THE HETEROGENEOUS EFFECTS OF GASOLINE TAXES: WHY WHERE WE LIVE MATTERS

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Overview

Given the threats of air pollution, climate change, and political instability in countries that provide foreign oil, U.S. policy makers have struggled with how to reduce gasoline consumption. Economists tend to focus on gasoline taxes as an optimal solution to the externalities associated with driving, with the added benefit of providing revenue for the government. However, policymakers are concerned with the burden these increased gasoline prices may place on households, given the substantial amount of money people spend on gasoline each month. While decreasing the demand for gasoline and reducing contamination through higher prices may end up negatively affecting some households, gasoline taxes will not affect every household in the same way.

In general, gasoline taxes reduce the amount of vehicle miles traveled (VMT) and gasoline consumed through the price effect. A household's location affects not only its ability to minimize consumption of gasoline when faced with higher gasoline prices and gasoline taxes but it also affects the household's tax burden. For example, there is evidence that rural households drive much more than urban households (Schmalensee and Stoker [1999], Gillingham [2011]). There is also evidence that household structure can affect a household's sensitivity to gasoline prices; for example, Schmalensee and Stoker (1999) found that larger households have higher demands for gasoline, and are less elastic. Finally, vehicle ownership also affects elasticities of demand for gasoline: households with more than one vehicle can substitute driving to the more efficient vehicles when faced with high gasoline prices (Berkowitz et al. [1990], Feng, Fullerton and Gan [2005], Spiller [2011], Wadud [2010]).

As variations in household characteristics, location, and vehicle ownership result in diverse elasticity estimates and driving patterns across households, it is important to account for these differences when estimating the distributional effects of gasoline taxes. This is especially important given the wide range of demographics and income across different regional areas as environmental taxes may especially burden the poor (Cremer et al [2003]).

While there has been extensive research demonstrating the need to account for regional variation in economic outcomes when conducting policy analysis (e.g. Ferguson et al. [2007], Partridge et al. [2008a], and Porter [2003]), the elasticity literature has mostly failed to account for regional heterogeneity in gasoline price sensitivities. Therefore, our paper improves the elasticity literature by incorporating significant geographic heterogeneity (within and across different regions) into the estimation of gasoline tax impacts.

The paper is organized as follows: Section 2 outlines the model; Section 3 provides details on our estimation approach; Section 4 describes the data; Section 5 presents the elasticity results; Section 6 looks at the resulting gasoline tax burdens; and Section 7 concludes.

Methods

We use a structural model that allows us to find the parameters that maximize the probability that every household made an optimal decision with respect to its vehicle purchase and vehile miles travelled (VMT) decisions, given the assumption that they would have been worse off had they made a different choice.

The method is a parametric maximum likelihood estimation technique adapted by Spiller (2011) from Manski's (1975) semiparametric maximum score estimation strategy.

Using the parameters, we can estimate the price elasticity of demand for gasoline for each household. We then use this information to look at how elasticities vary across regions and household characteristics. We also look at the burdens imposed by higher taxes.

Results

The mean elasticity estimate of all households of -0.54 is reasonable and near the average elasticity estimated in the literature (-0.5).

We find that households with higher incomes are more elastic and households with more vehicles also have higher elasticities, proving that substituting between vehicles in the garage allows the household to react more readily to gasoline prices. Households facing higher gasoline prices and with higher VMT also have higher demand elasticities. These types of households have a higher share of consumption dedicated to driving, and thus are affected more by any increase in gasoline prices, forcing them to make greater adjustments to their driving patterns. We also find hat living far from an urban center and being in a rural household increases a household's elasticity of demand; these are also the households that drive the most. We also find that there is significant heterogeneity in household characteristics and how they affect the price elasticity of demand for gasoline across U.S. regions.

The average tax burden from an "optimal" tax (Parry and Small [2002]) is found to vary widely across households. The tax burdens are increasing in distance to MSA, income, commute time, VMT, and percent rural. These are some of the households who also had the highest price elasticities, thus demonstrating that having a higher elasticity does not mitigate your tax burden.

Conclusions

The results demonstrate that it is important to take into account regional differences when implementing public policies that affect gasoline prices and driving, rather than imposing a national one-size fits all gasoline tax.

As we have found, there is tremendous heterogeneity in the responsiveness to gasoline prices (i.e., the price elasticity of demand) among different types of households and across different regions. Perhaps even more significant is the fact that higher gasoline prices (as a result of the tax) can impose large, negative burdens on households with high VMT needs, even those with high gasoline price elasticities.

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