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Environmental preferences and consumer behavior

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HIGHLIGHTS

- I estimate the effects of environmental preferences on gasoline elasticities.
- I find that environmentalists have lower gasoline retail price and tax elasticities.
- Environmentalists are also less sensitive to the source of the pecuniary signal.
- The policy implications of heterogeneous environmental preferences are discussed.

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ABSTRACT

This paper demonstrates that environment-conscious consumers have lower gasoline retail (tax-exclusive) price and excise tax elasticities, suggesting that they are less sensitive to changes in prices and taxes than their less environmental counterparts. These results on an American state-year dataset are robust to the use of two environmental proxies and to the instrumentation of gasoline retail prices. These findings support the existence of heterogeneous environmental preferences by demonstrating that certain consumers incorporate environmental ideology into their utility functions distinctly from income considerations. The implication that environmental preferences contribute to differential responsiveness to pecuniary signals has repercussions for the forecasting of consumer behavior and for the ease of implementation of environmental policy.

1. Introduction

The welfare outcomes of policy changes are inextricably linked to how consumers respond to the effects on their economic environment, and an understanding of the determinants of behavior thus is central to the implementation of economic policy. However, despite increasing empirical evidence that questions the validity of the archetype of the consumer as a self-interested, price-conscious homo economicus,[1] policymakers continue to favor price-based instruments. Pecuniary policy instruments such as taxes are broad-based, and typically fail to target specific groups where the adjustment of monetary incentives would be most economically efficient and most effectively encourage the desired behavioral shift (Allcott, 2010).

This paper examines how heterogeneous consumer environmental preferences influence consumption decisions through differential responsiveness to price signals. My findings show that environmentalists are less sensitive to changes in gasoline retail (tax-exclusive) prices and taxes, hypothetically due to the relative strength of their moral priorities. This paper constitutes the first evidence that environmental preferences influence elasticities; the limited existing literature on the influence of environmental ideology on gasoline consumption focuses exclusively on changes in consumption levels,[2] which differ in significance depending on baseline usage. As discussed in Section 3, these results have significant implications for the forecasting of consumer responses, for the differential efficiency of tax policy, and for the potential role of non-pecuniary environmental policies.

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[1] For example, Jacobsen et al. (2013), Bollinger and Gillingham (2012) and Allcott (2010).

[2] See Kahn (2007) and Flamm (2009).

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2. Methodology

The empirical approach employed in this paper to estimate the differential effect of environmental preferences on gasoline price and tax elasticities extends the model of Li et al. (2014) by including interaction terms with revealed preference proxies for environmental concern. More specifically, for each state s and year t, I estimate:

$$\ln(q_{st}) = \alpha \ln(p_{st}) + \beta \ln(1+\tau_{st}) + \lambda E_{st} + \delta \ln(p_{st}) * E_{st} + \phi \ln(1+\tau_{st}) * E_{st} + X'_{st}\theta + \epsilon_{st} \quad (1)$$

where q_{st} is highway gasoline consumption per adult, p_{st} is the retail (tax-exclusive) real price of gasoline,[3] τ_{st} represents the combined federal and state excise tax rate on gasoline,[4] and E_{st} is a proxy for the level of environmental concern.

My first proxy is average annual League of Conservation Voters (LCV) score for each state's delegation to the US House of Representatives from 1983 to 2008.[5] US House representatives are elected on a biennial basis and then annually vote on a wide variety of environmental issues, and hence represent the voting priorities of the citizens of each state. Recent research has documented the high correlation between environmental concern and political ideology and the divergence of American political parties on environmental issues,[6] which supports the use of an environmental political variable as a proxy for environmental ideological considerations previously omitted in the gasoline elasticity literature.

My second proxy consists of the interaction of this (standardized) score with standardized percentage of municipal solid waste recycled and with standardized Sierra Club membership per capita. This green index is used to corroborate the results obtained using LCV scores. The state-by-year panel dataset is very similar to that of Li et al. (2014), where the data are drawn from a variety of publicly available sources. More limited additional Sierra Club and recycling data were obtained through personal correspondence.

In order to address concern about the general equilibrium relationship between gasoline consumption and retail prices, I construct an instrument in the logic of Li et al. (2014). Specifically, I instrument for retail prices using the interaction of state tax-exclusive gasoline prices in 1980 with the annual average import price of crude oil – as measured by the real US refiner average acquisition cost – in each year.[7] This instrument is correlated with gasoline prices from 1983 to 2008 since 1980 prices reflect state domestic production factors, differences in market structure, and distances to refineries, while the annual average import price of crude oil captures international factors that contribute to the price of gasoline in a given year. Conditional on driving-related and socio-economic characteristics, the F-statistic for the first stage regression is 745.903. This instrument is also uncorrelated with supply and demand shocks that occur at the state level as of 1983 since price and consumption shocks are unlikely to persist over two decades and because a state-level shock is very unlikely to be large enough to affect the world price of crude oil[8] (Li et al., 2014). Meanwhile, gasoline taxes are plausibly exogenous, and hence are uninstrumented in this paper and in the literature.[9]

While my proxies support an upward trend in environmental concern, the lack of substantial time variation precludes the use of state fixed effects. Hence, in addition to standard vehicle-related covariates, I also control for potentially confounding socio-economic factors which constitute the most important components of state fixed effects.[10] My elasticity estimates are robust to the inclusion and exclusion of state fixed effects after controlling for environmental preferences.[11]

3. Results and discussion

Table 1 presents the estimates for the effect of environmental concern on gasoline consumption using average House LCV score as the proxy for level of environmentalism. In all specifications, the one-year elasticities that I estimate are consistent with the magnitudes of the elasticity estimates obtained in the literature. Espey (1998) provides an overview of hundreds of prior estimates of gasoline elasticities, and approximates that short- to intermediate-run price elasticity falls within the range of 0 to −1.36 with a mean of −0.26. In my paper, the price elasticities estimated by least squares range from −0.07 in the model without environmental interaction terms, covariates, or year fixed effects (column 1) to −0.46 in the full model (column 6), while the instrumental variables estimates range from −0.18 in the baseline model (column 7) to −0.36 in the full instrumental variables specification (column 10).[12]

While classical consumer theory predicts that changes in prices and taxes generate identical responses for all economic agents, my results corroborate the negative effect of environmental concern on gasoline consumption levels and also indicate lower price and tax elasticities for environmentalists; the implication is that, in addition to consuming less gasoline, environmentalists are also less responsive to price and tax signals than non-environmentalists. Focusing on columns 5 and 6, a 10 percentage point increase in environmental concern – an increase of around 4 in pro-environmental votes – with a constant price reduces gasoline price elasticity by 0.02, while the same increase in environmental concern for a constant tax rate reduces gasoline tax elasticity by between 0.06 and 0.09. My paper thus supports the existence of heterogeneous environmental preferences by demonstrating that certain consumers incorporate environmental ideology into their utility functions separately from income effects, and hence exhibit smaller behavioral shifts in response to small price signals that are insufficient to overwhelm their personal sources of motivation.[13]

[3] Gasoline prices are inflated to 2008 US dollars following Li et al. (2014).

[4] The gasoline excise tax rate is calculated as total federal and state excise tax on gasoline divided by tax-exclusive gasoline price.

[5] The League of Conservation Voters annually scores voting delegates of the US House of Representatives on a 0–100 scale by dividing the number of pro-environmental votes by the total number of environmental bills tabled that year. See League of Conservation Voters (2015) for detailed scorecard methodology.

[6] Kahn (2007) in particular indicates a high correlation between Green Party membership and LCV score in California.

[7] An alternative approach to correcting for the endogeneity of gasoline prices has been to instrument for gasoline prices using gasoline taxes; see Davis and Kilian (2011). Coglianese et al. (forthcoming) refine this approach by accounting for anticipatory behavior in gasoline markets. Here I abstract from the implications of this work for the estimation of tax and price elasticities.

[8] Note that this approach in the literature ignores the fact that gasoline price shocks at the state level may be correlated with national demand shocks in the United States, which in turn may affect the global price of oil. See Kilian (2009) for a complete discussion of the endogeneity of oil prices.

[9] Davis and Kilian (2011) and Li et al. (2014) support that the lag between the drafting and the implementation of tax legislation precludes a contemporaneous correlation between unobserved supply and demand shocks and gasoline tax rates.

[10] Gallagher and Muehlegger (2011) also use demographic controls instead of state fixed effects due to lack of variation in their proxy for environmental preferences.

[11] Results available upon request.

[12] Note that while the comparatively limited literature on gasoline tax elasticity precludes a comparison to an equally wide range of models, the tax elasticities estimated here are consistent with the findings of Li et al. (2014).

[13] See Benabou and Tirole (2003) for a discussion of the interplay of intrinsic and extrinsic motivators.

Table 1
The effect of LCV score on gasoline elasticities.

	OLS						IV			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
LCV score	−0.00227***	−0.00143***	−0.000613*	−0.0224***	−0.0159***	−0.00956**	−0.00227***	−0.00145***	−0.0197**	−0.0143**
	(0.000594)	(0.000334)	(0.000326)	(0.00727)	(0.00503)	(0.00430)	(0.000565)	(0.000316)	(0.00978)	(0.00686)
ln(price)	−0.0714***	−0.124***	−0.409***	−0.247***	−0.257***	−0.462***	−0.179***	−0.235***	−0.332***	−0.355***
	(0.0229)	(0.0375)	(0.124)	(0.0676)	(0.0596)	(0.114)	(0.0432)	(0.0436)	(0.0983)	(0.0837)
ln(1 + tax)	−0.324***	−0.416***	−1.481***	−1.010***	−0.910***	−1.767***	−0.648***	−0.711***	−1.246***	−1.140***
	(0.118)	(0.132)	(0.246)	(0.370)	(0.263)	(0.269)	(0.175)	(0.165)	(0.441)	(0.355)
LCV ∗ ln(price)				0.00343***	0.00248***	0.00151*			0.00298*	0.00223*
				(0.00111)	(0.000843)	(0.000751)			(0.00159)	(0.00115)
LCV∗ln(1+tax)				0.0136**	0.00936**	0.00613*			0.0119*	0.00801
				(0.00603)	(0.00411)	(0.00323)			(0.00709)	(0.00522)
Controls		×	×		×	×		×		×
Year FE			×			×				
Observations	1248	1104	1104	1248	1104	1104	1248	1104	1248	1104

Specifications 1–6 are estimated by least squares and specifications 7–10 are estimated by instrumental variables. The dependent variable in each specification is ln(gasoline consumption per adult), by state and year. Row 2 provides a baseline estimate of the price elasticity of demand for an LCV score of 0 for each specification; row 4 estimates the incremental effect on the price elasticity estimate of a 1 percentage point increase in LCV score holding prices constant. In columns 7–10, ln(gasoline price) per state-year is instrumented using the interaction of state gasoline price in 1980 with the annual average import price of crude oil. Controls include average family size, miles of public road per adult, per capita registered cars, per capita licensed drivers, per capita real income, proportion living in metropolitan areas, proportion living in metropolitan areas with rail transport, proportion graduating high school, proportion graduating college, dummy variable indicating a Democrat governor, manufacturing GSP share, budget surplus as a fraction of revenue, and unemployment. Oil and gasoline prices are real and are inflated to 2008 US dollars. Standard errors clustered by state are in parentheses.
* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

Of further interest is the larger magnitude of the interaction between environmental concern and taxes, relative to the same effect on retail prices. This reduction in the relative salience of excise taxes lessens the discrepancy between the responses to retail price and tax changes. These findings indicate that the source of the signal is less important for environmentalists. A Wald test rejects the equality of the coefficients on the interaction terms at 5% and 10% respectively for columns 5 and 6.

These findings are maintained in the instrumental variables specifications. Additionally, the estimates obtained using the green index as a proxy for environmentalism continue to corroborate all the general results obtained when average House LCV score is used as a proxy, both in the baseline and the instrumental variables specifications.[14]

My empirical results imply several policy implications. Firstly, if price and taxes rise, the people who will exhibit the largest behavioral shift are the non-environmentalists. This suggests that environmentalists will constitute more of the tax base than would have been predicted had all consumers responded equally to the adjustment of price incentives. Adjusting for baseline usage, environmentalists pay less tax on net and experience a smaller reduction in consumer surplus,[15] but these findings support that policymakers should consider the characteristics of the jurisdictions upon which tax policies are imposed, both in order to achieve the desired behavioral displacement and to accurately predict tax revenue.

Relatedly, the higher elasticity associated with non-environmental states exacerbates the deadweight loss associated with a given change in the tax rate. Since non-environmentalists are also the highest consumers of gasoline, this added inefficiency will make it more challenging to pass carbon tax legislation in these jurisdictions, underscoring the potential role of a state-by-state carbon pricing plan.

Thirdly, this evidence encourages the consideration of non-pecuniary incentives for environmental behavior. While my research supports that environmentalists are less responsive to price signals, Bollinger and Gillingham (2012) and Jacobsen et al. (2013) find that green communities are more responsive to community-level rewards that encourage the uptake of environmentally-friendly technologies. Allcott (2010) also points out that Pigouvian carbon pricing schemes have met significant political opposition, which non-pecuniary programs could perhaps avoid. Targeted behavioral approaches could therefore represent a cost effective alternative to traditional cap-and-trade programs and carbon taxes.

4. Conclusion

In this paper, I examine how environmental concern influences the elasticity of responses to relative price and tax incentives. Environmentalists are consistently less sensitive to changes in the two distinct components of gasoline prices as well as to the source of the price change. This paper constitutes the first evidence of the effect of heterogeneous environmental preferences on price and tax elasticities. Hence, my results lay an important foundation for future research in this domain.

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14 Results available upon request.
15 Calculations available upon request.

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