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Incidence of Federal and State Gasoline Taxes

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Abstract

The federal specific gasoline tax falls equally on consumers and wholesalers; whereas state specific taxes fall almost entirely on consumers. The consumer incidence of state taxes is greater in states that use relatively little gasoline.

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1. Introduction

Federal and state gasoline specific taxes have different incidences on consumers. State consumer tax incidences are higher because the elasticity of supply to a given state is substantially greater than to the nation as a whole. If the tax is higher in one state than in others, wholesalers can shift gasoline to other lower tax states. Moreover, because the elasticity of supply is greater in states that sell smaller quantities of gasoline, consumers in those states bear a relatively large tax incidence.

Politicians have expressed substantial concern about the consumer incidence of gasoline taxes. President Jimmy Carter, when advocating an increase in the tax on gasoline, and President Bill Clinton, when calling for an energy tax, proposed providing income compensation for poor consumers. Similarly, in 1993, when the federal gasoline tax was increased by 4.3¢ to 18.4¢, Senator Max Baucus called the initial proposal for a larger tax increase a "non-starter" because a "gasoline tax was a bad way to raise revenue"(*Chicago Sun-Times,* July 24, 1993). Controversy over using a gasoline tax to generate revenue arose again in 2000 when some policy makers considered suspending the 4.3¢ tax increase and others suggested suspending the entire tax in an attempt to mitigate consumers concerns over high gasoline prices. As recently as April 2003, Congress argued over the merits of including an increase in the gasoline tax in the transportation budget. Similar debates occur at the state level.

These concerns may be responsible for U.S. gasoline taxes being among the lowest in the industrialized world. As of 2002, the U.S. federal gasoline tax was 18.4¢

per gallon, and average state and local taxes raised the total tax to 38.2¢ per gallon, which is 28% of the price that consumers pay. European taxes per gallon average 20 times U.S. federal rates. The tax per gallon in U.S. dollars for regular, unleaded gasoline in the first quarter of 2000 was $2.43 in Italy, $2.56 in Germany, $2.57 in France, $2.77 in the Netherlands, $2.85 in Norway, and $3.29 in the United Kingdom (OECD). The U.K. tax is 77% of the price that consumers pay and produces 17% of the government's budget revenues. Taxes in Italy, Germany, and France raise 4% to 5% of the national budget revenues. In contrast, the U.S. federal government raises less than 1% of its final budget from the gas tax.

Strangely, little is known about the relative incidence of federal and state taxes in general and nothing is known about the relative incidence of gasoline taxes. Barnett, Keeler and Hu (1995) examined the incidence of federal and state taxes for cigarettes. They found that consumers pay more of the federal excise tax than the state taxes. (The relative incidences of federal and state taxes may be different for cigarettes than for gasoline because cigarettes are "smuggled" across state lines after retail purchases, whereas gasoline is moved across state lines by wholesalers.) Previous work on the incidence of gasoline taxes has been limited to the investigation of the incidence of federal taxes across income levels (e.g., Chernick and Reschovsky 1997, Shepard 1976, Weise, Rose and Schluter 1995, and Zupnick 1975).

We present a theoretical explanation of the expectations of federal and state gasoline tax incidence in the next section. Then, we discuss our empirical specification and results. We summarize our results in the last section.

2. Theory of Incidence

To make the basic idea clear, we start by assuming that the wholesale market for gasoline is competitive. As is well known, the incidence of a federal specific tax in a competitive market is approximately $\eta/(\eta - \varepsilon)$, where η is the national supply elasticity and ε is the national demand elasticity.

The state tax incidence in State *i* is similar, where state-specific elasticities are substituted for the national ones: $\eta_i/(\eta_i - \varepsilon_i)$. Although, the elasticity of demand in a particular state may differ slightly from the national elasticity, presumably the main difference across states is in the elasticity of supply.

The residual supply curve facing State *i* is $S^i(p) = S(p) - D^o(p)$, where S is the market supply, D^o is the demand in other states, and p is the price. Differentiating with respect to p and using algebra, we find that the elasticity of supply to State *i* is $\eta_i = \eta/s_i - \varepsilon^o/s_i^o$, where η_i is the residual supply elasticity in State *i*, ε^o is the market demand elasticity in all states except *i*, s_i is the share of quantity in State *i* relative to total quantity in all states, and s_i^o is the share of quantity in State *i* relative to quantity in all the other states not including State *i*. Thus, all else the same, the residual elasticity of supply for State *i* is greater, the smaller is the state's share of consumption. Consequently, we would expect the tax pass through to consumers to be greater in relatively small states. (The residual supply elasticities may also depend on distances between states and formulation laws that affect the ability of wholesalers to move gasoline between states.)

We can gain a feel for how the consumer incidence falls with the share through a simulation. As long as gasoline sales in a state are small relative to that of the nation, s_i^o approximately equal s_i. According to our empirical results, the federal gasoline tax

consumer incidence is roughly a half, which suggests that the national demand elasticity roughly equals the negative of the national supply elasticity: $\varepsilon \approx -\eta$. If the demand elasticity in each state is roughly the same as the national elasticity, then a reasonable approximation of the consumer incidence in a state is

$$\frac{\eta_i}{\eta_i - \varepsilon_i} = \frac{\frac{\eta}{s_i} - \frac{\varepsilon^o}{s_i^o}}{\frac{\eta}{s_i} - \frac{\varepsilon^o}{s_i^o} - \varepsilon_i} \approx \frac{\frac{\eta}{s_i} + \frac{\eta}{s_i}}{\frac{\eta}{s_i} + \frac{\eta}{s_i} + \eta} = \frac{2}{2 + s_i}.$$

This approximation formula shows the consumer incidence varies inversely with a state's gasoline sales share. According to this formula, the consumer incidence is 99% for a state with 2% of the national quantity share, which is the average share in our sample. This approximation formula is accurate for the average size state, but overestimates the incidence for the larger share states presumably because the approximation is less close to the mean and because demand and other factors do matter.

Similar results may be derived for an oligopolistic market, where the tax incidence varies with the elasticity of demand and firms' quantity responsiveness to shocks, which in turn depends on the number of firms and the firms' strategic beliefs (e.g., Katz and Rosen 1985, Stern 1987, Delipalla and Keen 1992, Karp and Perloff 1989, Besley and Rosen 1999, and Fullerton and Metcalf 2002).

3. Econometric Specification and Results

We estimate fixed effects, seemingly unrelated, reduced-form average wholesale and retail, unleaded gasoline price equations. We use monthly data for the 48 mainland states and the District of Columbia from March 1989 through June 1997 (4,949 total observations). The exogenous and predetermined variables represent demand

determinants, cost factors, seasonality dummies, market power proxies, anti-pollution laws, vertical relations, and taxes. See Chouinard and Perloff (2003) for an extensive discussion of the variables and data sources.

Table 1 reports the estimation results for the major variables. The average per gallon wholesale price is 75¢ and retail price is $1.26. Crude oil prices, mergers and divestitures (not shown in the table but available from the authors), and taxes contribute the most to the explanation of price changes. The price of crude oil accounts for 63% of the estimated wholesale price, and taxes account for an additional 12%. Similarly, 37% of the estimated retail price is due to the price of crude oil, and taxes account for 24%. (See Chouinard and Perloff 2003 for a discussion of the impact of mergers and divestitures.)

From 1989 through 1997, the federal specific gasoline tax ranged from 11¢ to 20¢ per gallon (in $1997). Most of the state gasoline taxes are specific taxes. Only California, Georgia, Illinois, Indiana, Louisiana, Michigan, Mississippi, and New York apply ad valorem taxes to the retail gasoline price. These ad valorem tax rates range from 3.11% to 7% of the retail price that includes the specific taxes. In our analysis, we convert the ad valorem taxes to their specific equivalent and combine them with the actual specific taxes. (We also tried specifications where we treated the specific and ad valorem taxes separately and found that the estimated incidences were similar to the ones we report.) The state specific tax ranges from 7¢ to 36¢ without the ad valorem adjustment and from 9¢ to 36¢ with the adjustment.

In our regressions, the tax variables are the federal specific gasoline tax, the combined state tax, and the state tax interacted with the share of total quantity sold in

each state, share squared, share cubed, and share raised to the fourth power. The calculated incidences do not differ much if we use only the share interaction.

The federal specific tax coefficient is statistically significantly different from zero at the 0.05 level in both equations. All five state tax coefficients are individually statistically significantly different from zero in the wholesale equation. All but the state specific tax interacted with the state share raised to the fourth power coefficient is statistically significant in the retail equation, and that term just barely misses. Higher order terms were statistically insignificant in both equations.

We can reject the hypothesis that the state specific tax coefficient and the state specific tax coefficient interacted with the state share terms are collective zero for the wholesale equation ($\chi^2 = 25.89$) at the 0.01 level, and for the retail equation ($\chi^2 = 3.62$) at the 0.06 level. We can reject the hypothesis that the coefficients on these two variables are zero in both the retail and wholesale equations simultaneously ($\chi^2 = 13.66$).

Using the estimated coefficients, we can determine the incidence of federal and state specific taxes. An increase in the federal tax by 1¢ raises the retail price by 0.47¢ and decreases the wholesale price by 0.56¢. Thus, consumers and wholesalers each pay roughly half of the federal specific tax.

In contrast, state specific taxes fall primarily on consumers. The average quantity share, s_i, across states is 2.04%. At this average, a 1¢ increase in the state specific tax causes a 1.01¢ increase in the retail price and a 0.02¢ increase in the wholesale price (the retail effect is much more precisely measured than the wholesale one). Thus, consumers bear the full burden of a state tax.

We can also determine how consumer incidence varies with each state's share of the total quantity of regular unleaded gasoline sold. Vermont is the state with the smallest average share of quantity sold for the time period at 0.19% (the District of Columbia's share is 0.06%). At the other extreme, California has largest average share of quantity at 11.32%. A 1¢ increase in a specific tax raises the retail price by 0.97¢ in Vermont but by only 0.75¢ in California. Similarly, a 1¢ specific tax increase lowers the wholesale price by 0.16¢ in Vermont, and decreases it by 0.11¢ in California.

4. Conclusions

Using a simple competitive model of tax incidence, we formulated two hypotheses: that the consumer incidence of a state specific gasoline tax would exceed that of a federal tax, and that the state consumer incidence would fall with the share of national gasoline sales in a state. These predictions were based on the result that the residual supply elasticity is greater for state than for federal taxes and greater for small than for large states.

These predictions are confirmed by our empirical study. The consumer incidence is a half for the federal tax but nearly one for the average size state. The consumer incidence is much smaller in the larger states than in smaller ones.

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Table 1: Retail and Wholesale Reduced-Form Price Equations (1997¢)

	Retail		*Wholesale*	
Variable	*coefficient*	*t-statistic*	*coefficient*	*t-statistic*
Demand				
Income	1.27	1.74	0.69	0.95
Vehicles per Capita	-0.76	-0.48	-0.79	-0.50
Share of Pop. In Metro. Area	3.41	0.80	7.58	1.80
Miles Per Gallon	0.11	0.82	0.15	1.17
Urban Speed Limit	0.16	3.72	0.02	0.49
Rural Speed Limit	-0.20	-6.73	-0.07	-2.22
Cost				
Crude Oil Price	0.63	33.86	0.82	44.50
Crude Oil Price Lagged Once	0.14	5.02	0.05	1.59
Crude Oil Price Lagged Twice	0.21	11.22	0.13	6.93
Persian Gulf War	1.69	5.13	3.05	9.35
Seasonality				
Heating Degree Days	-0.21	-4.98	-0.24	-5.80
Market Power				
Density of Retail Stations	-0.01	-1.57	-0.02	-1.92
Pollution Laws				
Federal Reformulated Gasoline	0.76	2.74	0.55	2.03
CA Reformulated Gasoline	2.77	1.74	0.73	0.46
Oxygenated Gasoline	3.55	13.11	2.88	10.72
Vertical Relations				
Lease Operated	0.29	15.64	0.19	10.06
Company Operated	-0.002	-0.02	0.07	0.82
Taxes				
Federal	0.47	11.08	-0.56	-13.31
State Specific	0.94	13.32	-0.24	-3.47
State Specific * Share of Gasoline	17.06	2.31	44.76	6.13
State Specific * (Share of Gasoline)^2	-670.11	-2.53	-1656.99	-6.31
State Specific * (Share of Gasoline)^3	7566.34	2.22	19402.20	5.74
State Specific * (Share of Gasoline)^4	-27439.90	-1.97	-72160.70	-5.24
R-Squared	0.89		0.90	

Note: Not reported to save space are 11 monthly (seasonal) dummies, mergers and divestiture dummies, and fixed effects dummies for each state and the District of Columbia.