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THE RAMSEY TAX COMPONENT IN THE TERMS OF GASOLINE TAXATION IN TURKEY

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Abstract

Ramsey who took the first foundations of optimal tax theory and handled optimal consumption taxes analytically for the first time, discussed how taxation rules should be in order to ensure efficiency in resource allocation and to minimize loss of efficiency. In this respect, he put forward the Inverse Elasticity Rule. The Inverse Elasticity Rule refers to tax lower than the goods with a high change in the amount of compensated demand due to taxation and higher than the low changes in the amount of compensated demand. Accordingly in this study, price elasticity of gasoline demand for Turkey was estimated by the Static Ordinary Least Square and the Dynamic Partial Adjustment Model for the period 2006-2017. According to the Dynamic Model, the price elasticity of the short-term gasoline demand is inelastic and according to the Inverse Elasticity Rule, gasoline is favorable in terms of obtaining higher government income. In this case gasoline may be subject to higher taxes to obtain government revenue by The Inverse Elasticity Rule as the price elasticity of gasoline demand in Turkey for the period 2006-2017 is inelastic. In this context Ramsey Tax Component that allowing the possibility of gasoline consumption being a weak substitution of leisure time and situated in the optimal gasoline tax was calculated for Turkey. The Ramsey Tax Component is expressed as a component based on the Inverse Elasticity Rule and calculated on the basis of the idea that goods are which lower change in the amount of compensated demand resulting from taxation provides higher government revenue. In this direction, Ramsey Gasoline Tax Component calculated for the year of 2017 for Turkey. Calculated Ramsey Gasoline Tax Component was determined to be less 2.46 times from the gasoline Excise Tax amount taken by the government.

Keywords: Inverse Elasticity Rules, Ramsey Tax Component, Gasoline Demand, Elasticity

JEL Code: C13, H20, R48

1. Introduction

Ramsey (1927) demonstrated the taxation rules of indirect taxes in order to ensure efficiency in resource allocation and to minimize the loss of efficiency. Debates on optimal excise tax have improved in direction whether to be optimal when the indirect taxes have a single ratio (lump sum tax) or differentiated rates (Heady, 1993: 384). Ramsey (1927) suggested that differentiated tax rates are optimal because the single rate tax is not optimal because it leads to loss of efficiency (Sorensen, 2007: 385). In this respect, Ramsey (1927) developed the Rule of Inverse Elasticity. Accordingly, it has been tried to find the optimal consumption taxes that maximize the benefit function of the representative individual. According to the Inverse Elasticity Rule, An equal amount of demand will be reduced from all goods by lower taxes than the goods with high change in the amount of compensated demand and by higher taxes than the goods with low change. Thus efficiency losses can be minimized.

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The aim of this study detects Ramsey Tax Component for Turkey that taken to obtain government income. In this regard firstly made gasoline price elasticity estimate for Turkey and has been found to be inelastic in the short term of the price elasticity of demand for gasoline. The use of short or medium term elasticity values in tax calculations is proposed by Lin and Prince (2009). In thisa direction, Ramsey Gasoline Tax Component that developed to obtain government income by Parry and Small (2005) calculated for Turkey by used 2017 data.

2. Literature

Parry & Small (2005) calculated the optimal gasoline tax (OGT) for UK and the United States and then compared it levied by government. Lin & Prince (2009) calculated OGT by developed Parry & Small (2005) for California adding the external dependence variable of oil as externality. Ley & Boccardo (2009) discussed the appropriateness of taxation of engine fuels for the OECD, BRICs and South Africa in the framework of the OGT developed by Parry and Small (2005). Lin & Zeng (2014) calculated the Pigovian Tax Component by developed Parry & Small (2005) and taked over externality for China. Sarabia & Trillo (2014) predicted OGT for Mexico. Williams (2005) examined the optimal taxation of gasoline in heterogenous consumer and existing adjustments of pre-taxes considering efficiency and equality.

3. The Price Elasticity of Gasoline Demand and the Prediction of VkMT Elasticity

3.1. Static Model

Demand elasticity is extremely important to measure the impact of a tax on consumer. In this study a basic log-log model was first used to estimate the elasticity of gasoline price and income.

$$lnD_t = \beta_0 + \beta_1 lnP_t + \beta_2 lnY_t + e_t \quad (1)$$

To represent the year t, D_t indicates the per capita domestic gasoline sales annual per liter, P_t annual average real gasoline price (2010 fixed price), Y_t annual per capita disposable income, e_t is zero average error.

The domestic sales volume of gasoline[3] (tonnes) was obtained from the Energy Market Regulatory Authority Petroleum Market Annual Sector Report. The amount of gasoline was converted to liters and was divided into population data from World Bank and thus the amount of gasoline per capita was reached. The nominal price of gasoline was obtained from the Statistics Institute of Turkey. According to 2010 fixed dollar prices, it was converted into real gas price. Household disposable per capita income were obtained from the Turkey Statistical Institute. According to 2010 fixed dollar prices, real household disposable per capita income was obtained. Due to limited data, analysis was performed with annual series. Since the household disposable per capita income is produced annually, it can only be estimated with annual data, cannot monthly or quarterly data.

Table 1. OLS model for Turkey: 2006-2017
Dependent Variable: Logarithm of the difference of Turkey's gasoline sales volume

β_1	-0.48*** (0.079)
β_2	-0.19** (0.062)
β_0	5.88*** (0.048)
Number of Observation	12
R2	0.93
***%1**%5*%10 expresses significance levels. Robust standard errors are given in parenthesis.	

According to the static model, the price and income elasticities of gasoline demand are estimated in the long term. The results are shown in Table 1. Long term price elasticity was estimated to be -0.48.

The variables were analyzed using the Augmented Dickey Fuller (ADF) Test. According to the test results lnP_t and lnY_t variables were found both at level and in the trend. The lnD_t variable was found to be rooted in the trend. So the first difference was determined and the stability was tested and found to be stable at both the level and the trend.

3.2. Dynamic model: partial adjustment model

The dynamic model assumes that the gasoline demand cannot suddenly respond to changes in gasoline price and income but gradually converges towards long term equilibrium. D_t' is represented the demand for equilibrium gasoline that is desired or directly observed. A pattern can be obtained as follows:

$$lnD_t' = \beta_0 + \beta_1 lnP_t + \beta_2 lnY_t + e_t \quad (2)$$

The correction at the balance demand level is expressed as follows:

$$lnD_t - lnD_{t-1} = \delta(lnD_t' - lnD_{t-1}) \quad (3)$$

δ>0 and δ correction speed is given. When the number 3 equation is placed within the number 2 equation and the necessary arrangements are made such as in the equations 4 and 5, the number 6 equation is obtained. This equation gives the dynamic model. The acquisition of a dynamic model can be expressed as follows:

$$lnD_t - lnD_{t-1} = \delta(\beta_0 + \beta_1 lnP_t + \beta_2 lnY_t + e_t - lnD_{t-1}) \quad (4)$$

$$lnD_t = \delta\beta_0 + \delta\beta_1 lnP_t + \delta\beta_2 lnY_t + \delta e_t - \delta lnD_{t-1} + lnD_{t-1} \quad (5)$$

$$lnD_t = \delta\beta_0 + \delta\beta_1 lnP_t + \delta\beta_2 lnY_t + (1-\delta) lnD_{t-1} + \delta e_t \quad (6)$$

$\delta\beta_1$ and $\delta\beta_2$ coefficients in the dynamic model give the short term price and income elasticity. It has generated consistent estimation with OLS because there was not autocorrelation in the error term (δe_t). The results are shown in Table 2. The price elasticity of gasoline demand in the short term was estimated to be -0.18 when one year delayed estimation considered. According to İnverse Elasticity Rule, this result is expressed that gasoline to be inelastic and can be addressed in terms provided government income in Turkey.

Table 2. Partial adjustment model for Turkey: 2006-2017
Dependent Variable: Logarithm of the difference of Turkey's gasoline sales volume

lag length	no lag	1 year	2 year
$\delta\beta_1$	-0.48*** (0.079)	-0.18** (0.051)	-0.19** (0.072)
$\delta\beta_2$	-0.19** (0.062)	0.35*** (0.040)	0.32*** (0.077)
$(1-\delta)$	-	0.51*** (0.139)	0.12* (0.055)
$\delta\beta_0$	5.88*** (0.556)	-3.33*** (0.380)	-2.95*** (0.698)
Number of Observation	12	10	9
R^2	0.93	0.92	0.75
Adjustment speed (δ)	-	0.49	0.88
***%1**%5*%10 expresses significance levels. Robust standard errors are given in parenthesis. The results were estimated based on OLS			

3.3. The estimation of VkMT elasticity

VkMT[4] price elasticity shows how the change in price of gasoline as percentage changed the vehicle mileage as percentage. The results are given in Table 3.

Table 3. VkMT elasticity Estimation with OLS model for Turkey: 2006-2017
Dependent Variable: Logarithm of the VkMT per capita for Turkey

β_1	-0.33** (0.117)
β_2	0.83*** (0.126)
β_0	-0.70 (1.214)
Number of Observation	12
R^2	0.87
***%1**%5*%10 expresses significance levels. Robust standard errors are given in parenthesis.	

VkMT price elasticity (β_1) was estimated to be -0.33. 1% increase in the price of gasoline reduces

VkMT by 0.33%. VkMT expenditure elasticity shows how the change in household income as percentage changed the vehicle mileage as percentage. VkMT expenditure elasticity (β_2) was estimated to be -0.83. 1% increase in the household income increases VkMT by 0.83%.

4. Ramsey Tax Component

Ramsey Tax Component (RTC) that taked part in OGT developed by Parry and Small (2005) and allowed gasoline to be a poor subtitution leisure time was calculated for Turkey. RTC is as follows:

$$\text{Ramsey Tax} = \frac{(1 - \eta\text{mı}) * \varepsilon\text{ll}}{\eta ff} * \frac{tl * (qf + tf)}{1 - tl}$$

It refers to ηmı VkMT expenditure elasticity, εll labor supply elasticity, ηff price elasticity of gasoline demand, tl tax rate on labor income, qf producer price of gasoline, tf tax amount on gasoline consumption, $1 - tl$ net fee. The values detected for Turkey defined the parameters are given below:

Price elasticity of gasoline demand: ηff **-0.18**

The price elasticity estimation of gasoline demand was realized with the annual data for the years 2006-2017 using the dynamic model.

VkMT expenditure elasticity: ηmı **0.83**

VkMT expenditure elasticity estimation was realized with the annual data for the years 2006-2017 using OLS model.

Labor supply elasticity: εll **0.06**

Labor supply elasticity was used by Aykaç (2016) for Turkey and estimated for between 2003-2011.

Gasoline producer price: qf **0.54$/liter**

The product prices used for the years 2015-2017 have been transformed at the fixed prices of 2010 to 2017 real dollar exchange rate. The average of product prices for 2015-2017 was taken.

Table 4. Average price formation of gasoline ($/liter)

Product	Year	Product Price	Wholesaler Marjin	Income Share	Total of Distributor and Dealer Marjin	Total Tax	Final Sale Price
95 octane unleaded gasoline	2017	0.66	0.029	0.00118	0.20	1.36	2.24
	2016	0.46	0.017	0.00114	0.19	1.25	1.92
	2015	0.50	0.021	0.00108	0.17	1.22	1.91

Source: Energy Market Regulation Board (EMRB)

Tax amount on gasoline consumption : tf **1.01$/liter**

The tax amount of gasoline consumption has been reached from Energy Market Regulation Board 2017 Annual Sector Report. This amount has been converted by 2017 real dollar exchange rate with fixed prices in 2010 (EMRB, 2017: 67).

The calculated RTC and values of other parameters used to calculate the RTC are given in Table 4. The RTC calculated based the following values of parameters for Turkey was estimated to be $1.57/liter.

Table 5. Ramsey Tax Calculation for Turkey

Parameters	**Values**
VkMT expenditure elasticity(ηmı)	0.83
price elasticity(ηff)	-0.18[5]
Labor supply elasticity(εll)	0.06
Tax rate on labor income (tl)[6]	0.8238
Gasoline producer price(qf)	0.54$/liter
Tax amount on gasoline consumption[7](tf)	1.01$/liter
Net fee(1-tl)	0.1762
Government spending share in national output(αg)[8]	0.8410
Gasoline production share in national output(αf)[9]	0.0092
Government spending(G)	339,668,230,277$
Labor income(L)	403,871,562,046$
Taxable gasoline sales(F)	6,879,051,946$
Ramsey tax component	**0.41$/liter**
*The calculations are based on 2017 data	

5. Conclusion

According to the results of the analysis for Turkey price elasticity of gasoline demand was determined to be as inelastic in short term. According to the Inverse Elasticity Rule, goods with inelastic compensated demand should be taxed at a higher rate. Thus higher tax revenues will be obtained. According to the analysis it is determined that gasoline have inelastic demand for Turkey. For this reason gasoline has been found to be favorable in terms of obtaining high government revenue. In this regard Ramsey Gasoline Tax Component developed by Parry & Small (2005) and used to obtain the government revenue has been calculated $0.41/liter. According to the Energy Market Regulatory Authority 2017 Report, The Excise Tax amount for 2017 is $1.01/liter by real dollar exchange rate. The total tax amount received from gasoline is $1.36/liter by the real dollar exchange rate. It was determined that the calculated Ramsey Gasoline

[5] Negation is not taken into account in the calculation.
[6] αg – tf/qf*αf
[7] Excise tax
[8] (G/L)
[9] (F/L*qf)

Tax Component was 2.46 times less than the Excise Tax received by the government and 3.32 times less than the total tax received from gasoline.

Calculated Ramsey Gasoline Tax Component calculated by using elasticities determined as of 2006-2017 years. Therefore the Ramsey Gasoline Tax Componentcalculated with predictable elasticities for different years may be different. Further studies are recommended for other types of fuel.

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