DIFFERENTIAL GASOLINE PRICES ACROSS COUNTRIES AND TIME - A PANEL ECONOMETRIC ANALYSIS

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Overview

The globalization of world trade has leveled motor vehicle price all over the world to such an extent that the price ratio for equivalent vehicles no longer exceeds about 1 to 2 between any two countries. However, transport gasoline price in different countries still differs on a scale of as much as 1 to 150. The three cost components that make up the final gasoline price are generally pointed as (1) the crude oil price; (2) the costs related to refining, distribution, transportation, etc; and (3) national gasoline taxes (Bentzen, 2002). Among the three components, taxes share the most parts of the price and hence are considered the major factor that contributes to the differential gasoline prices across different countries (Rietveld and van Woudenberg, 2005). However, why the gasoline tax levels differ among countries? Are the major determinants of gasoline taxes differ across countries that makes the difference, or there are country-specific factors other than the determinants of tax level responsible for the difference? Although earlier studies have indicated that for industrilizd countries (especially EU countries), the introduction or increasing of energy tax to cope with the international pressure of combating the global warming problems will reduce the international differences in gasoline prices (e.g., Bentzen, 2002), recent studies have shown a contradictory result that constant price differences caused mainly by existing tax differences between countries still remain (Dreher and Krieger, 2004).

This paper examines a number of considerations from the theory of public finance that may explain the differences between a number of countries and explores empirically the factors that contribute to these differences. Previous studies tackling this issue empirically have applied mainly the multiple regression method. By using the cross-sectional data and examining the statistical significance of variables considered to be the determinants of gasoline tax levels, the major factors that contribute to the differences can be identified (e.g., . Rietveld and van Woudenberg, 2005). It is argued, however, that the differences in gasoline prices exist not only across countries at a specific time, but also across different time points. Countries may respond to the movement of internatonal environmental affairs differentially due to many considerations, e.g., competitiveness. Over time, these differential reactions may vanish. But, the actions taken by different countries at different point in time may significantly change the significance of the factors that originally shown to have the major determining power. Consequently, the current paper intends to deal with the issue by applying an approach that takes into account both the cross-sectional and the time series differences.

Methods

With the nature of the problem spans not only over different countries but also over different time periods, we chose to specify panel data models for our empirical analysis. Panel data analysis extends regression analysis to include both a spatial and temporal dimension. The spatial dimension covers a set of cross-sectional units of observation. The temporal dimension has periodic observations of the variables characterizing cross-sectional units over a particular time span (Greene, 2003). As such, panel data analysis allows us to study the dynamics of change with short time series. There are several types of panel data analytic models, such as constant coefficients models, fixed effects models, and random effects models. The coice between the models can be done by performing a set of statistical tests (F test) and specification tests Hausman test). The empirical model we specified is as follows.

$$GP_{it} = \alpha_i + \ln \beta_1 GDP_{it} + \beta_2 GOV/GDP_{it} + \beta_3 GOVDEBT/GDP_{it} + \beta_4 CPI_{it} + \beta_5 GNI_{it} + \ln \beta_6 POP_{it} - \beta_7 FAT_{it} + \beta_8 CAR_{it} + \beta_9 OIL_{it} + \beta_{10} CO2_{it} + \varepsilon_{it}$$

where GP is nominal gasoline price, GOV/GDP is the ratio of government expenditure to nominal GDP, GOVDEBT/GDP is the ratio of government debt to nominal GDP, GNI is per capita income, POP is population density, FAT is road casuality, CAR is car density, OIL is dependency on imported oil, and CO2 is the growth rate of CO_2 emissions.

When estimating the model, heteroskedasticity and autocorrelation in errors need to be suitably taken care of in order to get more accurate and efficient estimation results. Fixed effects models with groupwise heteroskedasticity cannot be efficiently estimated with OLS. However, if the sample size is large enough and autocorrelation plagues the errors, feasible GLS (FGLS) can be used. And if the model exhibits autocorrelation errors, first differences in variables can be used (Wooldridge, 2002).

Results

We found from the theory of public finance that differential tax policies between counties are the main reason that causes the difference in gasoline price among different countries. Empirically, by using the data set containing gasoline prices for 17 countries (15 EU, US, and Taiwan) spanning from 1999 to 2004, and by applying fixed effect model with FGLS estimation method, we found that the factors that contribute to the significant differences in gasoline price include government expenditure, government debt, income, as well as car density and road casualties (see Table 1 below; Models 1 and 2 include all 17countries, while Models 3 and 4 include only 15 EU countries). Environmental situations (CO_2 emissions) and the dependency in imported oil are also found to be significant factors that may cause the gasoline price to differ. Basically, our results for traditional factors are in line with those of most previous studies. The most interesting parts are, however, on the additional variables we included in this study, i.e. OIL (import oil dependency) and CO2 (CO_2 emission growth rate). Our results indicate that EU countries have a higher tendency to increase gasoline prices due to the energy security and environmental considerations compare the coefficients between Model 2 and Model 4). For all countries, our results do suggest that raising gasoline price may improve the quality of the environment to some extent, which indicates that designing suitable policy for gasoline price should be a good way of achieving sustainability of the economy.

Table 1. Estimation results for the empirical models

Variable	Model 1	Model 2	Model 3	Model 4
CONSTANT	-1.0935	-1.9916	1.3504	6.5837
	(-0.32)	(-0.41)	(0.23)	(0.74)
GOV/GDP	-3.3123***	-1.6340**	-2.5249***	-0.7565
	(-3.92)	(-1.81)	(-2.78)	(-0.8)
GOVDEBT/GDP	0.0043***	0.0036***	0.0037***	0.0020
	(4.07)	(3.19)	(2.92)	(1.47)
CAR	0.0106***	0.0089***	0.0181***	0.0121***
	(2.69)	(2.82)	(3.42)	(3.2)
CPI	0.0008	-0.0013	0.0002	-0.0022
	(0.7)	(-0.56)	(0.18)	(-0.9)
lnGDP	0.3065**	0.4088***	0.3435***	0.5037***
	(2.56)	(3.06)	(2.68)	(3.69)
GNI	0.0212***	0.0114**	0.0196***	0.0080
	(5.3)	(2.21)	(4.75)	(1.54)
lnPOP	-0.2343	-0.2748	-0.4663	-1.1330
	(-0.63)	(-0.53)	(-0.79)	(-1.34)
FAT	-0.0391***	-0.0276***	-0.0481***	-0.0393***
	(-4.66)	(-2.81)	(-5.26)	(-3.63)
OIL	-	0.1508	-	0.1752*
		(1.43)		(1.65)
CO2	-	0.2276**	-	0.2380**
		(2.15)		(2.04)

Conclusions

We examine in this paper the factors that contribute to differences in gasoline price between countries. By using the data set containing gasoline prices for 17 countries spanning from 1999 to 2004, and by applying fixed effect model with FGLS estimation method, we found that the factors that contribute to the significant differences in gasoline price include government expenditure, government debt, income, as well as car density and road casualties. Environmental situations and the dependency in imported oil are also significant factors that may cause the gasoline price to differ, which suggests the importance of the fuel taxation policy.