Energy Policy 96 (2016) 119–130

Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

Evidence of asymmetric behavioral responses to changes in gasoline prices and taxes for different fuel types

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HIGHLIGHTS

- Provide evidence of asymmetric responses of gasoline demand due to changes in prices and taxes.
- Identify differences in the elasticity of the demand of diesel fuel and unleaded gasoline.
- Perform robustness checks considering dynamic effects and IV regression.
- Provide some policy recommendations for future gasoline tax changes.

ARTICLE INFO

Article history:
Received 13 May 2015
Received in revised form
2 November 2015
Accepted 17 May 2016

Keywords:
Gasoline taxes
Behavioral responses
Demand elasticity
Diesel fuels
Energy policy

ABSTRACT

Using monthly data from the Spanish gasoline retail market we explore asymmetries in consumers' behavioral responses to changes in gasoline prices and taxes. In particular, we are interested in investigating whether an increase in gasoline taxes has a more negative impact on the demand than a –similar in magnitude– increase in the "pre-tax" price of gasoline for different fuel types. We estimate fuel consumers' responses using a rich set of robust panel data models considering potential dynamic effects and endogeneity problems. We find evidence to confirm the existence of asymmetric responses for the demand of unleaded fuels and agricultural diesel fuel. However we cannot support this statement for the regular diesel case: for this fuel both the tax-exclusive price and the tax elasticities are roughly the same. This result agrees with the fact that "diesel drivers" tend to be better informed about changes in both fuel prices and taxes. Some implications in terms of fiscal policy and pollution and climate change policy are also discussed.

1. Introduction

The second half of the 2000s was a tough period for the public finances in several countries in the advanced world. The poor evolution of unemployment, GDP, savings, and/or private consumption –among other economic indicators– seriously compromised both the government revenue as well as the debt-to-GDP ratio of many of these countries.

Because of budget shortfalls, many governments chose to raise taxes. Gasoline was a common target. Indeed, over the last years, and coinciding with the onset of the economic downturn, many of the governments in trouble decided to increase taxes on gasoline.

That was true in (among others) Lithuania and Latvia in 2009; Romania, first in 2009 –see Box 1: "Overview of the main tax related measures taken in response to the economic and financial crisis" in European Commission (2009) – and again in 2014, when there was a 7 cents per litre increase in excise duties for unleaded petrol, leaded petrol, diesel and kerosene (used as motor fuels) –see European Commission (2014b); Greece, where the price of unleaded gasoline increased by 0.12 euro per litre and the price of diesel fuel increased by 0.05 euros a litre in February 2010 in order to mitigate the negative economic and budgetary impact of the global crisis –see European Commission (2010); Italy, where the tax incremented first by 0.005 euro per litre and then by 0.02 euro per litre with the goal of increasing the revenue to mitigate the 2009 and 2012 earthquakes damages respectively; the Netherlands, where the excise duty on Liquefied Petroleum Gas (LPG) products went up by 7 cents per litre and the excise duty of diesel by 4 cents per litre in January 2014 –see European Commission (2014a); and twice in Slovenia, first in 2011 and later in 2012 –see European Commission (2012).

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http://dx.doi.org/10.1016/j.enpol.2016.05.028
0301-4215/

As the politicians in some of these countries indicated, there were also environmental and climate change objectives behind such policies. However, in most of the cases (if not all) the main goal behind these tax increases was to raise public revenues in a complicated situation for the public treasury.[1]

This was the case, for example, in Spain. This Southern European country suffered after 2007 a progressive deterioration of its key macroeconomic indicators –especially the unemployment, which rose from approximately 10% in 2008 to around 25% in 2014, according to the OECD (2015) (p.106). At the same time, the government was running out of money. In fact, while the public debt was 35.5% of GDP in 2007, it increased to 92.1% of GDP by the end of 2013, and it is expected to reach a peak of 103.2% of GDP in 2017 according to the European Commission (2015) (p.34). Thus, following the advice of the European institutions and other international bodies –see ECB (2008, 2009) and IMF (2007), among many others–, and in order to demonstrate fiscal discipline, Spain had to consolidate its public accounts by cutting the public spending and increasing the taxes. Thus, as many other countries' governments did, the Spanish government decided to raise gasoline taxes for that purpose. Indeed the Spanish Council of Ministers approved on June 13, 2009 an increase of 0.029 euro per litre of the excise duties on diesel fuels and unleaded gasoline fuels. In fact the government recognized that the main goal behind such a measure was to increase tax collection in a very complicated situation for the Spanish public treasury,[2] but was this decision a wise one in terms of tax collection? Was the Spanish government –and the rest of the countries with similar policies– doing the right thing?

We want to point out that actually a raise in gasoline taxes is not as effective as previous studies have concluded. In particular, we cast doubt on previous studies that estimated the effect of taxes based on the "overall" (i.e. the tax-inclusive) elasticity of the gasoline demand. For that purpose, using detailed level data from Spain on different fuel types, we estimate consumers' responses to changes in gasoline consumption by taking into account separately both changes in tax-exclusive gasoline prices and changes in gasoline taxes. We provide empirical evidence to state that, for the case of unleaded gasoline (both regular and premium) and for agricultural diesel, the price elasticity of demand due to changes in taxes is much higher than the price elasticity of the demand due to changes in the tax-exclusive price. In other words, we demonstrate that an increase in gasoline taxes implies a greater reduction in gasoline consumption than an equal-sized increase in gasoline "pre-tax" prices. We show that the results are robust to alternative specifications that take into account potential dynamic adjustments in the consumption patterns and we also validate this result using an instrument for the price of the fuels.

On the other hand, and contrary to the evidence that Li et al. (2014) found for the unleaded gasoline case and that we also refute for the agricultural diesel fuel, such an asymmetric response is not found in the (regular) diesel case.[3] In fact, we show in all the different specifications of our baseline model that the consumption of gasoline decreases equally due to increases in taxes and prices. This result is consistent with the fact that frequent drivers are usually "diesel drivers", so they tend to be better informed about changes in both taxes and prices –Baranzini and Weber (2013) and Verboven (2002).

The study of the price elasticity of gasoline demand is a classic topic in the energy economics literature. Indeed, many authors have previously studied and empirically assessed this elasticity in different countries, in different periods of time and using all kind of approaches.[4] However, the literature has not explored as deeply the differences that arise when we estimate separately the impact of changes in taxes and in "pre-tax" prices.

The most relevant study investigating this issue is by Li et al. (2014), whose paper is closely related to ours. Thus, as they do, we are concerned about the existence of asymmetric behavioral responses in consumption due to changes in prices and taxes, and we seek to reinforce their conclusions. However, our approach differs from theirs in a few ways. First of all, we want to check that this asymmetric effect holds for all the main fuels used for transportation purposes. For that reason we estimate the elasticities not only for unleaded gasoline, but also for premium unleaded gasoline, regular diesel fuel as well as agricultural diesel fuel, which is mainly used by tractors. By doing so, we are able to identify that asymmetric responses are not equally observed in all fuel types. In fact, for the Spanish case, it does not hold for regular diesel fuel consumers.

Second, instead of using annual data, we use monthly data. Thus, as Klier and Linn (2010) do, we are able to check that this effect is not only true in the long-run, but also in the short-run.[5] Another closely related work is by Davis and Kilian (2011). They also explicitly recognize that "the responsiveness of gasoline consumption [due] to a change in tax may differ from the responsiveness of consumption [due] to an average change in price". However, they take this fact into account to perform a different kind of analysis, namely, they explore the potential impact of a carbon tax in carbon emissions.

Taking the advantage that almost all the regional governments in Spain implemented several changes in excise duties on gasoline after the crisis –along with the few changes implemented by the central government– we find evidence to support the fact that, at least in Spain, the sensitivity of gasoline consumption to changes in taxes is greater than the sensitivity of gasoline consumption due to changes in tax-exclusive prices for three fuel types, namely unleaded gasoline 95, unleaded gasoline 98 (premium) and diesel B (agricultural). As a robustness check, we also perform an analysis taking into account potential dynamics effects, namely, a lagged effect of (agricultural) unemployment on diesel B consumption[6] as well as the existence of a partial adjustment in the consumption of gasoline. Moreover, in Section 2.4, and due to the potential concern of *endo*geneity of fuel prices and fuel consumption, we propose an instrumental variable regression. Again, in this regression, the asymmetric behavior is also refuted.

Previous literature has given (at least) up to two different (and complementary) potential explanations of such an asymmetric

[1] As M. Tanner from CATO Institute points out, during the austerity years, "fuel, alcohol, and tobacco were […] prime tax targets" during the "austerity" years. See Tanner, Michael D. 2012. Europe's Failed 'Austerity'. *National Review*. May 9, 2012, Available at: http://www.cato.org/publications/commentary/europes-failed-austerity [accessed October 30, 2015].

[2] *Real Decreto-ley 8/2009, de 12 de junio, por el que se conceden créditos extraordinarios y suplementos de crédito, por importe total de 19.821,28 millones de euros, y se modifican determinados preceptos de la Ley 38/1992, de 28 de diciembre, de Impuestos Especiales*. BOE, June 13, 2009 no. 143, pp. 49,890–49902.

[3] Notice that the factors that impact the price of both unleaded gasoline and diesel fuel are quite similar. In particular, both types of fuels have a reference index in both the Genoa market (MED) and Rotterdam market (NWE), which are the relevant markets for the Spanish wholesale gasoline sector. As shown in Rodrigues (2009) (Chart 2 and Chart 3) the MED and NWE prices for both fuels evolve similarly to the Brent crude oil price. In addition, there is also a wholesalers' markup, which is also similar for both fuels and is approximately 2 per cent of the final price

(*footnote continued*)
according to the information provided by the Spanish Association of Operators of Oil Products (AOP).

[4] For instance, Akinboade et al. (2008); Baranzini and Weber (2013); Brons et al. (2008); Galindo (2005); Havranek et al. (2012); Lin and Zeng (2013) and Ramanathan (1999) make up just a small sample of the previous papers that have studied the elasticity of gasoline demand.

[5] Notice that Li et al. (2014) use a monthly model as part of the robustness analysis (see Table 5). However, no control variables are included in such model.

[6] Jimeno and Bentolila (1998) find evidence that the impact of unemployment on wages is lagged. Therefore, we could expect that there is also a lagged effect on gasoline consumption too.