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Citizenship: Chinese

Fields of Concentration: Environmental Economics, Applied Microeconomics

Desired Teaching: Environmental Economics, Econometrics

Dissertation Title: *Climate Policy: Firm-Level Impacts in China*

Education:
PhD in Economics, University of Gothenburg, Sweden, 2016 – June 2021 (expected)
Supervisors: Professor Thomas Sterner, Professor Aico van Vuuren, and Assistant Professor Inge van den Bijgaart

Visiting Scholar, Institute of Energy, Environment and Economy, Tsinghua University, China, 2019-2020, Host: Professor Xiliang Zhang and Assistant Professor Da Zhang

M.S. in Management Science and Engineering (*Best MSc dissertation*), China University of Petroleum (Beijing) (CUPB), China, 2014-2016

B.A. in Economics, Jilin University, China, 2011-2014
B.S. in Information Management and Information System, Jilin University, China, 2010-2014

Publications *(Before PhD Studies)*:
"Study on the Promotion of Natural Gas-Fired Electricity with Energy Market Reform in China Using a Dynamic Game-Theoretic Model", with Qi Zhang et al., *Applied Energy*. 2017, *185*, 1832-1839.

Working Papers:
"Emissions Trading Schemes and Directed Technological Change: Evidence from China" **[*Job Market Paper*]** (submitted)

"Heterogeneous Responses to Carbon Pricing: Firm-level Evidence from Beijing Emissions Trading Scheme", with Da Zhang, Xiliang Zhang and Thomas Sterner

"The Weakest Link: Assessing the Supply Chain Effect of Natural Disasters", with Katharina Längle and Ankai Xu

Work in Progress:

"Environmental Regulation, Trade and Innovation"

"Environmental Regulation and the Geography of Green Innovation", with Ankai Xu

Teaching Experience:

Teaching Assistant, Econometrics (Undergraduate), 2017-2021
Teaching Assistant, Econometrics (Graduate level), 2019-2020
Teaching Assistant, Mathematics (Graduate level), 2019-2020
Thesis Advisor of Bachelor Students (Undergraduate level), 2020-2021

Honors and Awards:

OSHER Ph.D. Student Fellowship 2020
Outstanding Graduates of Beijing, Beijing Municipal Education Commission, 2016
Best MSc Dissertation Prize, CUPB, 2016
ENN Energy Scholarship, ENN Energy, 2015
Outstanding Students Scholarship, CUPB, 2014
Academic Scholarship, CUPB, 2014
Jilin University Scholarship, Jilin University, 2011-2013

Research Grants:

Jan Wallanders och Tom Hedelius Stiftelse 2020/2021, 182 000 SEK, 2020
Adlerbertska Stipendiestiftelsen Travel Grant, 2019
Donationsnämnden Travel Grant, 2018

Technical Skills:

Proficiency: LaTex, Python, Stata, SQL
Familiarity: ArcGIS, GAMS, R

Presentations:

VU Eureka Seminar, VU Amsterdam, 2020
Environmental Economics Research Seminar, Helsinki GSE, 2020
Brown Bag Seminar, Stockholm University, 2020
AERE Virtual Conference, 2020
EAERE-ETH European Winter School, 2020
The 3rd NAERE Workshop, 2019
The 26th Ulvön Conference, 2019
The 24th Annual Conference of the EAERE, 2019

EEU Seminar, University of Gothenburg, 2018-2020
Labour/Applied Micro Seminar, University of Gothenburg, 2018-2020
PhD Conference, University of Gothenburg, 2018-2019
The 7th International Conference on Applied Energy, 2015

Other Professional Activities:
Refereeing: Energy Journal, Economics Bulletin
Co-organizer of PhD Student Workshop, University of Gothenburg, 2019
Research Assistant, Policy Research Unit, Aviation Industry Corporation of China Poly-Technology Establishment (AVIC), Beijing, 2015
Energy Analyst Intern, S&P Global Platts, Singapore, 2015

Languages: Chinese (native), English (fluent), Swedish (basic)

References:

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Dissertation Abstract:

The dissertation is comprised of several papers that study the firm-level impact of climate policy in China. China contributes to over a quarter of global carbon emissions (Le Quéré et al., 2017), which makes it the largest contributor to such emissions. Over the past decade, China has aimed to reduce its emissions, with its ambitious pilot Emissions Trading Scheme (ETS) as the foremost policy initiative. The first two dissertation chapters assess the impacts of the pilot ETS on technical change and emissions reduction. The third chapter puts the emphasis on green technology and studies how the foreign demand for renewable technology has affected the development of green technology in China.

The *job market paper*, "**Emissions Trading Schemes and Directed Technological Change: Evidence from China**", studies the effect of carbon emissions trading scheme (ETS) on 'green' technological change, as measured by the number of green patents. The empirical identification of the ETS effect on innovation is based on a differences-in-differences estimation, using a count data model. The sources of variation are the years of implementation of the pilot ETS in different pilot

regions with both regulated (i.e. treated) firms and non-regulated (i.e. control) firms in each region. Ideally, one would either compare firms that are identical in all aspects except for treatment status (being regulated or not), or exploit a random assignment of the treatment to firms. However, in the Chinese pilot ETS, only firms with yearly carbon emissions above a certain threshold are regulated. Hence, estimates from simply comparing the patent counts between treatment and control before and after the implementation of the regulation would be biased. I address this challenge by matching regulated firms with non-regulated firms on a vector of pre-treatment variables, such that firms in the two groups are balanced on the observable variables.

I estimate the impact of the pilot ETS in China both at the extensive (i.e., entry into green innovation) and intensive (i.e., amount of green innovation) margins. I find that the pilot ETS increased the firm average annual number of green patents by 0.16. This increase amounts to 11.7 percent of the yearly average green patents in the pre-treatment period (2007-2012) and 2.8 percent in the post-treatment period (2013-2017). In addition, I estimate the carbon price elasticity: a 10 percent increase in carbon prices will increase green patents produced by 2.3 percent. The effects are heterogeneous across both pilot regions and firms, with the strongest effects for the two regions that have some of the highest carbon prices (Beijing and Shanghai) and, at the intensive margin, for the relatively larger firms (at the higher end of worker productivity).

These findings provide insight into the effectiveness of the pilot ETS in China. Overall, the regulation seems to be effective in inducing green innovations. However, effectiveness differs across the pilot regions. A potential explanation for this is the regional differences in the policy design, such as the allowance allocation, the coverage threshold, the sectors being regulated and the cost of non-compliance. I show that, on average, the higher the resulting carbon price, the more green innovations are induced by the pilot ETS. This increase in green innovation is primarily driven by intensive margin decisions by regulated firms that already have high output per worker (and therefore higher productivity and/or more capital) and are more competitive initially. Technology entry to green innovation is less likely to be induced for the firms at the higher end of output per worker. The heterogeneity findings indicate that an important policy challenge is to encourage the regulated firms *to start* innovation in green technologies and this is especially important for firms that are larger and more productive.

In the second chapter of my dissertation, "**Heterogeneous Responses to Carbon Pricing: Firm-level Evidence from Beijing Emissions Trading Scheme**" (with Da Zhang, Xiliang Zhang and Thomas Sterner), we focus on the Beijing pilot ETS, and assess whether and how the pilot ETS induces firms to reduce emissions. The Beijing ETS is of particular interest because it is one of the pilots with highest carbon prices. We therefore expect stronger firm responses due to more salient energy price increases in Beijing compared to other pilots in China. This paper exploits a unique firm-level dataset on the population of regulated firms in Beijing from 2009 to 2017. Our identification strategy relies on the specific coverage threshold that determines whether a firm would be regulated. The role of the cutoff here motivates us to use a fuzzy regression discontinuity design (RDD) to identify the causal effect. We rely on a fuzzy RDD, instead of a sharp RDD, as there are some other random determinants on the regulatory status, such as administrative errors. We find that emissions are reduced by 36 percent. However, this result is not significantly different from zero. We then estimate the effects by sectors and find that pilot firms in the industrial sector significantly reduce carbon emissions by 54 percent. A potential explanation for this surprisingly large effect is that the Beijing government also launched the coal phase-out campaign during the same period and the carbon pricing accelerated this process for pilot firms.

Next, we study whether the allocated allowances influence firms' emissions and to what extent. The hypothesis we test is that higher allowances surplus is associated with lower emissions reduction. The allowances surplus is endogenous in that there is a problem of reverse causality: firms' emissions reduction may also affect firms' allowances shortage. To address the issue, we instrument for the shortage of allowances using the past shock to emissions, measured as the difference between the actual emissions and the predicted emissions. The intuition is that a positive shock in the past should increase firms' allowances surplus because allowances are a function of the average emissions between 2009 and 2012. This instrument is exogenous in that there is no serial correlation in the error terms.

My final chapter, "**Environmental Regulation, Trade and Innovation"**, explores the drivers of the innovation surge in renewable energy technology in China from the perspective of international trade. My identification strategy relies on the large variation in feed-in tariffs (FIT) in Europe and the US which induces the incentive change on the deployment and production of renewable energy in the markets. Feed-in tariffs are prices (or price premium) paid for each unit of electricity or heat from renewable energy sold to the electricity grid and offer a guaranteed energy price, typically for more than a decade. I exploit the effect of surging FIT overseas on domestic innovation related to renewable energy in China through the channel of trade. More generous FIT creates incentives for the electricity market to supply more renewable energy, leading to higher demand on renewable-energy equipment. This additional demand has stimulating effects on trade, such that the market with FIT demands more from the domestic market as well as imports renewable-energy equipment from the rest of the world to meet the domestic market's demand.

Bibliography:

Le Quéré, C., R. M. Andrew, P. Friedlingstein, S. Sitch, J. Pongratz, A. C. Manning, J. I. Korsbakken, G. P. Peters, J. G. Canadell, R. B. Jackson, et al. (2017). Global Carbon Budget 2017. *Earth System Science Data Discussions,* 1–79