Emissions are a major concern in modern society. They cause city smog as well as contribute to global climate change, and various national policies as well as international treaties have been implemented to combat their growth and effects.

Vehicles are a major contributor to emissions. The transportation sector generated 31% of CO$_2$ emissions in 2011 according to the International Energy Agency. Across the globe, pollution reduction policies have been directed at vehicular emissions ranging from gasoline taxes and vehicle taxes to even restrictions on when certain cars or drivers are allowed to be on the road.

In PERC Working Paper 1406, PERC Research Fellow Li Gan, Don Fullerton and Miwa Hattitori explore the effectiveness and costs of various vehicular emissions reductions policies in Japan. Using prefecture-level data, the authors develop a structural model using the effects of changes in gasoline prices in order to simulate the effects of taxes on gas, distance travelled and specific cars on the simultaneous choices of type of car and distance driven.

Reducing emissions via taxation is achieved most efficiently by a direct tax on emissions themselves. Pigou originally suggested this in 1920, but it is not feasible for vehicular emissions. As a second best alternative, governments typically tax things that are strongly correlated with emissions, (for example, gasoline consumption or miles driven). They can also tax characteristics of cars that cause drivers to consume more gasoline given miles travelled and gasoline consumed. Typically, these characteristic-based taxes are tied to vehicle age or size.

The authors simulate the effects of a number of these second best market-based policies to determine which policy is the least costly in welfare terms (i.e., which policy costs consumers the least while resulting in sufficient abatement of pollution). They adapt the Dubin-McFadden model for their application because it is an accepted tool for modeling two sequential choices when one of them is discrete and one is continuous.

They make a number of important contributions to the literature. The first contribution is methodological: they develop a model that does not require individual-level data, which previous models based on the Dubin-McFadden model have required. Second, they estimate both the discrete choice of vehicular choice and the continuous choice of miles driven simultaneously, allowing for interaction and feedback between these two intertwined decisions. Third, the model allows for heterogeneity across prefectures, which allows for various regions to respond to policies according to local preferences. Fourth, they simulate the outcomes expected due to various policy changes not yet enacted by the Japanese government, and, lastly, they explore the welfare implications of such effects.

The structural model supposes
that households derive utility from vehicle miles travelled as well as another consumption good. The authors set up a constrained maximum problem in which the households make the discrete choice of vehicle type and the number of miles travelled. Households are subject to a budget constraint based on their income, the cost of gasoline and their car’s fuel efficiency. The authors derive both an indirect utility function for the households as well as an equation describing the shares of each car type represented in the total fleet of cars in a prefecture.

The authors use 3 years of prefecture-level aggregated survey data in order to infer the effects of changes in gas price per kilometer driven (a tax per unit of local emissions, a tax per unit of CO₂ emissions, a tax per liter of gasoline, and a tax per kilometer driven) or the cost of each vehicle (a tax on engine size, a tax on emissions rate, and a tax on vehicle age).

All policies that alter price per kilometer driven reduce vehicle miles travelled. A tax on local emissions reduces the vehicle miles travelled the most, followed by a tax on distance, then a gasoline tax and a CO₂ tax. These policies also induce households to shift away from driving cars with large emissions rates. All four policies cause drivers to shift away from small, old cars, which have the highest emissions rates, towards those with lower rates, especially new cars.

Policies that vary the cost of vehicles have less consistent results. The authors find that a tax on engine size has little effect on emissions of any pollutant, and conclude that it is not an effective policy tool. The tax on vehicle age induces more emission abatement and a greater reduction in vehicle miles travelled. The tax on emissions rates could achieve a reduction, but this outcome hinges on households changing the types of cars that they drive.

The authors then translate their findings into a marginal cost of abatement for each policy. Importantly, they account for the combined effects of the multiple technological changes induced by each policy. They use this combined cost along with the direct costs of the policy to calculate the total cost to consumers. Based on the assumptions of the model, this cost is a loss in consumer surplus.

Combined with the deadweight loss of the tax (derived from the equivalent variation) and the government’s gained tax revenue, the marginal cost of abatement contributes to understanding the net welfare changes associated with each policy.

The analysis suggests that the use of distance-reducing taxes is more costly in welfare terms than inducing changes in car choices. The authors conclude that taxing each vehicle at a rate proportional to its emissions rate is the most cost efficient method of emissions abatement.

“...The use of distance-reducing taxes is more costly in welfare terms than inducing changes in car choices. The authors conclude that taxing each vehicle at a rate proportional to its emissions rate is the most cost efficient method of emissions abatement.”
The Identification of Response of Stock Returns to Monetary Policy Actions Using Market-Based Measures of Monetary Policy Shocks

Monetary policy is an important economic tool, and it has vast repercussions across various sectors of the economy. Its effects on interest rates and the stock market reverberate throughout American life, impacting households’ consumption and saving behaviors significantly.

It is possible to model monetary policy shocks using market-based measures, but doing so risks a well-known problem in this literature, “the joint response bias.” This bias occurs when an unobserved variable jointly impacts the market-based measure of monetary policy and the outcome variable in question.

Jordan Professor of Economics, Dennis Jansen, and Chun-Li Tsai explore this issue in the context of studying the effect of monetary policy on stock returns in PERC Working Paper 1407. The authors compare three approaches previously used to estimate models using market-based measures and compare two approaches suggested to mitigate problems caused by the joint response bias.

The models estimated use the surprise change in the federal funds rate futures, calculated by the authors, as the market-based measure of monetary policy. The authors also account for Federal Open Market Committee events using a binary indicator for whether such an event occurred during a given time.

The authors first estimate daily-level models. This type of model is most likely to exhibit the joint response bias because it is harder to temporally isolate the effect of the shock without the problematic unobserved variable distorting the effect.

Intraday models that focus on smaller temporal windows, in this case 40 minutes, help to isolate the effect of the change in monetary policy while introducing less bias. They find similar estimates using these two methods. The daily models indicate that a 1% increase in the Federal Funds Rate results in a -4.9% change in stock returns, and the intraday models indicate a -3.8% change.

The authors also use a methodology suggested by Thornton in 2013 that allows them to control for the joint response bias. They find slightly larger effects; a 1% increase in the Federal Funds Rate reduces stock returns by 6.7%. This methodology also tests for the presence of the bias directly, and the bias is not statistically significant in this model.

Bull markets and bear markets create vastly different economic environments, and monetary policy may have different effects depending on these conditions. The authors test this hypothesis by estimating models separately for these different situations. Across all specifications, they find that an incremental increase in the Federal Funds Rate has a much larger negative effect on stock returns in bear markets.

Joint response bias estimates are positive, but not statistically significant. They suggest that their estimates do indicate a positive bias in bull vs. bear market models. They attribute it to a phenomenon known as “pre-FOMC announcement drift.”

Overall, the authors consistently find that monetary policy has a strongly negative impact on stock returns. This negative effect is considerably larger in bear environments. Because bear markets usually occur in conjunction with recessions, the massive negative effect that increasing the Federal Funds Rate has on the stock market should be a consideration in monetary policy decision-making.
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