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How effective are policies to reduce gasoline consumption? Evaluating a set of measures in Spain

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ABSTRACT

Using a panel of 48 provinces for four years we empirically analyze a series of temporary and permanent policies aimed at curbing fuel consumption implemented in Spain between March and June 2011. The first policy was a reduction in the speed limit in highways. The second policy was an increase in the biofuel content of fuels used in the transport sector. The third measure was a decrease of 5% in commuting and regional train fares that resulted in two major metropolitan areas reducing their overall fare for public transit. The results indicate that the speed limit reduction in highways lowered gasoline consumption by 2% to 3%, while an increase in the biofuel content of gasoline increased this consumption. This last result is consistent with experimental evidence that indicates that mileage per liter falls with an increase in the biofuel content in gasolines. As for the reduction in transit fares, we do not find a significant effect for this policy. However, in specifications including the urban transit fare for the major cities in each province the estimated cross-price elasticity of the demand for gasoline – used as a proxy for car use – with respect to the price of transit is within the range reported in the literature. This is important since one of the main efficiency justifications for subsidizing public transit rests on the positive value of this parameter and most of the estimates reported in the literature are quite dated.

1. Introduction

In late February 2011 the Spanish government announced several permanent and temporary measures to reduce fuel consumption in the transport sector, which were then included in an "Energy savings and efficiency plan" dated March 4th.[4] The ultimate aim of these measures was to reduce the high dependency of the Spanish economy on imported oil at a time of rising international prices.

Oil provides half the primary energy supply in Spain and is 99.9% imported. In terms of final consumption, the transport sector accounts for 42% of the total, of which 80% is consumed by road transport. However, since the beginning of the economic crisis consumption of oil had been falling in Spain, both in absolute and relative terms. What can be identified as the trigger to the government's policy was the increase in international petrol prices, which put a lot of pressure on Spain's balance of payments at a time when reducing the borrowing requirements was a major objective. The spot price of Brent crude oil started rising in the summer of 2010 from 75.58 USD/barrel in July to 91.45 in December and 103.72 in February 2011. This led to a parallel increase in the balance of trade deficit in energy products: while the average monthly deficit between January and November 2010 had been 2.89 billion euros, it rose to 3.58 in December and to 3.97 in January 2011.

Among the measures announced was a reduction in the maximum speed limit from 120 km/h to 110 km/h in the highway network. In 2011, 59% of vehicle–kilometers traveled in Spain were in high speed roads ('autopistas', 'autovías' and double lane highways) subject to this change in the speed limit.[5] This policy was applied from March 7th 2011 until June 30th of the same year. The government expected a reduction of 15% in gasoline consumption and 11% of diesel consumption from this measure alone, although it did not present any technical studies to substantiate these claims.

The second measure announced by the government was an increase in the biofuel component of fuels used by the transport sector. Spain sets yearly minimum requirements on the percentage of biofuels to be used in transport as well as, since 2009, specific separate requirements for

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[4] See a summary of the Government's announcement at http://www.lamoncloa.gob.es/idiomas/9/gobierno/news/2011/25022011energybill.htm. The details of the plan are available (in Spanish) at http://www.lamoncloa.gob.es/consejodeministros/referencias/_2011/refc20110304.htm and then following the link 'Eficiencia Energética' [accessed January 24th, 2013].

[5] Anuario Estadístico (Statistical Yearbook), Ministerio de Fomento, Spain.

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petrol and diesel. Prior to the analyzed policy change the minimum overall percentage set for 2011 was 5.9%, with at least 3.9% both for diesel and for gasoline. The new policy increased the overall figure to 6.2% and that of diesel to 6.0%, while leaving the gasoline limit unmodified.[6]

The final measure was a nationwide transitory reduction of 5% in the fares of regional and commuter train services operated by *Renfe* (the public national rail company), applicable from March 7th to June 30th 2011. Shortly after this measure was announced it became apparent that the reduction would be difficult to implement in those transport systems operating with integrated fares and negotiations ensued with the corresponding transit authorities. In the end, the reduction in fares was applied to all public transport services (including metro, train and buses) in two metropolitan areas (Barcelona and Asturias) for a period of three months (April to June 2011). However, in the rest of the country only *Renfe* fares were reduced. In the case of one of the most important metropolitan areas (Madrid) this measure had only a limited impact on overall public transport prices as will be discussed below. Only 10 of the other provinces had *Renfe* commuting train services where this measure could be expected to have an impact.

It is important to note that the national authorities explicitly stated that the fare reduction measure was aimed at reducing gasoline consumption and car use. Press reports cite expected savings of 5.9 million liters of gasoline and a reduction of 2.2 million car trips in the largest cities, according to the *Ministerio de Fomento*'s calculations.[7]

In this paper we use monthly data across 48 Spanish provinces to estimate gasoline demand equations in order to infer the impact of the three measures just described. This includes all provinces in Spain except the two that are part of the Canary Islands, which have a particular tax regime that strongly affects petrol prices and consumption.

All else constant the reduction of the speed limit in the high speed network system would be expected to reduce fuel consumption for both gasoline and diesel, although the focus of this paper is on gasoline consumption. Our results confirm this prediction although we find that the impact was much lower than what was originally announced by the authorities. Our empirical results are consistent with simulation studies (European Environmental Agency, 2011) and estimates from the enactment of a national speed limit in the USA in 1974 (Blomquist, 1984; GAO, 2008).

The question of the performance of fuels used in transport when mixed with different shares of biofuels has been addressed by engineering researchers in various studies.[8] The results they reach vary according to the performance measure employed, as well as on the type of biofuel considered and variables such as engine and vehicle design, driving conditions or load factors, among others (Bayraktar, 2005; Cataluña et al., 2008; Crookes, 2006). In the case of the type of biofuel employed in Spain and the EU (ethanol obtained from different biomass sources, technically known as ethyl tert-butyl ether, or ETBE), Kowalewicz and Wojtyniak (2005) report that "because ethanol contains approximately 60% of the energy content of gasoline, it takes more ethanol to get the same mileage as a similar gasoline vehicle" (page 111). Taking that percentage as a reference value, it can be inferred that an increase of 1% in the biofuel content of gasoline from its average value in Spain during our sample period should lead to a 0.41% increase in the total consumption of fuel (gasoline plus ethanol) for the same mileage. We test this proposition below with a gasoline consumption model and find values that are in accordance with that result. As far as we are aware, this is the first empirical confirmation of this effect that to date has only been documented based on experimental and laboratory conditions.

As for the third measure introduced – the reduction in public transit fares – we exploit the variation in policy treatment across the different regions and metropolitan areas of the country – that is the 5% reduction in overall transit fares in Barcelona and Asturias vis à vis slight or no reduction in other areas – in order to estimate the effects of transit prices on car use. Since gasoline is almost exclusively purchased by private automobile owners, we take this consumption as a proxy measure of private car use after controlling for other variables affecting fuel demand. As mentioned above, one of the explicit policy aims of this measure was the reduction in car use. Given the above description of the implementation of this policy, we would expect gasoline consumption to fall in Barcelona and Asturias relative to other regions of the country when transit fares were reduced in April 2011 and to increase when this policy was reversed at the end of June 2011.

With respect to this last policy change, our estimation results when controlling for the transit fare change applied between April and June 2011 show that the magnitude of the discount (5% of established fares) had no effect on consumption in the affected provinces. This could be due to the limited time period and geographical extension where this policy was applied (3 months and only two provinces). The robustness of this result is checked with the inclusion of public transport fares in the gasoline consumption equation. In this specification we find evidence of a cross-price effect implying that car use and public transport are substitutes.

We believe that the evidence provided in this paper is very relevant to current policy discussions in Europe. Although higher fuel taxes and/or congestion tolls could be used to reduce car use and gasoline consumption, these policies are often difficult to implement due to political opposition and other restrictions; particularly in Europe where fuel taxes are relatively high by world standards. In this context, alternative policies to reduce gasoline consumption in order to limit negative externalities or in the pursuit of other policy aims – such as saving foreign reserves in the face of rising international fuel prices – may be of interest. Evaluating the speed limit policy change in Spain or the impact of changes in the biofuel content of fuels used in the transport sector provides relevant information regarding these less conventional policy instruments. In Europe there is an on-going discussion regarding the benefits of lowering speed limits (European Environmental Agency, 2011) and the results of this paper provide relevant empirical information on this topic.

As regards public transit fares, determining whether transit fares affect car use is important. One of the main efficiency justifications for subsidizing public transport is that lower transit fares reduces private car use and the associated externalities related to this transport mode.[9] For example, Parry and Small (2009) in their detailed study of optimal transit subsidies in Los Angeles, Washington D.C. and London conclude that this second-best argument justifies increasing subsidies in these cities particularly during peak-periods.

Considering how ubiquitous and large transit subsidies are around the world, it is curious to note how little research there is concerning the cross elasticity of transit fares on car use. Although we review the existing evidence for Spain and other countries below, it is interesting to note that even careful studies such as Parry and Small (2009) need to rely on quite weak evidence on the cross elasticity of demand to arrive at their results. In fact, the parametrization of their model comes from just three studies that measure the diversion ratios between car use and public transport, all of them from the mid-70s; that is, more than 40 years old. For Europe they do not present any evidence and use the parameters estimated in the US in their empirical analysis for London. Litman (2012) in a recent review of transport elasticity studies also notes that many of the estimates of transport demand elasticities are quite dated.

[6] Although the minimum biofuel content for gasoline was not changed, below we will show that there was an observed increase in the biofuel content of gasolines after the policy announcement; possibly as a reaction to the increase in the overall minimum requirement for fuels used in the transport sector.

[7] "El billete T-10 costará 7,85 euros entre el 1 de abril y el 30 de junio", *El Periódico*, March 10th, 2011.

[8] See Rutz and Janssen (2007) for an introductory review to the technical issues related to the different types of biofuels available.

[9] The reasonable assumption being that private car users do not face the full social cost they impose on society through congestion, pollution and accidents and that first-best congestion charges or tolls are not feasible.