss the macroeconomic implications with a more realistic perspective. The challenge is now to include these findings in the quantitative modelling approach with CITE.

6 Next steps

P1: finalised

P2.1 / P2.2: close to be finalised

- main paper: working paper, ready for submission until end of 2019
- second paper: submitted

P2.3: data analysis ongoing; first raw draft until spring 2020

P3: ongoing

- work on model
- detailed data analysis
- first raw draft until spring 2020

P4: started

- first insights in spring 2020

7 National and international cooperation

Not applicable

8 Communication

Not applicable

9 Publications

Schaefer, A and Stünzi, A (2019). The impact of green preferences on the relevance of history versus expectations. Environment and Development Economics.

10 References

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11 Appendices

Not applicable