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EXCISE TAX POLICY AND CROSS-BORDER PURCHASES OF AUTOMOTIVE FUELS

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Abstract

In a small open country such as Slovenia, drivers can either purchase automotive fuel within the country or abroad. A simple demand model is used to test the proposition that changes in excise tax policy caused the decline of purchases in the country, and to delineate the effects of excise tax policy from the effects of the simultaneously occurring economic crisis. To do that, short- and long-run, and direct- and cross-price elasticities are estimated for the purchase of gasoline and automotive diesel in five regions: Slovenia's four border regions and the interior. For the estimation of "volume of transportation" elasticity, vehicle crossings through road sites with automatic traffic meters are used. The simulations indicate that more than half of the decline in the purchase of automotive fuels in 2009 can be attributed to excise tax policy and less than half to the economic crisis, and that the increase in tax revenues generated by excise tax policy significantly exceeded the decrease in the sellers' earnings.

Keywords: retail trade, taxation, time series model

JEL: L81, H2, C22

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1. Introduction

Most empirical studies of price and income elasticity of demand for fuels deal with the subject in the framework of a traditional expenditure model and attempt to distinguish between short- and long-run elasticity. They use national or household-level data and different econometric techniques. More recent studies deal with the consequences of non-stationary and co-integrated time series, which imply that short-run elasticity should be estimated using an error correction method. A survey of international research dealing with responses to fuel price changes (D. J. Graham and S. Glaister, 2002) reports large differences in countries between short- and long-run price elasticity, often dependent upon the estimation technique used. Nevertheless, the conclusions of most studies are similar; short-run price elasticity of demand for automotive fuels is relatively low, long-run price elasticity is higher and income elasticity is high. Recently, the possibility of a link between elasticity of demand for automotive fuels and fuel efficiency has come to the fore as researchers analyze the implications of fiscal policies for traffic levels, vehicle emissions and environmental issues (see Romero-Jordan et al., 2010). The aim of the research presented in this paper was to quantify the effects of excise tax policy in the road fuels market, which is heavily exposed to cross-border shopping. This brings us to many different concepts of interest such as distinction between elasticity on the national and local level (Crotte, A. et al., 2010; Besley and Rosen, 1998)., long and short run elasticity (M.L. Polemis, 2006), price asymmetry (Bettendorf, L. et al, 2003), taxation of fuels (S.Gupta and W. Mahler, 1995) etc. Nielsen (2002) created a theoretical model which explains why net cross-border purchases not only flow from large to small countries, but also in the "wrong" direction, (i.e. from small to large countries) if tax rates in the large country considerably exceed tax rates in the small country. Devereux at al. (2007) provided a general theoretical framework for the distinction between horizontal and vertical tax competition in excise taxes; they relate elastic demand for taxed goods with the likelihood of cross-border purchases and smuggling, which plays a role in the case of cigarettes but not gasoline in the empirical part of their study.

2. Characteristics of the market

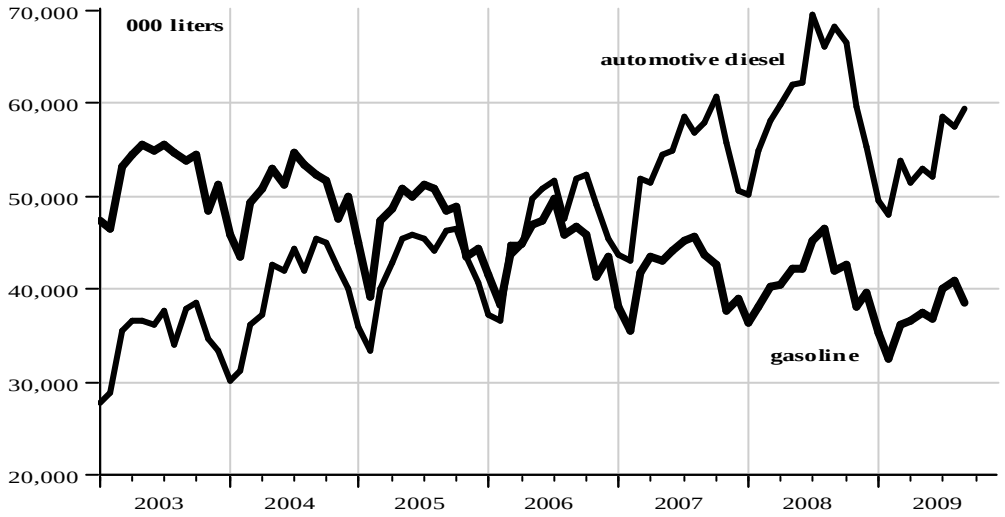
Slovenia is a small open country and most consumers can buy automotive fuel, either within the country or abroad. The government therefore kept domestic retail sale prices below retail sale prices in neighboring countries. When, in December 2008, the government began to increase excise taxes to cope with the enormous fall in other tax revenues, the purchase of automotive fuels declined and the sellers began to blame tax policy for their drop in earnings. A simple demand model is used to test

their viewpoint and to delineate the effects of excise tax policy from the effects of the world economic crisis.

Two markets for automotive fuels are explored: the gasoline market and the automotive diesel market. The analysis is based on monthly data on gasoline and automotive diesel purchases from a sample of 320 gasoline stations, or approximately 64 percent of gasoline stations in the country. The stations in the sample are well spread throughout the whole country, alongside major highways crossing the country, and connecting three neighboring countries (Austria, Hungary and Croatia) with Northern Adriatic ports and Italy. In the observed period, 2003–2009, the gasoline stations sold a monthly average of 47.2 million liters of automotive diesel; the quantity increased from 34.8 million liters in 2003 to 62.0 million liters in 2008. During the same period, the average monthly quantity of 45.7 million liters of gasoline decreased from 52.4 million liters in 2003 to 41.1 million liters in 2008.

Graph 1

Quantity of gasoline and automotive diesel



The retail sale price of gasoline and automotive diesel is set using the "administrative price determination model", introduced in 2000. The model adjusts the "production" (pre-tax) price to the oil price in the Mediterranean and US dollar exchange rate every two weeks. The administratively set "mark-up" of a seller is included in order to cope with a dualistic market structure – two companies

controlling approximately 90 percent of the market.[1] By adding 21 percent value added tax and excise tax (in absolute value per liter), the retail sale price is set. The excise tax thus allows the government to directly determine the retail sale price and, also, indirectly – depending on price elasticity of demand – quantities, tax revenues, purchases and the earnings of companies selling automotive fuels. Excise tax on automotive fuels also affects the amount of other goods sold at gasoline stations, notably cigarettes and alcoholic beverages – two items which are also subject to excise taxation. Furthermore, by affecting the earnings of gasoline stations, excise tax affects income tax and profit taxes paid by the companies and/or their employees.

During the observed period, "production" prices (prices before taxes) in Slovenia did not differ greatly from "production" prices in neighboring countries and fluctuations were very similar. The differences in retail sale prices between Slovenia and neighboring countries were caused by taxation. In the 2003–2008 period, gasoline and automotive diesel in Slovenia were approximately ten percent cheaper than in neighboring countries, the average domestic price of gasoline being EUR 0.991 for a liter and EUR 0.971 for a liter of automotive diesel, while corresponding "foreign" prices were EUR 1.154 and EUR 1.078, respectively.

In December 2008, the Slovenian government began to increase excise taxes on automotive fuels to cope with a general fall in other tax revenues.[2] In effect, the government made use of the drop in world oil prices to enhance tax revenues. This altered previous policy, which had kept domestic retail sale prices below retail sale prices in neighboring countries. Indeed, in 2009, the gap between domestic and "foreign" prices for gasoline narrowed and the gap between domestic and "foreign" prices for automotive diesel disappeared entirely.[3]

[1] The price determination model is considered to be appropriate in the existing situation in which the largest Slovenian company, Petrol, is a price taker in the oil market, while sharing a near duopoly with Austrian-owned OMV in the retail sale market of automotive fuels.

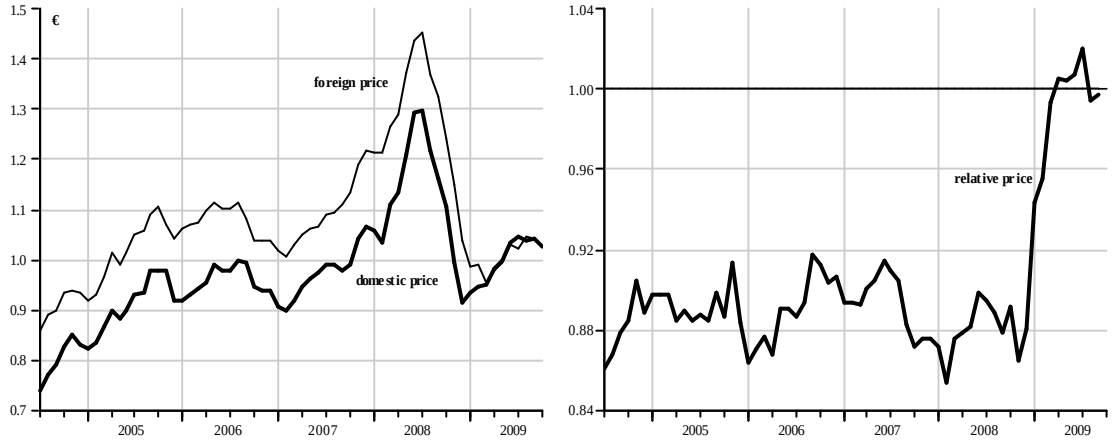
[2] Excise taxes on gasoline and automotive diesel are by far the most important source of revenues from excise taxation, and because of their flexibility they are crucial in maximizing tax revenues and the financial situation of the companies selling automotive fuels.

[3] There were no changes in Italy, while Croatia increased VAT from 22 percent to 23 percent in August without changing excise tax Austria even reduced excise tax slightly in April, while Hungary decreased excise tax and increased VAT from 20 to 25 percent.

Table 1
Tax policy in Slovenia and neighboring countries in 2009

	Austria	Croatia	Hungary	Italy	Slovenia
gasoline					
price before taxes	-22.7	-13.5	-14.4	-12.0	-15.4
taxes	+3.9	-4.8	-7.9	-2.9	+18.7
retail sale price	-7.6	-8.7	-10.8	-5.9	+2.9
automotive diesel					
price before taxes	-21.5	-17.8	-14.4	-18.7	-22.3
taxes	+4.2	-4.4	-10.8	-2.2	+25.4
retail sale price	-8.7	-11.4	-11.3	-10.2	+0.6

Graph 2
Retail sale prices of automotive diesel



The purchase of automotive fuels declined considerably, possibly as a result of the economic crisis. This is reflected in the decline in transportation, due not only to the drop in economic activity in Slovenia and its neighboring countries, but also in other Eastern European countries such as Romania, Poland, Ukraine and Slovakia, which use the transit through Slovenia for their imports and exports.

3. Data

The data on the quantities and prices of gasoline and automotive diesel in Slovenia and the data on prices in the four neighboring countries were provided by SNNK (Slovenian National Oil Committee). The number of days of administratively set price levels in a month was used to calculate the monthly price as a weighted average.

Gasoline stations were grouped into four border regions and the interior. In each border region, the relative price of fuel is the retail sale price in Slovenia divided by the retail sale price in the corresponding neighboring country. For the interior, the relative price is the domestic retail sale price divided by the "foreign" retail sale price, which is a weighted average of retail sale prices in neighboring countries – the "weight" being the number of road vehicle crossings in the relevant border region.

Table 2
Crossings of road vehicles (monthly averages)

border region with:	**site**	**all vehicles**		**trucks**		**share of trucks**
		average	**SD**	**average**	**SD**	
Italy	**Škofije**	408,757	99,713	12,333	3,687	3.0
	Kozina	161,898	49,920	11,609	2,566	7.1
	Fernetici	354,573	131,257	75,757	39,973	21.4
	Vrtojba	220,078	30,649	47,042	8,332	21.3
	Total	**1,145,307**	**183,788**	**146,741**	**27,351**	**12.8**
Austria	**Lipce**	267,507	57,699	17,721	2,744	6.6
	Šentilj	152,179	21,410	43,135	10,500	28.3
	G. Radgona	137,948	30,238	5,916	1,208	4.3
	Total	**672,570**	**79,417**	**66,921**	**12,577**	**10.0**
Croatia	**Obrežje**	261,350	68,570	32,287	5,417	12.4
	Gruškovje	243,532	116,876	25,354	4,847	10.4
	Total	**504,889**	**183,788**	**57,651**	**9,866**	**11.4**
Hungary	**Lendava**	**149,500**	**54,749**	**73,217**	**28,507**	**48.9**
interior	**LJ-North**	897,387	74,698	53,341	9,470	5.9
	LJ-South	821,260	108,107	75,684	16,177	9.2
	LJ-East	818,923	97,561	66,392	12,438	8.1
	Total	**2,557,195**	**304,807**	**197,604**	**39,012**	**7.7**
TOTAL		**5,029,461**		**542,184**		**10.7**

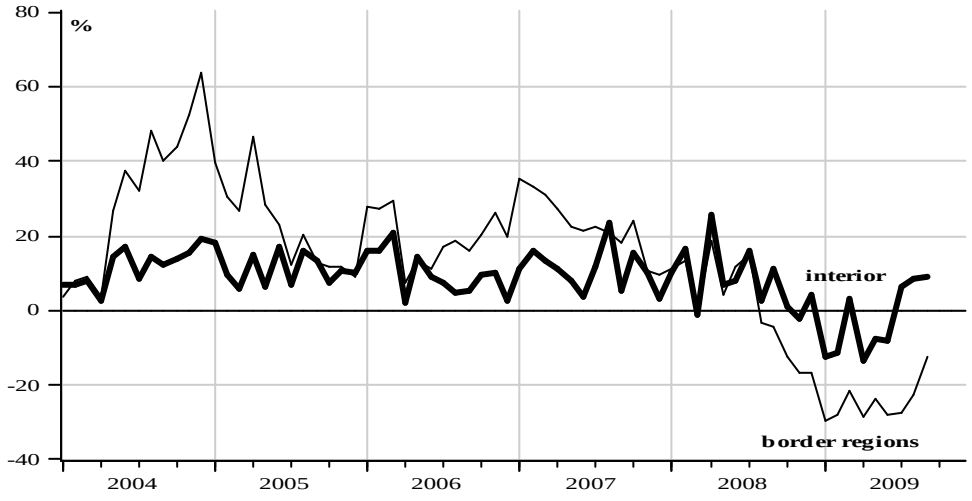
Monthly data on the volume of road transportation were obtained from daily data on vehicle crossings through 13 sites with automatic car and truck crossing meters. Four sites were situated on the roads in the region bordering Italy, three in the region bordering Austria, two in the region bordering Croatia and one in the region bordering Hungary. Three sites on the ring around the capital, Ljubljana, represent the interior. If a time series at a crossing site was interrupted, the dynamics on a nearby site were used instead.

The percentage share of trucks of the total vehicles in the various regions differs considerably, ranging from 7.7 percent in the interior to 48.9 percent in the border region with Hungary. High standard errors reflect seasonal oscillations. The dynamics (yearly growth rates) in Table 3 and Graph 5 (trucks only) indicate that the economic crisis significantly reduced truck crossings, particularly in the border regions. In the first nine months of 2009, there were 25 percent fewer crossings than in the same period in 2008; in the interior region, the number of trucks was only 3 percent lower.[4]

Table 3
Dynamics of cars and trucks in the period 2004–2009
(yearly growth rates = 100* X_t / X_{t-12})

	cars		trucks	
	interior	**border regions**	**interior**	**border regions**
2004–2009	4.45	6.85	8.63	13.77
2004	5.76	4.94	11.62	30.77
2005	3.77	2.89	11.30	22.69
2006	3.05	12.16	9.82	19.48
2007	3.23	5.96	10.97	23.00
2008	4.48	13.92	8.16	1.67
2009	7.10	-0.60	-2.96	-24.59

Graph 3
Yearly growth of truck crossings



[4] In the entire period, the number of trucks grew by 13 percent yearly; in 2004, when Slovenia joined the EU, this figure increased by nearly 30 percent. On the other hand, the crisis did not affect car crossings - indeed, the figure in 2009 increased more than average.

4. Price and "volume of transport" elasticity

The demand function should answer a "simple" question: Was the decline in the purchase of automotive fuels in 2009 caused by the economic crisis or by changes in excise tax policy, and/or what share of the decline can be attributed to the former and what to the latter? As prices are set administratively, the causality and, therefore, the specification of the demand function is straightforward; a multiplicative form enables straightforward estimation of price and "volume of transport" elasticity. As gasoline is only used by cars, while automotive diesel is used by both cars and trucks, the demand equations for automotive diesel have two "volume of transport" variables: car crossings and truck crossings.

As Slovenia's size and income level differs from the size and income levels of neighboring countries,[5] affecting price and income elasticity, one could expect strong response to changes in relative prices in the regions bordering neighboring counties even in the case of otherwise low price-elasticity of demand for automotive fuels. Furthermore, one could expect asymmetry, defined as a difference between the response to a one percent change in the domestic price of automotive fuels and the response to a one percent change in the corresponding "foreign" price. The asymmetry as defined above should be stronger in demand for gasoline used only by cars and weaker in demand for automotive diesel, as a large share of diesel is sold to truck drivers who cross the country comparing relative rather than absolute prices. Furthermore, as they can cross Slovenia without purchasing fuel in the country, their response to changes in relative prices can also be expected to be strong.

The demand function is of the following form:

$$Y_t = ß0 * Pd_t^{ß1} * Pf_t^{ß2} * T_t^{ß3} * T_t^{ß4} * X1_t^{ß5} * X2_t^{ß6} * \ldots u_t \quad (1)$$

or

$$Y_t = ß0 * (Pd_t/Pf_t)^{ß1} * T_t^{ß2} * T_t^{ß4} * X1_t^{ß3} * X2_t^{ß4} * \ldots . u_t \quad (2)$$

where:

Y_t – quantity sold in period t

Pd_t – price of gasoline or automotive diesel in Slovenia

Pf_t – price of gasoline or automotive diesel in Austria, Italy, Hungary or Croatia

Pd_t/Pf_t – relative price

T_t – crossing of vehicles

[5] Austria and Italy (particularly its relevant Northern part) are richer, while Croatia and Hungary are poorer than Slovenia.

Xi_t – other relevant factors affecting purchases

u_t – random error

ß1 – domestic price elasticity of demand

ß2 – "foreign" price elasticity of demand

ß3, ß4 – "volume of transportation" elasticity of demand

ß5 – elasticity of demand of other relevant determinants

According to basic textbook economics, the position of the demand curve is set by the volume of transportation or number of vehicles crossing the sites with traffic meters, while the slope is set by the price elasticity of demand. In Equation (1), the value of ß1 should be negative and the value of ß2 positive. Indeed, ß2 could be considered to be cross-elasticity of demand while automotive fuel in a neighboring country can be considered a nearly perfect substitute for automotive fuel in Slovenia. If the absolute direct price elasticity exceeds 1, the quantity would decrease, which would lower purchases, the earnings of the companies and tax revenues; if direct price elasticity is less than 1, the quantity and the earnings (determined administratively as a fixed mark-up for a liter) of the companies selling fuel would decrease, while purchases and tax revenues would increase. The effects of cross-elasticity are similar with the opposite sign. The expected values of ß3 (crossings of trucks) and ß4 (crossings of cars) are positive. If there is symmetry in the responses of drivers to changes in domestic and "foreign" prices, i.e. if only relative prices matter, Equation (1) can be replaced by Equation (2).

To diminish the effects of other factors (long-run changes in fuel efficiency or in the structure of cars, etc.), which also affect the quantity of gasoline and automotive diesel – and because we are interested in what happened in 2009, price and "volume of transportation" elasticities were estimated for the period 2006/01 – 2009/09 only.[6] The number of observations was therefore reduced to 45. Long- and short-run demand elasticities for gasoline and automotive diesel were estimated for each border region and the interior separately, assuming symmetry and also allowing for asymmetric responses. The short-run elasticities were estimated using an error correction method. The results are presented in Tables 4 and 5; in the former assuming price symmetry (Equation 2), in the latter allowing for price asymmetry (Equation 1).

[6] The accession of Slovenia and other CEE countries to the EU in May 2004 increased transit considerably.

Table 4

Long-run and short-run price and "volume of transportation" elasticity of demand for automotive fuels with a symmetric response to price changes

$$\log Y_t = ß0 + ß1 * \log (Pd_t/Pf_t) + ß3 * \log Tcars_t + ß4 * \log Ttrucks_t \quad \text{(long-run)}$$

$$dlog Y_t = ß0 + ß1 * dlog (Pd_t/Pf_t) + ß3 * dlog Tcars_t + ß4 * dlog Ttrucks_t +$$

$$+ ß5 * (\log Y_{t-1} – \log Y_{t-1}) \quad \text{(short- run)}$$

border region with:	gasoline			diesel			
	ß1	ß3	ß5	ß1	ß3	ß4	ß5
Austria long-run	-0.824 (-3.02)	0.970 (9.00)		-1.218 (-3.19)	1.107 (8.78)	-0.010 (-0.08)	
short-run	-0.477 (-0.91)	0.979 (8.53)	-0.445 (-3.37)	-1.209 (-2.26)	0.568 (5.18)	0.257 (2.55)	-0.171 (-1.44)
Croatia long-run	-1.514 (-8.03)	0.419 (13.7)		-0.421 (-2.36)	0.310 (10.67)	0.625 (7.86)	
short-run	-1.393 (-3.28)	0.389 (12.3)	-0.163 (-2.15)	-0.094 (-0.25)	0.255 (7.63)	0.385 (5.22)	-0.763 (-4.97)
Hungary long-run	-2.416 (-5.01)	0.094 (1.60)		-0.495 (-1.95)	0.272 (9.21)	0.791 (10.99)	
short-run	-1.393 (-3.28)	0.389 (5.39)	-0.163 (-2.15)	-1.229 (-4.35)	0.311 (5.36)	0.695 (9.96)	-0.371 (-3.35)
Italy long-run	-1.665 (-2.75)	1.535 (11.37)		-1.500 (-3.03)	0.95 (7.46)	1.22 (10.07)	
short-run	-0.299 (-0.61)	0.841 (7.81)	-0.117 (-1.40)	-0.715 (-1.60)	0.427 (5.16)	0.635 (10.52)	(-1.53) (-2.28)
interior long-run	-0.182 (-1.23)	0.991 (8.58)		-0.839 (-4.19)	0.695 (3.70)	0.565 (5.43)	
short-run	-0.329 (-1.35)	0.778 (8.59)	-0.518 (-3.97)	-0.338 (-1.47)	0.521 (6.93)	0.419 (8.88)	-0.316 (-3.57)

t – values in parentheses

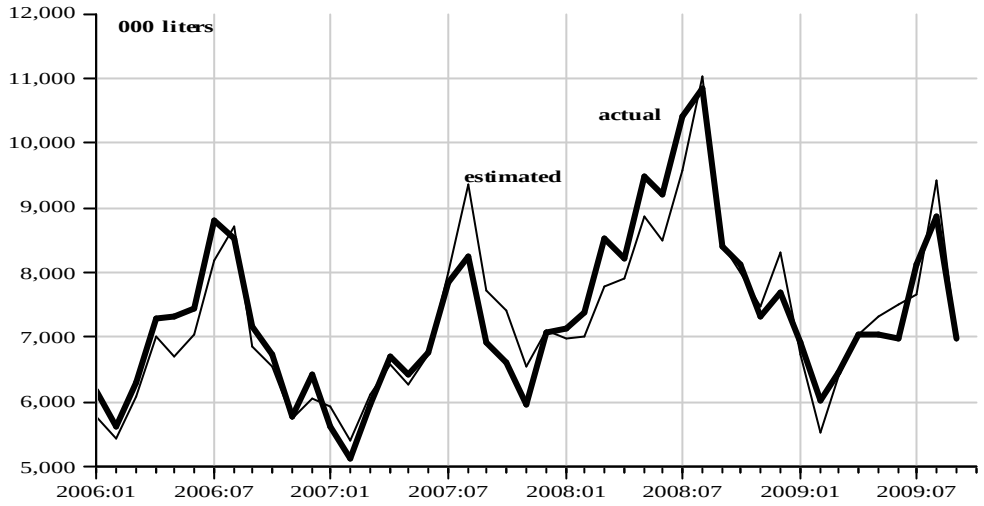
Coefficients presented in Table 4 are in accordance with expectations; both long and short run price elasticity being high in the border regions and low in the interior of the country; short run price elasticity being lower than long run. Error correction term has proper negative sign. The behavior of car drivers regarding "volume of transportation" elasticity differs by region. In the region bordering Italy (with the most expensive gasoline), the quantity increases more than the number of cars driving in the region; this would imply that tourists (visits peak in the summer months) buy relatively more gasoline in Slovenia than the local population, which buy a higher share in winter months. High price elasticity reflects large price differences. In the region bordering Austria (where the links between the region on the Slovenian side and Austria are partly hindered by mountains), the quantity of gasoline fluctuates with the number of car crossings in the region, and price elasticity is close to -1. Car drivers from Croatia and Hungary, which are both poorer and non-euro countries, apparently do not readily choose to buy gasoline in Slovenia, and both react strongly to relative prices. Finally, price elasticity of demand for gasoline in the interior is extremely low, while "volume of transportation" elasticity is close to 1.

Demand for automotive diesel differs from the demand for gasoline. The price elasticity for automotive diesel in the interior is high, which reflects the importance of transit for the whole country, which is intersected by two highways. The demand is price elastic in the regions bordering Austria and Italy, and inelastic in the regions bordering Croatia and Hungary. Insignificant "volume of transportation" elasticity in the border region with Austria is the only surprising result, but this can be explained by high price elasticity of demand for automotive diesel in the interior. Most of trucks transiting Slovenia may use numerous petrol stations on the highway in the interior.

Graphs 4 and 5 are illustrative. Graph 4 exhibits actual and estimated quantities of gasoline in all four border regions; these data are obtained by summing the actual and estimated values of the regions, while Graph 5 shows the actual and estimated quantities of automotive diesel sold in the interior.

Graph 4

Actual and estimated quantities of gasoline in the border regions



Graph 5

Actual and estimated quantities of automotive diesel in the interior

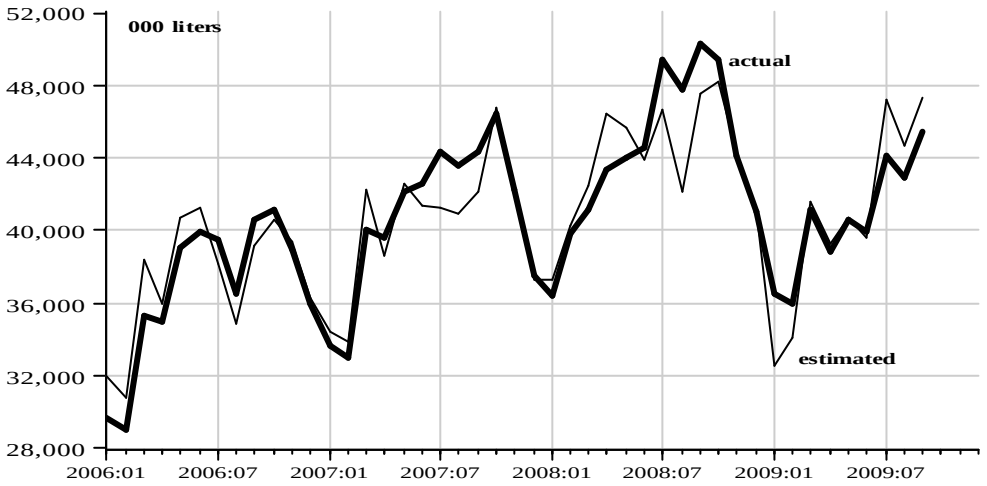


Table 5

Long- and short-run price and "volume of transportation" elasticity of demand for automotive fuels with an asymmetric response to price changes

$$log\ Y_t = ß0 + ß1 * log\ Pd_t + ß2 * log\ Pf_t + ß3 * log\ Tcars_t + ß4 * log\ Ttrucks_t \text{ (long-run)}$$

$$dlog\ Y_t = ß0 + ß1 * dlog\ Pd_t + ß2 * Pf_t + ß3 * dlog\ Tcars_t + ß4 * dlog\ Ttrucks_t +$$

$$+ ß5 * (log\ Y_{t-1} - log Y_{t-1}) \text{ (short- run)}$$

border region with:	gasoline				diesel				
	ß1	ß2	ß3	ß5	ß1	ß2	ß3	ß4	ß5
Austria long-run	-0.270 (-0.86)	0.950 (3.73)	0.737 (5.80)		0.424 (1.20)	0.786 (2.86)	0.657 (6.08)	0.002 (0.02)	
short-run	-0.233 (-0.47)	0.614 (1.07)	0.893 (8.29)	-0.555 (-4.25)	-0.455 (-0.85)	1.164 (2.45)	0.471 (4.82)	0.139 (1.44)	-0.495 (-3.49)
Croatia long-run	-1.503 (-5.68)	1.514 (7.94)	0.418 (10.7)		-0.149 (-0.58)	0.374 (2.09)	0.298 (10.02)	0.536 (5.41)	
short-run	-0.663 (-2.21)	0.736 (2.11)	0.404 (14.73)	-0.357 (-3.07)	-0.232 (-0.59)	-0.137 (-0.38)	0.265 (7.88)	0.402 (5.28)	-0.835 (-5.58)
Hungary long-run	-0.970 (-1.44)	1.966 (4.16)	0.028 (0.47)		-0.097 (-0.26)	0.364 (1.36)	0.241 (6.72)	0.726 (8.59)	
short-run	-0.774 (-1.81)	1.501 (3.58)	0.348 (5.02)	-0.172 (-2.19)	-0.685 (-1.99)	1.163 (4.06)	0.566 (5.94)	0.391 (5.66)	-0.358 (-2.85)
Italy long-run	-1.882 (-2.86)	1.570 (2.54)	1.595 (10.47)		-1.367 (-1.54)	1.437 (2.43)	0.928 (5.10)	1.206 (8.25)	
short-run	-0.353 (-0.68)	0.398 (0.55)	0.835 (7.11)	-0.110 (-1.25)	-0.698 (-1.54)	0.735 (1.41)	0.422 (4.74)	0.632 (9.88)	-0.152 (-2.10)
interior long-run	-0.123 (-0.29)	0.457 (1.22)	0.972 (8.58)		-0.553 (-2.24)	0.745 (3.72)	0.694 (3.81)	0.474 (4.25)	
short-run	-0.176 (-0.60)	0.252 (0.65)	0.704 (7.25)	-0.080 (-1.16)	-0.272 (-1.19)	0.355 (1.45)	0.529 (7.16)	0.400 (8.65)	-0.327 (-3.60)

t – values in parentheses

Most coefficients in Table 5 (Equation 1) are also in accordance with expectations; with direct price elasticity ß1 being negative and cross price elasticity ß2 positive; short run direct and cross price

elasticity is lower than long run direct and cross price elasticity. Error correction term retains proper negative sign. The responses to price changes are asymmetric; car drivers react strongly to price change in a neighboring country and less to price change in Slovenia which can be explained by the difference in the country size. Strong asymmetry which exists in the demand for gasoline does not exist in the demand for automotive diesel – most coefficients which enable distinction are insignificant.

5. Simulations

5.1. Effects of excise tax policy on quantities, purchases, earnings, excise taxes, value added taxes and total tax revenues

Excise tax policy in the period 2003–2009 had three distinct periods: a period of "neutral" policy in which excise tax in euros changed frequently (partly because of the fluctuation of the tolar, the former Slovenian currency, towards the euro) since the middle of 2005; this was followed by a period in which the excise tax was fixed and thus automatically anti-inflationary; and finally the period after December 2008 in which the government tried to compensate for the loss of tax revenues by increasing the excise tax on automotive fuels. The shift from the second to the third period is analyzed here as the original aim of the research project (on which this paper is based) was to estimate the consequences of the shift in excise tax policy. As excise tax in absolute value per liter directly increases retail sale price, Table 6 compares actual retail sale prices for gasoline and automotive diesel with the prices if excise tax policy remained unchanged. In such a case, gasoline and automotive diesel would be approximately 15 percent cheaper, which would, depending on price elasticity, affect quantities, purchases, earnings and tax revenues.

Table 6
Actual and experimental retail sale prices of gasoline and automotive diesel

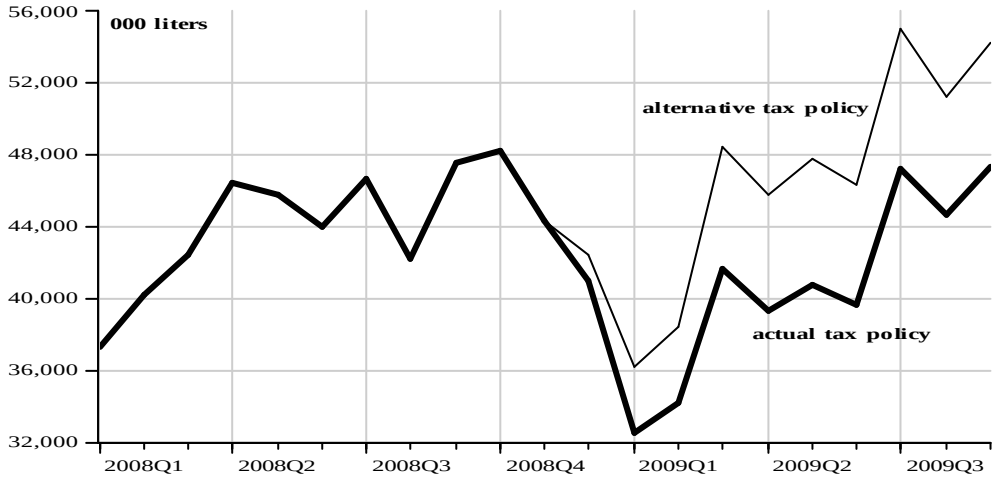
	gasoline			**automotive diesel**		
	control actual	**experimental alternative**	**ratio**	**control actual**	**experimental alternative**	**ratio**
2008/11	0.993	0.993	**1.00**	0.915	0.915	**1.00**
/12	0.916	0.881	**0.96**	0.829	0.811	**0.97**
2009/01	0.933	0.822	**0.88**	0.881	0.787	**0.89**
2	0.947	0.823	**0.87**	0.956	0.836	**0.87**
3	0.949	0.793	**0.84**	0.963	0.840	**0.87**
4	0.981	0.820	**0.84**	0.995	0.871	**0.88**
5	0.999	0.825	**0.83**	1.025	0.902	**0.88**
6	1.036	0.861	**0.83**	1.092	0.969	**0.89**
7	1.045	0.871	**0.83**	1.103	0.960	**0.87**
8	1.040	0.884	**0.85**	1.130	0.973	**0.86**
9	1.042	0.886	**0.85**	1.118	0.961	**0.86**
10	1.025	0.869	**0.85**	1.090	0.923	**0.85**

In calculating the effects of the policy, the long-run elasticities presented in Table 4 (assuming symmetry of domestic and "foreign" price changes) were used. The overall effects of alternative excise tax policy (i.e. keeping excise tax unchanged) are summarized in Table 7, while the individual effects of altered excise tax policy for both gasoline and automotive diesel (all regions) are shown in Appendix A by the differences between the experimental solution (the continuation of prior tax policy) and the control solution (actual tax policy). Graph 6 illustrates the effects on the quantity of automotive diesel in the interior.

Table 7
Overall effects of alternative excise tax policy for the sellers and government in the period 2008/12 – 2009/9
(gasoline and automotive fuel)

border region with:	AT	HR	HU	IT	? borders	interior	Total
quantity (liters 000s)	10,416	4,020	2,445	23,068	39,948	58,545	98,493
purchases (EUR 000s)	738	-587	668	7,611	8,432	-45,465	-37,034
earnings (EUR 000s)	808	321	194	1,793	3,116	4,470	7,587
excise tax revenues (EUR 000s)	-3,557	-4.27	-371	748	-3,606	-61,473	-65,080
VAT revenues (EUR 000s)	123	-98	2	1,268	1,295	-7,579	-6,284
tax revenues (EUR 000s)	-3,434	-525	-369	2,017	-2,311	-69,052	-71,363

Graph 6
Quantity of automotive diesel in the interior and quantity if excise policy is unchanged



In short, by increasing excise taxes, the government collected an extra EUR 71 million (EUR 65 million of excise tax and EUR 6 million of value added tax). On the other hand, gasoline stations sold 98.5 million fewer liters of fuel and lost EUR 7.6 million in net revenues; while cash flow increased by EUR 37 million.

To illustrate the results in the Appendix, let us look at January 2009. If excise tax policy had remained unchanged, the gasoline stations would have sold 1.229 million more liters of gasoline (1.142 million in the border regions and 87,000 in the interior). Euro purchases would have diminished by EUR 2.171 million (a EUR 2.511 million drop in the interior and a EUR 340,000 rise in the border regions). The gasoline stations would have earned EUR 100,000 more (EUR 93,000 in the border regions and EUR 7,000 in the interior). The government would have collected EUR 1.819 million less from excise taxes (EUR 289,000 more in the border regions and EUR 2.118 million less in the interior). Tax revenues from VAT would have been EUR 374,000 lower (EUR 45,000 higher in the border regions and EUR 419,000 lower in the interior). Finally, total tax revenues would have been EUR 2.213 million lower, due to a loss of EUR 2.537 million in the interior and a gain of EUR 334,000 in the border region.

The effects of the alternative tax policy on the automotive diesel market would have been greater. Gasoline stations would have sold 5.149 million more liters of automotive diesel (1.767 million liters in the border regions and 3.652 million liters in the interior). Purchases would have decreased by EUR 366,000 (an increase of EUR 246,000 in the border regions and a decrease of EUR 613,000 in the interior). Gasoline stations would have earned EUR 413,000 more (EUR 135,000 in the border regions and 278,000 in the interior). The government would have collected EUR 2.379 million less from excise tax (EUR 471,000 in the border regions and EUR 1.908 million in the interior). The revenues from VAT would have been EUR 61,000 lower (an increase of EUR 41,000 in the border regions and a decrease of EUR 102,000 in the interior). Altogether, tax revenues would have fallen by EUR 2.440 million, (EUR 2.010 million in the interior and EUR 430,000 in the border regions).

5.2. Separation of the tax policy effects from the crisis effects

Long-run price elasticity of demand was used to establish the effects of the changes in excise tax policy in the period 2008/12 – 2009/9 by comparing the experimental solution to the control solution. The experimental solution was easy to define as "no change in excise tax policy". To define the "absence of economic crisis" scenario is not so straightforward. Indeed, "income" in the demand equation was replaced by transportation activity, which is measured by the number of car and truck

crossings. Therefore, the question is: what would happen if there were no changes in the number of crossings and/or what is a "normal" number of crossings? The "normality" is defined as the number of crossings if growth rates from the period 2005/1 – 2008/7 would also continue after August 2008 (considered here as the starting point of the crisis). As the crisis hit truck transportation and transit particularly hard, the rest of the paper deals with automotive diesel only. The results of the simulations which enable the partitioning of the effects of the crisis and the tax policy are shown in Tables 8 and 9; they are depicted in Graph 7.

Table 8
Partitioning of the crisis and excise tax policy on the quantity of automotive diesel
(000 liters)

	Interior			**Border regions**			**Total**		
	crisis	tax policy	total	crisis	tax policy	total	crisis	tax policy	total
2008/8	1,618	0	1,618	1,283	0	1,283	2,900	0	2,900
9	-178	0	-178	251	0	251	73	0	73
10	2,224	0	2,224	1,308	0	1,308	3,532	0	3,532
11	2,718	0	2,718	1,629	0	1,629	4,348	0	4,348
12	1,348	1,382	2,636	1,905	637	2,639	3,253	2,018	5,274
2009/1	4,599	3,652	8,185	2,967	1,767	5,260	7,566	5,419	13,445
2	4,453	4,285	8,637	2,699	1,924	5,173	7,152	6,210	13,810
3	1,673	6,807	8,534	2,682	3,042	6,460	4,355	9,849	14,995
4	5,827	6,398	12,320	3,530	3,059	7,528	9,357	9,456	19,848
5	4,298	7,098	11,556	3,194	3,465	7,570	7,491	10,563	19,126
6	4,376	6,674	11,169	3,319	3,322	7,532	7,695	9,996	18,701
7	1,053	7,783	8,858	4,151	3,376	8,632	5,204	11,159	17,490
8	2,430	6,522	8,988	4,575	2,848	8,467	7,006	9,370	17,455
9	319	6,891	7,213	3,317	2,802	6,881	3,636	9,694	14,094

Table 9

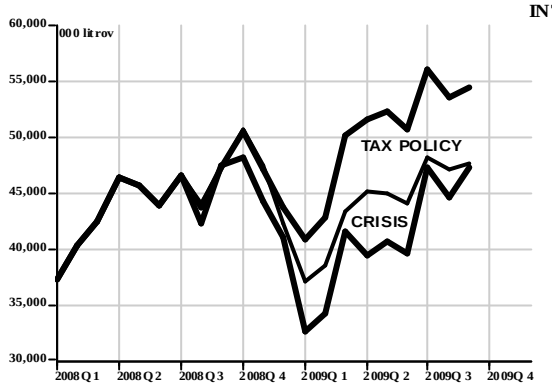
Relative contribution of the crisis and tax policy to the decline of purchases of automotive diesel

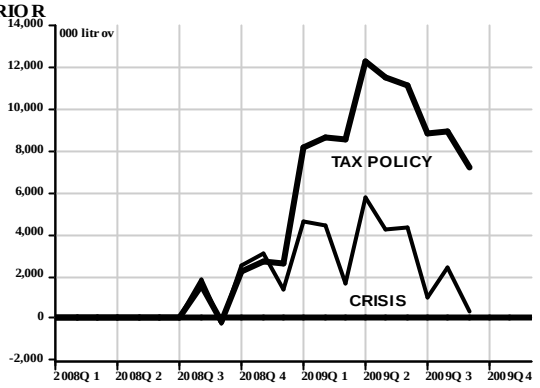
	Interior		Border regions		Total	
	crisis	tax policy	crisis	tax policy	crisis	tax policy
2008/8	1.0	0.0	1.0	0.0	1.0	0.0
/9	1.0	0.0	1.0	0.0	1.0	0.0
/10	1.0	0.0	1.0	0.0	1.0	0.0
/11	1.0	0.0	1.0	0.0	1.0	0.0
/12	0.494	0.506	0.749	0.251	0.617	0.383
2009/1	0.557	0.443	0.627	0.373	0.583	0.417
/2	0.510	0.490	0.584	0.416	0.535	0.465
/3	0.197	0.803	0.469	0.531	0.307	0.693
/4	0.477	0.523	0.536	0.464	0.497	0.503
/5	0.377	0.623	0.480	0.520	0.415	0.585
/6	0.396	0.604	0.500	0.500	0.435	0.565
/7	0.119	0.881	0.551	0.449	0.318	0.682
/8	0.271	0.729	0.616	0.384	0.428	0.572
/9	0.044	0.956	0.542	0.458	0.273	0.727

Graph 7

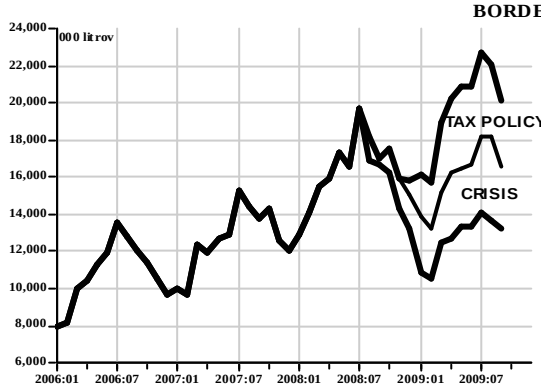
Split between the effects of excise tax policy and the crisis

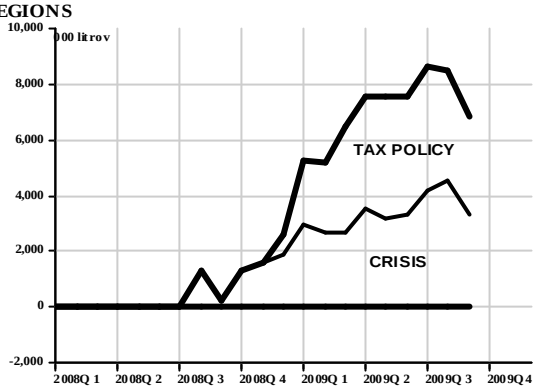
INTERIOR



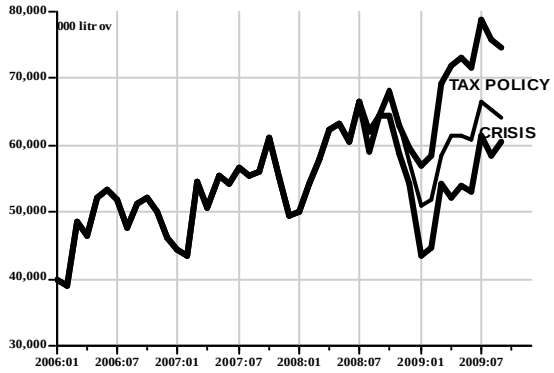


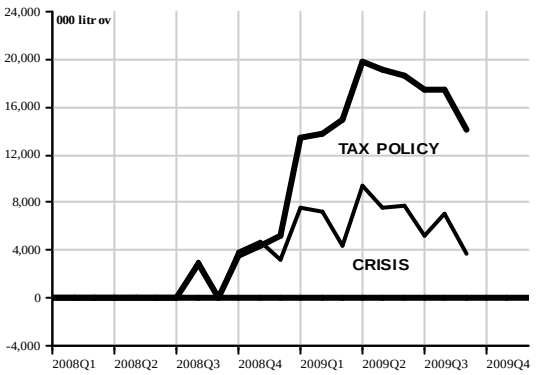
BORDER REGIONS





OVERALL





6. Conclusions

The "administrative price determination model" which adjusts "production" price to the oil price in the Mediterranean and US dollar exchange rate every two weeks together with the administratively set "mark-up", value added tax and excise tax allow the government to directly determine the retail sale price which – depending on price elasticity of demand – determines quantities, tax revenues, purchases and the earnings of companies selling automotive fuels. However, in a small open country such as Slovenia, drivers can either purchase automotive fuel within the country or abroad. The government therefore kept domestic retail sale prices below retail sale prices in neighboring countries until December 2008, when it altered previous policy to cope with the enormous fall in other tax revenues. The gap between domestic and "foreign" prices for gasoline narrowed and the gap between domestic and "foreign" prices for automotive diesel disappeared. The altered excise tax policy reduced purchases of gasoline only in the regions bordering neighboring countries while purchases of automotive diesel were reduced also in the interior which is crossed by two highways connecting neighboring countries. The responses to price changes for gasoline were asymmetric; car drivers reacted strongly to price change in a neighboring country and less to price change in Slovenia. This is not the case in the automotive diesel market where truck drivers crossing the country react to relative prices. In ten months of the new tax policy in 2009, nearly 100 million fewer liters of automotive fuels were sold, oil companies lost € 7.6 million, while the government collected an extra € 71 million by excise and VAT tax. By using the "volume of transportation" elasticity one can separate the effects of tax policy from the effects of economic crisis; in the case of more affected market for automotive diesel more than half of the decline in the purchase in 2009 can be attributed to excise tax policy and less than half to the economic crisis.

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Appendix A

Table A1
The effects of alternative excise tax policy for gasoline for the sellers

border with	Austria	Croatia	Hungary	Italy	?bodres	interior	Total
			quantity (1000 liters)				
2008/11	0	0	0	0	0	0	0
12	49	50	32	118	249	18	267
2009/1	238	232	139	533	1142	87	1229
2	249	238	141	495	1122	100	1223
3	274	256	142	663	1334	123	1457
4	279	291	145	726	1442	115	1557
5	283	286	153	725	1446	114	1561
6	282	283	141	656	1362	102	1464
7	284	395	196	818	1693	126	1819
8	382	444	224	1198	2248	134	2382
9	306	349	217	795	1667	134	1800
			purchases (1000 €)				
2008/11	0	0	0	0	0	0	0
12	-9	14	32	39	76	-528	-452
2009/1	-42	65	139	177	340	-2511	-2171
2	-47	72	141	177	342	-3106	-2764
3	-52	78	142	238	405	-3824	-3419
4	-55	92	145	270	451	-3717	-3266
5	-58	93	153	278	466	-3811	-3345
6	-62	99	141	269	447	-3658	-3211
7	-62	138	196	336	608	-4504	-3897
8	-85	158	224	501	797	-4860	-4063
9	-67	123	217	328	601	-4810	-4208
			earnings (1000 €)				
2008/11	0	0	0	0	0	0	0
12	4	4	3	10	20	1	22
2009/1	19	19	11	43	93	7	100
2	20	19	11	40	91	8	99
3	22	21	12	54	109	10	119
4	23	24	12	59	117	9	127
5	23	23	12	59	118	9	127
6	23	23	11	53	111	8	119
7	23	32	16	67	138	10	148
8	31	36	18	97	183	11	194
9	25	28	18	65	136	11	146

Table A2

The effects of alternative excise tax policy for gasoline for the governement

border with	Austria	Croatia	Hungary	Italy	?borders	interior	Total
			excise tax revenues (1000 €)				
2008/11	0	0	0	0	0	0	0
12	-23	19	12	44	52	-446	-394
2009/1	-106	101	61	233	289	-2118	-1829
2	-123	109	65	227	278	-2622	-2344
3	-137	118	65	306	351	-3228	-2877
4	-149	134	67	336	389	-3140	-2751
5	-159	132	71	335	378	-3221	-2843
6	-178	131	65	303	321	-3094	-2773
7	-177	189	94	391	497	-3809	-3312
8	-244	218	110	586	670	-4110	-3441
9	-191	171	106	389	475	-4067	-3592
			VAT revenues (1000 €)				
2008/11	0	0	0	0	0	0	0
12	-1	2	3	6	10	-88	-78
2009/1	-7	11	11	30	45	-419	-374
2	-8	12	12	29	46	-518	-472
3	-9	13	12	40	56	-637	-581
4	-9	15	13	45	64	-620	-555
5	-10	16	14	46	67	-635	-569
6	-10	16	14	45	65	-610	-545
7	-10	23	20	56	88	-751	-663
8	-14	26	23	83	118	-810	-692
9	-11	20	22	55	86	-802	-716
			tax revenues = excise tax + VAT (1000 €)				
2008/11	0	0	0	0	0	0	0
12	-24	21	14	51	62	-534	-472
2009/1	-113	112	72	263	334	-2537	-2203
2	-131	121	77	257	324	-3140	-2816
3	-146	131	78	345	408	-3866	-3458
4	-158	150	80	381	453	-3760	-3307
5	-169	148	85	381	445	-3856	-3412
6	-188	147	79	348	386	-3704	-3318
7	-187	212	113	447	585	-4560	-3975
8	-258	244	132	670	788	-4920	-4132
9	-202	191	128	444	561	-4869	-4308

Table A3

The effects of alternative excise tax policy for automotive diesel for the sellers

border with	Austria	Croatia	Hungary	Italy	?borders	interior	Total
			quantity (000 liters)				
2008/11	0	0	0	0	0	0	0
12	217	27	21	371	637	1382	2018
2009/1	625	74	63	1006	1767	3652	5419
2	613	82	74	1156	1924	4285	6210
3	847	125	105	1964	3042	6807	9849
4	883	138	101	1937	3059	6398	9456
5	975	146	114	2231	3465	7098	10563
6	1017	149	108	2049	3322	6674	9996
7	855	176	122	2223	3376	7783	11159
8	1004	147	97	1599	2848	6522	9370
9	753	133	111	1806	2802	6891	9694
			purchases (000 €)				
2008/11	0	0	0	0	0	0	0
12	35	-34	-19	111	93	-238	-145
2009/1	98	-89	-56	293	246	-613	-366
2	97	-100	-66	340	270	-725	-455
3	131	-149	-93	567	456	-1131	-675
4	141	-170	-92	578	457	-1099	-642
5	158	-182	-105	673	544	-1234	-690
6	171	-193	-104	643	518	-1207	-689
7	146	-231	-119	705	500	-1422	-922
8	172	-194	-95	510	393	-1198	-805
9	129	-176	-109	577	422	-1269	-847
			earnings (1000 €)				
2008/11	0	0	0	0	0	0	0
12	17	2	2	28	49	105	154
2009/1	48	6	5	77	135	278	413
2	47	6	6	88	147	327	474
3	65	10	8	150	232	519	751
4	67	11	8	148	233	488	721
5	74	11	9	170	264	541	806
6	78	11	8	156	253	509	762
7	65	13	9	169	257	594	851
8	77	11	7	122	217	497	715
9	57	10	8	138	214	526	739

Table A4

The effects of alternative excise tax policy for automotive diesel for the government

border with	Austria	Croatia	Hungary	Italy	?borders	interior	Total
			excise tax revenues (1000 €)				
2008/11	0	0	0	0	0	0	0
12	-65	-40	-25	-68	-198	-795	-992
2009/1	-158	-102	-71	-141	-471	-1908	-2379
2	-155	-115	-84	-160	-513	-2248	-2761
3	-194	-169	-115	-232	-711	-3383	-4093
4	-219	-194	-115	-257	-785	-3356	-4142
5	-244	-208	-132	-299	-882	-3764	-4646
6	-280	-223	-131	-315	-948	-3777	-4725
7	-241	-268	-151	-355	-1015	-4486	-5501
8	-293	-226	-122	-270	-911	-3835	-4746
9	-221	-205	-139	-307	-872	-4065	-4936
			VAT revenues (1000 €)				
2008/11	0	0	0	0	0	0	0
12	6	-6	-3	19	15	-40	-24
2009/1	16	-15	-9	49	41	-102	-61
2	16	-17	-11	57	45	-121	-76
3	22	-25	-16	94	76	-189	-113
4	24	-28	-15	96	76	-183	-107
5	26	-30	-18	112	91	-206	-115
6	29	-32	-17	107	86	-201	-115
7	24	-39	-20	118	83	-237	-154
8	29	-32	-16	85	65	-200	-134
9	22	-29	-18	96	70	-211	-141
			tax revenues (excise tax + VAT) (1000 €)				
2008/11	0	0	0	0	0	0	0
12	-59	-46	-29	-49	-182	-835	-1017
2009/1	-141	-117	-81	-92	-430	-2010	-2440
2	-139	-131	-95	-104	-468	-2369	-2837
3	-173	-194	-131	-137	-635	-3571	-4206
4	-195	-223	-130	-161	-709	-3539	-4249
5	-218	-238	-149	-186	-792	-3970	-4761
6	-251	-255	-149	-207	-862	-3978	-4840
7	-217	-306	-171	-237	-932	-4723	-5655
8	-265	-258	-138	-185	-845	-4034	-4880
9	-199	-234	-157	-211	-801	-4276	-5077

Table A5
Partition of crisis effects and tax policy effects on quantity of automotive diesel
(000 liters)

obs	Y	Y crisis	Y tax policy	Y both
		INTERIOR		
2008/8	42176	44018	42176	43793
2008/9	47537	47335	47537	47358
2008/10	48239	50778	48239	50463
2008/11	44326	47440	44326	47044
2008/12	41015	42362	42396	43650
2009/1	32553	37152	36205	40738
2009/2	34140	38593	38425	42776
2009/3	41635	43308	48442	50169
2009/4	39312	45138	45709	51632
2009/5	40705	45003	47803	52261
2009/6	39622	43998	46296	50791
2009/7	47223	48276	55006	56081
2009/8	44649	47080	51171	53637
2009/9	47276	47595	54168	54489
		BORDER REGIONS		
2008/8	16878	18160	16878	18160
2008/9	16736	16987	16736	16987
2008/10	16234	17542	16234	17542
2008/11	14275	15905	14275	15905
2008/12	13189	15094	13825	15827
2009/1	10866	13834	12634	16127
2009/2	10544	13243	12468	15717
2009/3	12476	15158	15518	18936
2009/4	12706	16236	15765	20234
2009/5	13288	16482	16753	20859
2009/6	13347	16666	16670	20879
2009/7	14054	18205	17430	22686
2009/8	13621	18197	16469	22088
2009/9	13214	16531	16017	20095
		OVERALL		
2008/8	59053	62178	59053	61954
2008/9	64273	64322	64273	64345
2008/10	64473	68320	64473	68005
2008/11	58601	63345	58601	62949
2008/12	54203	57456	56222	59478
2009/1	43419	50986	48838	56864
2009/2	44684	51836	50893	58493
2009/3	54111	58465	63959	69105
2009/4	52018	61375	61474	71866
2009/5	53993	61485	64557	73119
2009/6	52969	60664	62965	71670
2009/7	61277	66481	72436	78767
2009/8	58271	65276	67640	75725
2009/9	60491	64127	70184	74584