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RESEARCH BRIEF

Coordinating Separate Markets for Externalities

Jose Miguel Abito, Christopher R. Knittel, Konstantinos Metaxoglou, and André Trindade

Market-based policies addressing environmental externalities are rarely uniform across jurisdictions. Lack of coordination leads to inefficiency compared to the ideal case of a single coordinated policy. We estimate this inefficiency using data from an integrated wholesale electricity market and a dynamic structural model of production and investment. We show that inefficiencies of separate policies are significantly mitigated when regulated firms participate in an integrated product market (e.g. for electricity), which allows them to reallocate output and investment in response to policy. Profit-maximizing firms can play a crucial role in coordinating otherwise uncoordinated environmental regulations.

Economists have long advocated for market-based solutions to environmental externality problems such as harmful emissions from the combustion of fossil fuels. One such approach is to create a market for the externality. In an ideal world, there is a single market that covers multiple jurisdictions. A single market maximizes efficiency by allowing trade among heterogeneous polluting sources. In practice, however, only separate externality markets may be feasible due to the difficulty of coordinating regulations across jurisdictions.

Two recent examples illustrate this coordination challenge. First, consider the current legal and political challenge to the U.S. Clean Power Plan, a federal regulation put forward by the Obama administration setting CO2 emissions limits on electric power plants for 2022–2030. Although the intention of the Obama administration was the introduction of a comprehensive policy to combat climate change at the federal level, the exact design and implementation of CO2 regulation will ultimately be at the state level.

Second, the withdrawal of the UK from the European Union threatens a potential failure to coordinate CO2 pricing across jurisdiction. Brexit may lead to the UK's departure from the European Union Emissions Trading System, and force the country to create its own market for CO2 emissions.

This paper explores the extent to which having uncoordinated regulations in the form of separate externality markets is an adequate substitute for a single market. We examine the relative economic efficiency of single versus separate externality

markets, and explore the mechanisms that drive their relative efficiencies.

We consider a setting where an integrated product market (e.g. a market for electricity) exists across multiple jurisdictions. This market is regulated by a CO2 policy, which is either in the form of a single CO2 market or separate CO2 markets (with different CO2 prices) for each jurisdiction. Participating firms (e.g. electricity producers) make output decisions by taking into account externality prices in the jurisdictions where they operate. All else equal, profit-maximizing firms move production from markets with higher externality prices to markets with lower externality prices. In a frictionless environment, output reallocation (followed by externality price readjustment) will lead to convergence of externality prices, as if there were a single externality market. In practice, frictions such as capacity constraints exist, and prevent perfect reallocation of output and readjustment of externality prices. In this paper, we empirically examine the magnitude of the resulting inefficiency.

To simulate firm behavior, we develop a dynamic structural model of production and investment. We use data from the Pennsylvania-New Jersey-Maryland (PJM) wholesale electricity market. In the model, firms own several plants with different capacities located in different states. They make strategic investments that take into account rivals' reactions as well as the effect of investment on future market outcomes.

The paper demonstrates a novel approach to modeling firm behavior in this context. Our model accounts for the heterogeneity of costs across plants and tracks their evolution as firms invest in new capacity, while significantly alleviating the associated computational burden.

We consider two different cases of firm behavior: static and dynamic. In the static case, we treat capacity as fixed and exogenous, but allow firms to reallocate output given the existing portfolio of plants. In this case, we find that the difference in efficiency between the single and separate CO2 market cases depends on the exogenous level of new capacity. For intermediate levels of new capacity, we find separate markets increase policy costs relative to a single market by up to 35%. We consider this an upward bound on the cost inefficiency of separate markets.

Next, we examine a dynamic case where firms are allowed to use investments as an additional mechanism to respond to CO2 policy. In this case, we examine how different assumptions regarding firm investment behavior, from full coordination of investment across firms to non-strategic investment, affects the optimal level of investment under the two regulatory regimes.

We find that firms face stronger incentives to invest in cleaner plants with separate markets compared to a single market, which is the case across all assumptions regarding investment behavior. Intuitively, with separate markets, firms do not have the option to "buy emissions" from plants facing lower CO2 prices. As a result, higher CO2 compliance costs inflate plants' cost of generating electricity which increases the reward to investing in cleaner and more efficient capacity. Although in the short-run electricity prices go up due to the inability to trade across CO2 markets, more investment allows the electricity market to transition to a steady state that has a larger share of cleaner and more efficient capacity. Hence, static inefficiencies resulting from separate markets are significantly—and in some cases, completely—mitigated.

In conclusion, the paper's main contribution is to show both theoretically and empirically that the organization of the product market can effectively coordinate uncoordinated regulation of the externality.

References

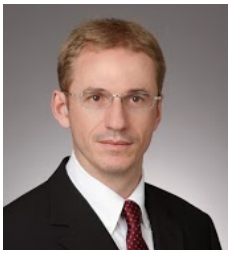
Abito, J. M., C. R. Knittel, K. Metaxoglou, and A. Trindade, 2018, “Coordinating Separate Markets for Externalities.” MIT CEEPR Working Paper 2018-011.

About the Authors

Mike‘s main areas of specialization are Industrial Organization, Regulation and Environmental Economics. He is interested in studying how government policies and regulations interact with markets and affect behavior of firms, and how this interaction impacts social welfare.

Mike received his Ph.D. in Economics from Northwestern University. Prior to his doctoral studies, he attended the Toulouse School of Economics and the National University of Singapore.

Christopher R. Knittel is the George P. Shultz Professor of Applied Economics at the Sloan School of Management, Director of the Center for Energy and Environmental Policy Research, and Co-Director of the MITEI Low-Carbon Energy Center for Electric Power Systems Research at the Massachusetts Institute of Technology. He joined the faculty at MIT in 2011, having taught previously at UC Davis and Boston University. Professor Knittel received his B.A. in economics and political science from the California State Uniersity, Stanislaus in 1994 (summa cum laude), an M.A. in economics from UC Davis in 1996, and a Ph.D. in economics from UC Berkeley in 1999. His research focuses on environmental economics, industrial organization, and applied econometrics.



Kostas Metaxoglou, Ph.D. (Economics, UC Davis) is an Associate Professor in the Economics Department at Carleton University. He joined the faculty at Carleton as an Assistant Professor in 2013 having previously worked as a senior consultant and manager with the Antitrust practice of Bates White LLC in Washington DC. His research focuses on Econometrics, Applied Industrial Organization, Energy Economics, Environmental Economics, and Empirical Finance.

André Trindade is an Assistant Professor at the Graduate School of Economics of the Getulio Vargas Foundation (EPGE-FGV). He received his Ph.D. in Economics from Northwestern University in 2011 and his B.A. in Economics at Nova School of Business and Economics in Lisbon. His research is focused in the areas of Empirical Industrial Organization and Applied Microeconomics. Recently, he has worked in estimating structural demand models to study competition in the supermarket sector.