A quasi-experimental evaluation of high-emitter non-compliance and its impact on vehicular tailpipe emissions in Atlanta, 1997–2001

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Abstract

A quasi-experimental evaluation is employed to assess the compliance behavior of high emitters in response to Atlanta's Inspection and Maintenance program between 1997 and 2001 and to predict the impact of compliance behavior on vehicular tailpipe emissions of ozone precursors, such as carbon monoxide, hydrocarbons and nitrogen oxide. Remote sensing data of a sample of approximately 0.8 million observations of on-road vehicles are matched with IM program data and vehicle registration data to identify the compliant and non-compliant high emitters. A mixed-pool time-series regression analysis is carried out to predict changes in the vehicular tailpipe emissions due to the compliance and non-compliance of the high emitters in the Atlanta airshed.
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1. Introduction

The broader aim here is to study the environmental impact of human behaviors that emerge in response to policy interventions. More narrowly, the paper focuses on evaluating the compliance behavior of high-emitting vehicle owners (henceforth "high emitters") in response to the policy intervention of vehicle inspection and maintenance (IM) programs.

Quasi-experiments provide a useful setting for policy analysis and evaluation to estimate the effects of policy interventions on the outcome variables for which the policies were introduced (Cook and Campbell, 1979). Meyer (1995) provides a broad review of the previous quasi-experimental studies used in policy analysis. A quasi-experimental design is employed to investigate:

- The probability of a high-emitter complying with the rules of the Vehicle Inspection and Maintenance program in the Atlanta airshed?
- The impact on the outcomes of vehicular emissions due to the compliance decisions of high emitters in the Atlanta airshed?

Previous literature (National Research Council, 2001) suggests that vehicular tailpipe emissions of carbon monoxide (CO), hydrocarbons (HC) and nitrogen oxide (NO) are complex functions of three broad groups of parameters: human behaviors (in response to policy interventions and market mechanisms), vehicular characteristics (such as vehicle age, type, manufacturer), and the physical characteristics of the atmosphere (such as temperature and pressure). Fig. 1 shows variables in these three broad groups of parameters that affect the vehicular tailpipe emissions in a conceptual framework of the quasi-experimental research design.

As the figure shows, the IM policy intervention leads to identification of two broad quasi-experimental groups of vehicle owners: the control and treatment groups. The control group represents groups of those vehicle owners who are not directly targeted by the policy intervention, such as those owning normal-emitting
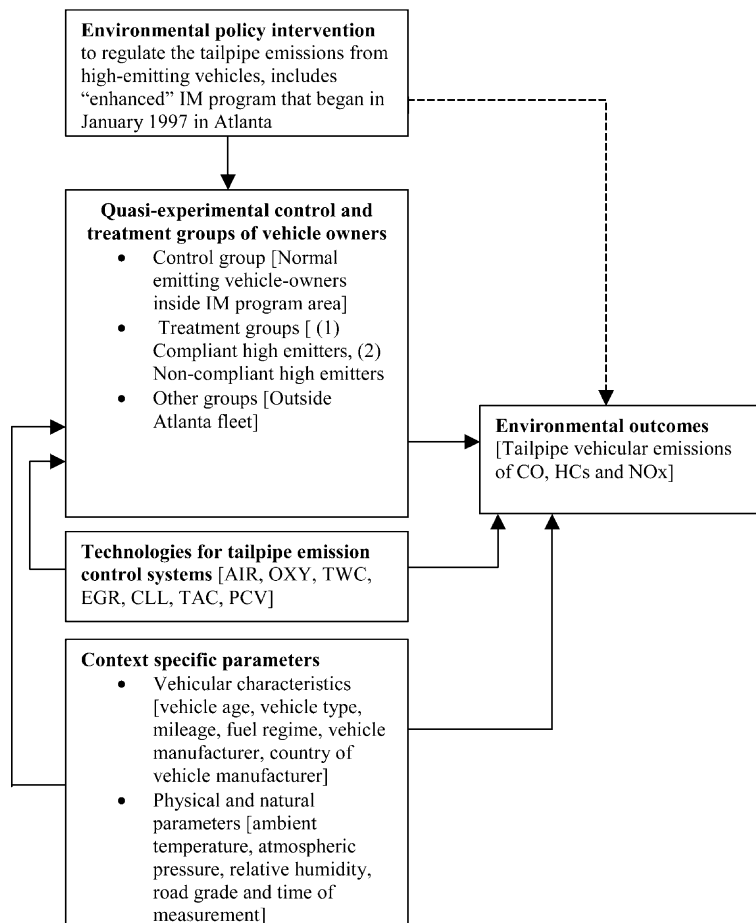

Fig. 1. A conceptual framework of quasi-experimental research design.