Macroeconomic Effects of the Universe of EPA Regulations

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Project Outline

The growing concerns about environmental-related issues have led to stricter environmental regulations. In the U.S., the environmental protection agency (EPA) is the main regulatory body of creating and enacting environmental rules. It has been shown that these regulations are successful in curbing firm pollution (e.g., Shapiro and Walker, 2018; Greenstone et al., 2012). However, firms' compliance with the rules is often accomplished through real activities, which may distort their investment and production decisions. The cost of such distortions may go above and beyond the typical estimates based on expenditures on control and monitoring equipment. In particular, environmental regulations imposed on one set of firms may affect other firms through the general equilibrium feedback effect; as a result, this can have important welfare implications. The analysis of these considerations is impossible without a fully-fledged micro-founded structural model.

In this paper, we assess the costs and consequences of environmental regulations by combining three key elements. First, we use an environmental regulation index that captures time-varying industry-level total effective environmental regulations. Second, we characterize the relationship between environmental regulation and pollution using detailed administrative data. Third, we build a state-of-the-art heterogeneous firm general equilibrium model

that captures the relationship between environmental regulations and pollution observed in the data. This approach allows us not only to study the distortions created by existing environmental regulations, but also to assess various counterfactual scenarios. This way we shed light on the effectiveness of various types of environmental regulations.

The objective of this project is twofold. From the positive analysis perspective, we aim at quantifying the impact of EPA regulations on the dynamics of aggregate output, investment and consumption over the last 5 decades by combining data on the universe of EPA regulations with a bottom-up general equilibrium multi-sector model of firm dynamics. As per normative analysis, we use the estimated model to investigate how regulatory requirements should be designed to maximize the welfare.

The project consists of two major parts: empirical analysis and the quantitative model. We next describe the plan and objective for both parts.

Empirics The existing literature on the impact of environmental regulations primarily focuses on individual rules, such as the the Clean Air Act (e.g., Greenstone et al., 2012; Ryan, 2012). These studies typically isolate the effect of individual regulations one at a time. However, over the past decades, and in light of increasing concerns over environmental issues, the EPA has implemented and modified hundreds of overlapping regulations. Many of these regulations have not been analyzed through policy evaluation tools. It is also difficult to apply the standard quasi-experimental research designs to study many of these regulations due to the lack of natural control groups.

To study the effect of all EPA regulations, we use the time-varying measure of the total new EPA restrictions at a disaggregated industry level developed in Fan and Wu (2022). This measure is based on the texts of all effective EPA rules contained in the Code of Federal Regulations (CFR) since 1973 and the machine-learned relevance of the regulations to each industry estimated by the Mercatus Center. Fan and Wu (2022) show that this measure meaningfully captures the total restrictions of EPA regulations and can identify industry specific variations.

Subsequently, we combine the constructed index with the administrative records from the

Annual Survey of Manufacturers (ASM) and the Census of Manufacturers (CM) to study the impact of industry-level EPA regulations on firm-level performance, including their impact on capital investment, labor and output decisions. We use these moments to put discipline on our quantitative framework. Since our quantitative model features multiple sectors, we additionally use Census data to estimate production functions at a fine NAICS 4-digit level (following, for example, Gao and Kehrig, 2021; Smirnyagin, 2022).

Theory We develop a multi-sector firm with heterogeneous firms; the model is set in general equilibrium which is critical for the meaningful policy analysis. The model represents a natural multi-sector extension of state-of-the-art models of firm dynamics with a rich set of adjustment costs (e.g., Khan and Thomas, 2008; Winberry, 2021; Smirnyagin, 2022; Smirnyagin and Tsyvinski, 2022). The presence of various capital adjustment frictions is necessary for the success of the model at the micro-level.

Our analysis of EPA regulations in the model represents a combination of approaches developed in classical papers, i.e. Restuccia and Rogerson (2008) and Shapiro and Walker (2018). Specifically, following Shapiro and Walker (2018), we assume that firms require an input of a dirty good to produce their final output. In turn, we model the price of the dirty good as a time-varying wedge in the spirit of Restuccia and Rogerson (2008); we use the EPA index to put discipline on the time-series properties of industry-specific wedges in our model.

Timeline of the Project

We started merging our EPA index with the Census data, and expect to produce the first set of results within the next 2 months. The quantitative model is a natural extension of the model we used in our earlier projects (i.e., Smirnyagin, 2022; Smirnyagin and Tsyvinski, 2022); thus, we plan to have the first quantitative results ready in the Spring of 2023.

References

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