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An analysis of the effect of a gas tax increase on consumption and revenue

Introduction

The United States House of Representatives recently attempted unsuccessfully to raise the federal gas tax. The 15 cent increase in the tax was intended to raise additional revenue for road projects in the United States. This paper analyzes the effect that the tax increase would have on gasoline consumption by US consumers, and thus the change in revenue. Consumer demand for gasoline is relatively inelastic in both the short and long term. As a result, while consumption would decrease some due to the tax increase, it is not at a level that would prevent the Federal Government from collecting a substantial amount of increased tax revenue. Therefore, the policy would be predicted to have its intended effect.

Policy background

In 1932, the Federal Government enacted the first gas tax in the United States at one cent per gallon. While it has been raised many times since then, it has remained constant at 18.4 cents per gallon since the mid 1990s (FHA 2015). The gasoline tax funds the Highway Trust Fund, which is the primary funding source for federal road projects around the country. As the gas tax has been held constant for two decades now despite inflation, increased fuel efficiency, and changing gas prices, the Highway Trust Fund has struggled to remain solvent. As a result, the Federal Government has had to fund the Highway Trust Fund through means other than the gas tax. Many members of Congress, the US Chamber of Commerce, and the American Trucking Association have all lobbied for an increase of the gas tax. Most recently, the House of Representatives blocked a

proposed amendment that would have raised the gas tax by 15 cents per gallon, bringing the new total federal gas tax to 33.4 cents per gallon (Laing 2015). The intention of this gas tax raise was an increase in revenue for the Highway Trust Fund. To determine whether or not it would have this result, it must first be calculated what effect the price increase would have on consumption. If consumption were to drop at too high of rate due to the price increase, revenue could potentially stay constant or even decrease.

Methodology

To understand what effect a 15 cent increase in the gasoline tax would have on US gas consumption, it is important to first determine who actually pays the tax. The gasoline sellers are responsible for paying the tax to the US government, and therefore bear the statutory incidence. However, that does not translate into the producer bearing the economic incidence, as this is borne almost entirely by the consumer due to their relatively inelastic demand for gasoline (Marion and Muehlegger 2011). For the purposes of this model, it is assumed that the consumer will bear 100% of the economic burden of the tax, therefore a 15 cent per gallon increase in the tax would result in a 15 cent per gallon increase in gasoline prices.

In order to estimate what effect a 15 cent increase in the gasoline tax would have on gasoline consumption, the 15 cents will be measured as a percentage change in recent mean annual gas prices. Then, that percentage price change will be plugged into common estimates of price elasticity of demand for gasoline in the United States. This calculation will result in the percent change in quantity demanded as a result of the increased gas tax, which can then be applied to actual gasoline consumption volumes. Annual consumption

and price figures will be used to account for the intra-annual variances in consumption and prices that could drastically sway the results.

In 2014, the average gas price in the United States was $3.437, and Americans purchased 136,780,000,000 gallons (EIA 2015). A 15 cent increase in the gas tax, passed on completely to consumers in the form of higher prices, would have resulted in a 4.4% price increase per gallon to $3.587 in 2014.

Determining price elasticity of demand is not as straightforward as measuring consumption. There is a wide body of research attempting to measure demand elasticity for gasoline over various periods of time in the United States. Because many different factors go into consumer's willingness to pay higher prices for gasoline, there is some variation in the findings. However, when the literature is all read together, clear patterns emerge. US gasoline consumers are relatively inelastic in the short run and somewhat more elastic in the long run. In a 2013 paper, researchers at UC Davis included a table with the results from the most well regarded elasticity studies. The mean of the short run elasticities included in this table was -.21 and the mean of the long run elasticities was -.54 (Prince and Lin 2013). Taking the mean of a number of studies protects against differences in instrumentation and point in time peculiarities, so this method provides a more accurate picture of true demand elasticity for gasoline than any one study. The table from Lin and Prince's paper can be found in the appendix as Table 1, along with further explanation of the elasticity calculation methodology used in this paper. For the purposes of this model, it is assumed that -.21 in the short run and -.54 in the long run are the correct elasticity for gasoline consumption in the United States.

Results

Price elasticity of demand = % change in Q/% change in P. Since both elasticity for gasoline and percent change in P are already known, this equation can be reversed to find the percent change in quantity of gas consumed.

Short run consumption effect of 15 cent gas tax increase at 2014 mean gas prices:

-.21 (SR elasticity) x 4.4 (% price change) = -.92 (% quantity change)

In the short run, gas consumption would decrease by .92%.

At the 2014 consumption level of 136.78 billion gallons this price increase would result in the following decrease in gasoline consumption in the short run:

136,780,000,000 x .9908 = 135,521,624,000 gallons

Long run consumption effect of 15 cent gas tax increase at 2014 mean gas prices:

-.54 (LR elasticity x 4.4 (% price change) = -2.38 (% quantity change)

In the long run, gas consumption would decrease by 2.38%.

At the 2014 consumption level of 136.78 billion gallons this price increase would result in the following decrease in gasoline consumption in the short run:

136,780,000,000 x .9762 = 133,524,636,000 gallons

Effect on government revenue:

In 2014, the gas tax was 18.4 cents per gallon, earning the federal government an estimated $25,167,520,000 in gas tax revenue. If the gas tax was increased to the proposed 33.4 cents per gallon, using the same baseline consumption and price numbers as above, the Federal Government would be predicted to increase its gas tax revenue, even with the decreased consumption as a result of higher prices. In 2014, with a 33.4 cent/gallon gas tax, the revenue from the tax would have been $45,264,222,416 under

short run elasticity and $44,597,228,424 under long run elasticity. This is a revenue increase of around 20 billion dollars from the previous gas tax level. These results can be seen in Table 2 in the appendix. The increase in the gas tax can reasonably be predicted to have the desired effect: an increase in revenue for the Highway Trust Fund.

External validity

The external and long-term validity of these findings is complicated by the point in time approach necessary to calculate elasticity. The starting price of gasoline chosen for the elasticity calculation has a major effect on results. Elasticity is a function of percentage change in price, so a 15 cent price increase will have a very different effect on consumption at low prices than at high prices. For example, the October 2015 average price/gallon in the United States was $2.29 (EIA 2015). At this price, the percentage price change would be 6.6%. However in 2008 for example, average gas prices were as high as $4.08 (Rooney and Musante 2008). At this price, a 15 cent tax increase results in only a 3.6% price change. Using the standard elasticity equation, identical price increases will result in different consumption effects at different starting prices. While it is relatively difficult to predict long-term gas prices, policy makers will need to consider long-term price fluctuations when estimating predicted revenue from a gas tax increase.

Conclusion

The demand of American consumers for gasoline is relatively inelastic, even in the long run. As a result, increasing the federal gas tax will reduce consumption, but not so much that the tax increase will not have its desired effect of raising revenue. Increasing the federal gas tax is a viable and realistic way to increase government revenue.

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Appendix

Table 1:

Elasticity estimates for short and long run gasoline consumption

Previous Estimates of Short-Run (SR) and Long-Run (LR) Price Elasticities of Demand for Gasoline					
	data range	SR		LR	
		mean	*range*	*mean*	*range*
Dahl and Sterner, 1991	meta analysis (pre 1989)	-0.26	-0.22 to -0.31	-0.86	-0.80 to -1.01
Espey, 1998	meta analysis (1929 - 1993)	-0.26	0 to -1.36	-0.58	0 to -2.72
Goodwin, 1992	meta analysis (pre 1987)				
- Time series		-0.27		-0.71	
- Cross Section		-0.28		-0.84	
Goodwin et al., 2004	meta analysis (1929 -1991)	-0.25	-0.01 to -0.57	-0.64	0 to -1.81
Graham and Gleister, 2002	meta analysis (pre 1994)		-0.2 to -0.5		-0.23 to -0.8
Graham and Gleister, 2004	meta analysis (pre 1994)	-0.25	0.59 to -2.13	-0.77	0.85 to -22.0
Hanley et al., 2002	meta analysis (1929 - 1991)	-0.25	-0.01 to -0.57	-0.64	0 to -1.81
Wadud et al., 2009	1978 - 2004		-.065 to -.091		-.102 to -.118
Small and Van Dender, 2007	1966 - 2001		-0.09		-0.16
	1997 - 2001		-0.07		-0.16
Hughes et al., 2008	1975 - 1980		-0.21 to -0.34		
	2001 - 2006		-0.034 to -0.077		

Source: Lin and Prince 2013.

Methodology note: To calculate short and long run elasticity for gasoline consumption, the mean of each of the studies reported in this table was used. If a study found only a range, the midpoint of the range was used in the mean calculation. Otherwise, the exact elasticity found was used.

Table 2:

Projected Revenue and Consumption

	2014 actual	**SR w/ tax increase**	**LR w/tax increase**
Price (USD)	$3.437	$3.587	$3.587
Consumption (gal.)	136,780,000,000	135,521,624,000	133,524,636,000
Revenue (USD)	$25,167,520,000	$45,264,222,416	$44,597,228,424