

ESTIMATING THE CROSS-PRICE ELASTICITY OF REGULAR GASOLINE WITH RESPECT TO THE PRICE OF PREMIUM GASOLINE

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Overview

Demand for gasoline is one of the more intensively researched topics in energy economics. Many studies using a variety of methods have been carried out to improve the accuracy of the findings. Interestingly, there has yet to be any studies that attempt to determine the substitutability between gasoline of different grades. Such knowledge is needed to be able to examine the inefficiency caused by a fuel pricing policy that has a different subsidy rate for different grades of gasoline. Most studies in the literature treat regular, midgrade and premium gasoline as a single commodity, while diesel and ethanol are occasionally treated as substitutes. We have found only two demand studies, Fullerton et al. (2015) using Mexican data and Hastings et al. (2013) using U.S. data, that consider regular and premium gasoline as separate products. However, neither attempts to estimate the cross-price elasticity.

The contribution of this essay is to build upon and improve the one study we found (Fullerton et al. 2015) that estimates gasoline demand own-price elasticities by grade for Mexico. We improve on their seminal work by specifically estimating both own and cross-price elasticities for regular gasoline. We are also able to increase the sample size and will perform much more substantive statistical testing including tests for structural change, adjustments for seasonality, and tests for stationarity and cointegration. Further, we test the assumption that the prices set by the government are exogenous because the government might respond to market conditions. The cross-price elasticities between regular and premium gasoline is found to be 0.875, which confirms high substitutability among gasoline with different grades.

Methods

Using monthly data on the Mexican gasoline market from 1999-2014, regular gasoline demand is estimated with an Autoregressive Distributed Lag (ARDL) model based on the work of Pesaran et al. (1998). The model includes prices of regular and premium gasoline, income, population and vehicle stock. Other variables such as road network and vehicle efficiency were also tested but did not improve the estimates. We performed stationarity tests and then ARDL bounds test (Pesaran et al. 2001) to check for cointegration. To ensure the validity of the estimates, we performed autocorrelation tests (Durbin 1970 and Godfrey 1978), ARCH disturbances test (Engle 1982), and RESET test (Ramsey 1969). Endogeneity of the price was investigated and found to satisfy the exogeneity test. In addition, structural break tests were also carried out to anticipate any changes in consumer behavior following the recession in 2008.

Results

In the best model, the income elasticity is estimated to be 1.09. The long run own-price elasticity is -2.00, while the cross-price elasticity is 0.875. This confirms our hypothesis that there is strong substitutability between regular and premium gasoline. You may notice that this own price elasticity is much more elastic than in the meta-analysis of Labandeira et al. (2017), who conclude the average estimated long-run price elasticity is -0.8. However, most of the gasoline studies used in their meta-analysis do not include the price of substitute fuels. Thus, when the price of gasoline increases effectively reducing its consumption, the price of the usual substitute, in most cases diesel, also increases causing an increase in gasoline consumption. Hence, the estimated price elasticity contains the sum of these two opposing effects.

Conclusions

Our results confirm that consumers of regular gasoline in Mexico are quite responsive to changes in the price of premium. However, attempts to estimate meaningful demand elasticities for premium gasoline were unsuccessful. There may be a core group of wealthy users of premium that are unlikely to alter their consumption based on prices and the overall changes in Mexican GDP and population. Or the data for this much smaller class of consumers may simply be inadequate.

Our unique results have interesting policy implications for any country with variable subsidies on gasoline by grade that is considering a subsidy reform. They suggest that own and cross-price elasticities are much higher than implied

by traditional studies that do not include substitute prices. Although there are some statistical weaknesses in our study resulting from collinearity, some ambiguity in statistical tests, and disappointing results for premium gasoline, our results strongly suggest high price elasticities for regular gasoline. Since we could only find data for Mexico, we are uncertain if our results are transferable. However, we suspect that other countries with variable subsidies may also have prices by grade that are not as collinear as in countries where prices are basically market based. We urge such countries to use our paper as a guideline to accurately estimate their own price elasticities.

References

- Durbin, J. (1970): 'Testing for serial correlation in least-squares regressions when some of the regressors are lagged dependent variables', *Econometrica*, 38: 410–421.
- Engle, R. F. (1982): 'Autoregressive conditional heteroscedasticity with estimates of the variance of United Kingdom inflation', *Econometrica*, 50: 987–1007.
- Fullerton Jr, T. M., Salazar, J. A. I., and Elizalde, M. (2015): 'Microeconomic gasoline consumption anomalies in Mexico: 1997-2007', *Asian Economic and Financial Review*, 5(4), 709-722. [http://www.aessweb.com/pdf-files/aefr-2015-5\(4\)-709-722.pdf](http://www.aessweb.com/pdf-files/aefr-2015-5(4)-709-722.pdf)
- Godfrey, L. G. (1978): 'Testing against general autoregressive and moving average error models when the regressors include lagged dependent variables', *Econometrics*, 46: 1293–1301.
- Hastings, J. S., and Shapiro, J. M. (2013): 'Fungibility and consumer choice: Evidence from commodity price shocks', *The Quarterly Journal of Economics*, 128(4), 1449-1498.
- Labandeira, X., Labeaga, J.M. and López-Otero, X. (2017). A meta-analysis on the price elasticity of energy demand. *Energy Policy*, 102, pp.549-568.
- Ramsey, J. B. (1969): 'Tests for specification errors in classical linear least-squares regression analysis', *Journal of the Royal Statistical Society, Series B* 31: 350–371.