Research Statement

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I am an applied microeconomist specializing in energy economics. My research applies structural microeconometrics and microeconomic theory to answer questions about efficiency and welfare in the energy sector.

My research agenda consists of two parts. The first is to understand households' adoption choice of distributed renewable technologies, the barriers they face, and the policies that can be implemented to achieve adoption goals more efficiently and equitably. The second lies in mechanism design, where I study how electricity markets should be redesigned to accommodate the uncertainty introduced by renewable energy.

Current Research

My job market paper, titled ″ Who Pays, Who Adopts? Efficiency and Equity of Residential Solar Policy ″, aims to understand how households' preferences and policy design affect the households' solar photovoltaics (PV) adoption behavior and the aggregate welfare effect. I develop a nested discrete choice model that incorporates household heterogeneity in price sensitivity and endogenous capacity decisions, and estimate the model using detailed Dutch administrative data on household characteristics and PV adoption status. With the estimates, I evaluate counterfactual policies and show that (1) households choose significantly different installation capacities depending on policy design, implying the existence of an intensive margin; (2) policies that allow for self-selection based on household type can achieve the same adoption and emissions goals at lower social cost; (3) low-income households benefit disproportionately from immediate-cost-reduction subsidies than production-based incentives; and (4) the way subsidies are financed significantly affect the redistribution. This paper contributes by providing a unified structural analysis of efficiency and equity outcomes in energy subsidy design and proposing incentive-compatible improvements grounded in behavioral heterogeneity.

My second project investigates how growing renewable penetration affects electricity forward and futures pricing. I extend the seminal model of Bessembinder and Lemmon (2002) by incorporating intermittent renewable supply and skewness preferences, and identify two additional components of the electricity forward premium: the covariance between electricity spot prices and renewable generation, and the coskewness between electricity spot prices and renewable generation volatility. I test the new model using data from the German electricity market. The results are consistent with model prediction and show that the asymmetric nature of renewable generation shocks helps explain deviations from forward premium predictions of the old model. This paper helps bridge the gap between historical forward pricing models and markets with high shares of renewables, and provides insights into how risk premia evolve with decarbonization.

My third project examines how electricity market design affects investment in flexible generation capacity during the energy transition. I extend the dynamic investment framework of Joskow and Tirole (2007) by introducing real-time uncertainty and adjustment costs. The model shows that efficient investment requires electricity prices to include a flexibility premium, which compensates for the capital cost of flexible assets such as gas turbines and storage. I find that current reserve market designs, which compensate generators based on opportunity costs, are insufficient to achieve the optimal flexibility investment.

Future Research

There are several unanswered questions arising from my job market paper that I plan to address in future work. The first concerns households' perceptions of the future benefits of residential solar PV. In my job market paper, I simplified expectations by assuming a naive and optimistic belief. However, solar adoption involves high upfront costs and long payback periods, which makes households highly sensitive to expectations about future subsidies. Hence, it is essential to understand how households perceive and respond to political uncertainty. Partisan shifts and policy reversals can change these expectations and distort both the timing and the sizing of adoption decisions. I plan to develop a dynamic discrete-choice model of household solar adoption in which forward-looking households internalize the risk of subsidy phase-outs and regulatory changes. This project will provide new evidence on the welfare costs of policy uncertainty in the distributed energy transition.

The second proposal extends my job market paper to investigate how the growing use of AI in electricity systems changes household energy generation and consumption patterns and, as a result, affects the design of distributed renewable energy policies. With the rise of smart meters, home energy management systems, and AI-powered load forecasting tools, households are increasingly able to adjust solar generation and consumption in real time, reducing waste and responding more efficiently to price signals. However, this may also widen welfare gaps across income groups, depending on awareness and access to the new technology. I will use difference-in-differences estimation and structural modeling to examine how AI-enabled information and automation affect household decisions regarding energy use and solar PV adoption, as well as the equilibrium investment and welfare distribution under counterfactuals. This analysis will build on administrative data from the Netherlands, combined with data from energy companies. I will also further explore data availability and policy variation from other countries. This research will provide new insights into how AI reshapes policy design and the equity of distributed energy transitions.

Conclusion

By combining theoretical foundations with empirical and structural tools, my work aims to generate policy-relevant insights that ensure energy transitions are reliable and fair. I look forward to continuing this research agenda and contributing to academic and policy communities working on the future of energy systems.

References

Bessembinder, H., & Lemmon, M. L. (2002). Equilibrium pricing and optimal hedging in electricity forward markets. The Journal of Finance, 57(3), 1347–1382. https://doi.org/10.1111/1540-6261.00464

Joskow, P. L., & Tirole, J. (2007). Reliability and competitive electricity markets. The RAND Journal of Economics, 38(1), 60–84. https://doi.org/10.1111/j.1756-2171.2007.tb00044.x