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Road accidents and business cycles in Spain☆

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ABSTRACT

This paper explores the causes behind the downturn in road accidents in Spain across the last decade. Possible causes are grouped into three categories: *Institutional* factors (a Penalty Point System, PPS, dating from 2006), *technological* factors (active safety and passive safety of vehicles), and *macroeconomic* factors (the Great recession starting in 2008, and an increase in fuel prices during the spring of 2008). The PPS has been blessed by incumbent authorities as responsible for the decline of road fatalities in Spain. Using cointegration techniques, the GDP growth rate, the fuel price, the PPS, and technological items embedded in motor vehicles appear to be statistically significantly related with accidents. Importantly, PPS is found to be significant in reducing fatal accidents. However, PPS is not significant for non-fatal accidents. In view of these results, we conclude that road accidents in Spain are very sensitive to the business cycle, and that the PPS influenced the severity (fatality) rather than the quantity of accidents in Spain. Importantly, technological items help explain a sizable fraction in accidents downturn, their effects dating back from the end of the nineties.

1. Introduction

Traffic accidents became an issue of primary political concern by the end of the nineties in Spain. The evolution of road fatalities in Spain exhibits three clearly identified periods: The first one extends from 60 s through 80 s showing an upward slopped trend, where fatalities reached a maximum of 9,344 victims in 1989; and a second period during the 90s, with a sharply decline in the number of deaths (Dirección General de Tráfico, 2014). Although this evolution is similar to those observed for other European countries (Brüde and Elvik, 2015), compared with countries such as France, Germany or the United Kingdom, Spain has evinced the highest fatality rates during the eighties and still during the nineties. Finally, the third period corresponds to 2000 s with an acceleration in the decline trend. This paper analyzes the factors behind road traffic accidents, injuries and fatalities in Spain.

Active policy intervention is often proposed as a key factor to pick down the number of fatal accidents (Brüde and Elvik, 2015). Within this line of intervention, the Spanish government implemented a Penalty Point System (henceforth, PPS) for licensed drivers in 2006, similar to those existing in other European countries. The success of the PPS, as a public policy, has recently been evaluated from an academic viewpoint. In general, there is a wide consensus in the literature concluding that the introduction of PPS in Spain helped to reduce the number of traffic victims. For an analysis of both the Spanish PPS and those of other countries, see Roca Ruiz et al. (2009); Aparicio-Izquierdo et al. (2011); Castillo-Manzano et al. (2010) and Castillo-Manzano and Castro-Nuño (2012), and references therein. These authors, however, disagree

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around the scope of its effects. Novoa et al. (2010) conclude that the main gain was in the reduction of injured people (drivers, vehicle occupants or pedestrians) in traffic accidents. Aparicio-Izquierdo et al. (2011), on the other hand, concluded that the PPS reduced the number of road fatalities. Regarding the duration of the positive impact of the PPS, the literature is far from consensus (Roca Ruiz et al., 2009): some studies conclude that the PPS had limited transitory effects (see Castillo-Manzano and Castro-Nuño, 2012; Castillo-Manzano et al., 2010 for Spain, and Farchi et al., 2007 for Italy), while another studies find that the PPS effects have been long lasting (Novoa et al., 2010; Aparicio-Izquierdo et al., 2011).

It is not straightforward to isolate the impact of PPS from that of other factors (SWOV, 2010). For example, vehicle design standards, for which the EU authorities have exclusive competence, may have played a crucial role by avoiding accidents (active safety, such as Electronic Stability Control, ESC) or by reducing the severity of accidents (passive safety systems such as front airbags, side airbags, knee airbags, seat-belts, car structure, load limiters, etc.).[1] Existing literature has emphasized the effectiveness of safety systems to reduce road accidents and specially accidents with fatalities, i.e., see Tingvall et al. (2003) and Page and Cuny (2004) for in European countries; Freiss et al. (2005); Farmer (2004), and Bahou (2005) for the US; and Aga and Okada (2003) for Japan; for a review of empirical studies see Erke (2008).

Shortly after the PPS in 2006, Spanish economy was hit by a global crisis occurring after 2007, which downsized GDP for a period spanning from 2008 to 2013, a fact dubbed as the great recession. At the very same time, fuel prices increased during the spring of 2008. These two facts help explain some aspects related to traffic, such as road congestion and accidents. To our knowledge, this is the first paper that attempt to identify which technology factors, such as ECS, are likely behind the evolution of road accidents in Spain at an aggregate level. Factors are grouped into three sorts: *Institutional* factors, *technological* factors (active safety and passive safety), and *macroeconomic* factors. For these reasons, the variables considered in this work are: the PPS, as a policy that could have affected individuals' incentives (Roca Ruiz et al., 2009), the proportion of registered cars equipped with ESC as a proxy of active car safety measures and also of passive safety,[2] the GDP to proxy aggregate income, and the fuel price index as proxy for the operating costs of motor vehicles.

We estimate both long-run and short-run equations. In particular, we first apply the Johansen's test and find one cointegrating vector among these series, and estimate a cointegration equation (i.e. long-run relationship). Second, following Pesaran and Shin (1999), we estimate an autoregressive distributed lag (ADL) structure to analyze the short-run behavior. Road accidents are in turn differentiated according to severity, i.e. non-fatal accidents versus fatalities. We are aware that there are some other possible candidates helping explain the decline in car accidents, such as the quality of roads and traffic infrastructures, drivers' habits and education, or the efficacy of police agents. However, we argue that the chosen factors provide an accurate description of recent evolution of road accidents in Spain.

Our main findings can be summarized as follows. *First* the declining trend of road accidents in Spain cannot be associated to a single cause, but rather to the confluence of several aspects earlier mentioned: technology, institutions and policies, and economic conditions. *Second*, PPS helped reduce fatalities, but not non-fatal accidents, so that its effects should be linked to the severity (rather than the quantity) of accidents. And *third*, last but not least, the effects of technology (active and passive safety) go beyond macroeconomic fluctuations and drivers' habits conditioned by the PPS: the downward trend of all type of accidents can be dated back to early 2000s, when motor vehicles were massively equipped with these items.

2. Facts and data description

2.1. The penalty point system

The Penalty Point System (PPS) was created and regulated through Law 17/2005 in Spain. Although the Law came into force in August 20th 2005, it was not fully applied until July 1st 2006 (*Disposición final segunda*, Law 17/2005). For the purpose of our analysis, we therefore consider the third quarter of 2006 as the starting date of the PPS System.

The Law implemented a punitive schedule aimed at reducing road traffic violations classified as serious or very serious. Basically, the PPS System works as follows: drivers are endowed with 12 credit points when the license is older than three years, and novel drivers are endowed with 8 credits.[3]

The ultimate target of the Law was halving the number of deaths in road accidents, which was set out in the European Commission's White Paper 2001. Analogous PPS Systems had already been introduced in the United Kingdom (1982), France (1992–2001) and Germany (1999).[4]

2.2. Road accidents

We use quarterly observations from different datasets. From the Spanish General Directorate of Traffic (henceforth, DGT), we download data on road accidents. DGT differentiates between fatalities and non-fatal accidents. These latter will be denoted as fatalities.[5]

Table 1 compiles some basic statistics related to accidents. These moments are reported for different periods, concerning the PPS implementation. The last column of this Table, labeled as Δ, presents the difference between the two selected sub-periods. The first subpanel of Table 1 introduces total number of accidents for three particular years: 1995 (start of the sample), 2005 (one year before PPS), and 2012 (the last observed year). As of 1995, there were 81.5 thousands road accidents in Spain. Out of them, 77.4 thousands were non-fatal accidents. The remaining 4.1 thousands were fatal crashes. Both total accidents and non-fatal accidents increased after 1995, peaked on 2005 and reduced in 2012 (see differences Δ comparing 2012 versus 2005).

Fig. 1 shows traffic accidents in Spain—total and non-fatal accidents- from 1995 to 2012 (thousands). The vertical dashed line (in this and the following figures) marks the PPS implementation date in 2006. Both series follow a similar path since most of accidents do not result in death, fortunately. Contrary to the findings in earlier studies, the bulk of the downturn of accidents started in 2008 rather than 2006, one year and a half after the implementa-

[1] The European New Car Assessment Program (EuroNCAP), introduced to complement the EU type-approval system, aims at testing and publishing new car safety against harmonized testing protocols, and has improved car safety. This is evident by the higher rating achieved by newer models compared to equivalent models by the time the program began.

[2] The passive safely series are strongly correlated with the evolution of the ESC system in cars, so the latter would capture information of both type of safely systems.

[3] For an overview of possible offences and their consequences in terms of loss of credits: https://sede.dgt.gob.es/Galerias/tramites-y-multas/permiso-por-puntos/informacion-permiso-por-puntos/DGT_Informacion_Puntos.pdf.

[4] Unlike France and Spain, the German and British systems are based on accumulation of points, with a driver losing his/her driving license upon accumulation of 18 and 12 points, respectively.

[5] According to the DGT, fatalities are persons who have died as a consequence of a traffic accident, where both death occurred instantaneously or within twenty-four hours after the accident.