Competition and Pass-Through:

Evidence from the Spanish 20 cents subsidy

By Agustin Fernández*

I measure how pass-through varies with competition in retail automotive fuel markets. Using daily pricing data from gas stations in all the Spanish territory, I study how an unexpected and exogenous introduction of a 20 cents subsidy is passed through consumers in markets with different numbers of retailers. I expect the pass-through to be lower in gas stations with low levels of competition.

A fundamental issue in economics is how firms pass cost shocks (subsidies, exchange rates, input prices) through to prices. "Cost pass-through" describes what happens when a business changes the price of the products or services it sells following a change in the cost of producing them. In the context of this study, we can think of gas stations directly bearing the benefit of the subsidy and then "passing through" the subsidy indirectly to consumers[1]. In addition, theoretical analysis shows that competition is a key determinant of pass-through Weyl and Fabinger (2013). As for the empirical analysis, there is a well-established line of research exploiting plausibly exogenous variability in costs to infer the magnitude of pass-through.

In this paper, I examine whether gas stations with low levels of competition, as measured by the number of competitors, are able to lower prices less after a change in costs than those stations that have higher levels of competition. To estimate the causal effect of the number of competitors on the pass-through we use as an exogenous shock the introduction in Spain of a 20 cents subsidy to all

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[1]For taxes, firms usually want to have a high pass-through while for subsidies is the opposite.

automotive fuel products and exploit the variation in the number of competitors of gas stations pre-policy. We take advantage of a rich panel dataset of daily prices of several automotive fuels for all stations located in Spain which allows us to control for a wide range of unobservable characteristics. We show the estimates as event-study plots for a window period of 30 days. As I expect the pass-through to be lower in gas stations with a low level of competition, the estimates should decrease after the 1st of April.

To the best of my knowledge, this will be the first study that analyzes how the pass-through of a subsidy *at the national level* depends on the degree of competition in local markets. Additionally, I will use methodological innovations identified from the competition literature in recent years such as defining local markets using the driving distance between gas stations.

In the international context, the Spanish case is interesting to study for at least two reasons. First, historically, the degree of competition in the Spanish retail gasoline market is lower than in other countries and it has not improved after numerous reforms. Second, the subsidy was introduced without the prevision of the customers and 20 cents is a large quantity as it represented 10.9% of the retail price of diesel the day the subsidy was introduced.

Policy-wise, the study is relevant because the subsidy was estimated to cost more than 600 million to taxpayers, and the subsequent extensions will have inflated the cost even more. It is important to evaluate how has it worked so far, especially in a context in which the energy crisis is not over yet. Additionally, as the subsidy can have heterogeneous effects depending on the level of competition in the market, this may affect importantly the distributive effect of the policy. Some gas stations (and customers) will be more benefitted than others.

I. Review of the Literature

There is a large empirical literature on competition and retail fuel prices that has found that a greater number of stations operating within predefined geographical areas implies lower prices.

The area is usually defined as the number of gas stations within a radius of 15 km depending on the Euclidean distance that separates them. However, current studies often present a number of problems: Firstly, variability in the number of close competitors captures some important aspects of horizontal market competition but does not guarantee that there are no significant substitution effects beyond the selected geographical area. For example, some consumers may commute across geographical markets for work. Secondly, although the number of competitors is commonly used for measuring the intensity of competition, it implicitly assumes that all competitors are equal. Some studies have analyzed how competition is characterized by other factors apart from the number of competitors, for example, the class of gas station (vertically integrated, independent, low cost) Jacint Balaguera (2019). Lastly, market structure is often endogenous since the location of gas stations may be related to the demand characteristics of the local market.

In the last years, this literature has improved by incorporating methodological improvements and by taking into account the endogeneity bias. First, by improving market definition. Perdiguero and Borrell (2019) delimits the relevant market for each gas station in Spain accounting for driving distance and not just geographical distance. It claims that the relevant geographic market is delineated by a 5-minute travel-time isochrone around each station. Second, controlling for a larger number of variables such as traffic and economic conditions or distance to the refinery, and by increasingly rely on panel data. Third, studies have been paying more attention to the endogeneity bias problem, even though it is generally considered to be small. Although it is not easy to find good IV, recent studies use islands Genakos and Pagliero (2022), or isolated areas such as natural parks Tappata and Yan (2017).

Regarding the literature on pass-through, there are several studies that have used variations of taxes or subsidies. For example, Doyle and Samphantharak (2008) analyze variations between two US states and focus on the pass-through of gas stations that are at the border. In Spain, since Autonomous Communities can fix a part of the excise tax on automotive fuel, studies such as Stolper (2016) and Cuadrado et al. (2018) take advantage of tax reforms at the regional level to get exogenous variation in costs. Even for the 20 cents subsidy under analysis in this paper, Juan Luis Jiménez and Artiles (2022) study the average pass-through of its introduction. They use national weekly oil prices and a standard DiD design differentiating the European countries that have implemented a subsidy from those that have not (control). They observe that for Spain the 20 cents subsidy increased by 3.7 cents the price (after taxes) of Gasoline 95 and by 6 cents the price of diesel.

However, there is less empirical evidence on the relation between competition and pass-through. The literature tends to be more theoretical as it will be shown later. The empirical evidence is mixed: Alm, Sennoga and Skidmore (2009) find a lower pass-through in rural (less competitive) than in urban (more competitive) gasoline markets in the US. Doyle and Samphantharak (2008) and Stolper (2016) find that greater brand concentration and market power are associated with larger pass-through rates in the gasoline market. In general, all the studies use the number of competitors in the area as a measure of competition and then use a DiD design exploiting some exogenous variation like changes in taxes across states. Additionally, Cuadrado et al. (2018) study how contract structure between gas stations and the wholesale operator affects pass-through, controlling for a number of competitors. Using a different setting, Genakos and Pagliero (2022) use small isolated oligopolistic markets of different sizes (Greek islands) to isolate the markets and conclude that pass-through increases with competition in a nonlinear fashion, growing from 0.4 for monopoly markets to about 1 for markets with four competitors or more.

II. Background

A. Background to the policy reform

On March 28 of 2022, the Government announced that as of April 1, an extraordinary and temporary measure (until June 30)[2] consisting of a reduction of 20 cents in the final price of hydrocarbons at service stations would enter into force. Later, the policy was postponed until December 31 and it may even continue in 2023 but targeting only some specific groups (professionals and low-income families).

The subsidy was part of a response shock against the economic consequences of the Ukrainian war that started on the 24 of February. The war represented an important indirect supply shock, especially to energy markets, and as figure A2 shows, gas prices increased remarkably in the days following the war before the introduction of the subsidy. As stated in the law, the subsidy was introduced with the main idea of stopping inflation and helping vulnerable households and the transportation sector. Lastly, it is worth mentioning that although the plan comprises several measures for different markets (such as energy, gas, and wheat), it is unlikely that there will be confounding effects between them.

As a side note, the policy has an important nuisance: for those companies with refining capacity in Spain (Repsol, Cepsa, and BP) the reduction from the State is 15 cents (instead of 20) and the companies have to commit to discount an additional 5 cents. This point is significant as it shows that the government was already expecting a differentiated behavior of gas stations by those brands that have higher market power.

B. Spanish retail fuel market

The Spanish retail automotive fuel market is far from perfectly competitive. It is dominated by three companies (Repsol, Cepsa, and BP), which own all nine oil refineries operating in Spain. In

[2] Real Decreto-ley 6/2022, de 29 de marzo, por el que se adoptan medidas urgentes en el marco del Plan Nacional de respuesta a las consecuencias económicas y sociales de la guerra en Ucrania. (page 62).

2022, there are about 11,800 gas stations in Spain; but the top five retailers (Repsol, Cepsa, BP, Galp, and Shell) accounted for nearly two-thirds (64%) of Spanish gas stations. In contrast, low-cost gas stations are not common. In fact, Spain is among the European countries with the lowest share of unmanned or low-cost stations – which represent only 5% of the total.

Moreover, decades of sectorial reforms -the last most important in 2013[3]-, have not been successful in fostering competition Cuadrado et al. (2018). In fact, the regulator sanctioned five operators for having collusive practices during the period 2011-2013[4]. Notwithstanding, Bernardo (2018) finds that entry of the so-called "low-cost" stations and those linked to supermarkets significantly decrease prices at their nearby stations.

More specifically, the importance of this can be illustrated by comparing the Spanish prices with those of the main fuel-consuming countries in the European Union (EU-28). Spain is the third country with the largest price before taxes, which prices a 5% than the average price in the EU [5].

III. Economic theory

Automotive fuels can be considered a homogeneous product with well-defined characteristics and simple pricing policies. The production technology is also very similar across fuel stations and capacity constraints are not typically a significant factor in this market. However, gas stations can be differentiated by their location, and local geographical markets often have an oligopolistic structure. Given these "textbook" characteristics, standard theoretical models can be used to accurately describe and analyze this sector.

Although a standard intuition is that more competition makes prices more "cost-reflective" and thus raises cost pass-through, this intuition is sensitive to many assumptions. Weyl and Fabinger (2013) obtain the following equation for the pass-through on the equilibrium price in oligopolistic

[3]Real Decreto-ley 4/2013, de 22 de febrero, de medidas de apoyo al emprendedor y de estímulo del crecimiento y de la creación de empleo.

[4]RESOLUCIÓN (Expte. S/474/13 PRECIOS COMBUSTIBLES AUTOMOCIÓN).

[5]According to the last annual report of the regulator (CNMC,2020).

markets with n symmetrically differentiated firms:

$$\rho = \frac{1}{1 + \frac{\theta}{\epsilon_\theta} + \frac{\epsilon_D - \theta}{\epsilon_S} + \frac{\theta}{\epsilon_{ms}}} \tag{1}$$

The key element of the equation is the "competition behavior" θ which is used in turn to describe the solution to the firm maximization problem, $\frac{p - mc(q)}{p}\epsilon_D = \theta$, where $mc(q)$ is the marginal cost of producing q and ϵ_D is the elasticity of demand. θ captures the intensity of the competition among firms ($\theta = 0$ in a competitive market and $\theta = 1$ in a monopolistic market).

The pass-through ρ depends on the conduct parameter θ and how it varies as the quantity produced changes ϵ_θ (a sort of elasticity for competition behavior), but also on the determinants of the elasticity of demand ϵ_D, the elasticity of the inverse marginal cost curve ϵ_S (the elasticity of supply), and the curvature of the demand function ϵ_{ms}[6]. As an example, with perfect competition, $\theta = 0$ and we get the standard pass-through: $\rho = \frac{1}{1 + \frac{\epsilon_D}{\epsilon_S}}$.

Following the discussion in Genakos and Pagliero (2022) and looking and the different parameters of 1, there are several assumptions to consider when analyzing the possible sign and magnitude of the pass-through: the functional form of the demand function, the marginal costs of the gas stations, and how the *theta* parameter changes with the quantity produced.

Overall, we can see that the impact of an increase in competition on the pass-through remains largely an empirical issue as the direction of the effect is unambiguous. As an example, if firms have even modestly increasing marginal costs (we change one of the assumptions), more intense competition can decrease pass-through Ritz (2019).

IV. Data

The data set consists of a panel of daily prices of several hydrocarbons (including diesel and gasoline) for all stations located in Spain over a 6 month period, extending from 1 of Setember 2022

[6] If the demand function is linear this parameter will be one, if convex $\epsilon_{ms} > 1$ and if concave $\epsilon_{ms} < -1$.

to 31 of February of 2023. Daily retail prices and station characteristics (brand and coordinates) are systematically collected from a public website [7]. Gas stations are required to send information on the prices they charge every Monday and whenever they change them; otherwise, they are exposed to sanctions (Ministerial Order ITC/2308/2007). The prices observed in the data are the transacted prices paid by customers. We exclude all national and regional taxes: the Value-Added Tax (of 21%) as well as the three components of the Tax on Petroleum Products as is done by González and Moral (2019). The aim is to eliminate the possible distortions generated by local taxes differences.

This data set contains information not only on prices but also on the brand affiliation and geographic coordinates (longitude and latitude) of each station. In figure A1 you can see the geographical distribution of the approximately 11,840 gas stations that were in Spain as of the 1st of September. As you can see the distribution of gas stations is more concentrated around more populated areas and roads connecting big cities.

We merged this panel data set with information from several other sources to get variables such as the household average income, rental prices and population density, at the municipality level from the National Institute of Statistics (INE). Finally, we incorporated information about explanatory variables related to traffic intensity. Examples include the number of daily traffic accidents (by province) and the average duration, in minutes, of commuting trips of the country's principal cities.

Finally, using the Google maps API, we can get the driving distance between stations and verify if each station is offering any additional services (such as a shop, carwash, or tire repairs). This data allows us also to compute measures of competition based on the number of competitors within a X Km driving distance from each station, X Km radius, or alternatively, a X-minute driving time, thus taking into consideration not just the (Euclidean) distance but also the underlying geography. As suggested by Perdiguero and Borrell (2019) we use as market definition the 5-minute travel-time isochrone around each station.

[7]Web from the Secretariat for Energy. Access to other European fuel-related portals can be found at link.

V. Empirical specification

To estimate the causal effect of the number of competitors on the pass-through we use as an exogenous shock the introduction in Spain of a 20 cents subsidy to all automotive fuel products and exploit the variation in the number of competitors of gas stations. We examine the differential effects of a subsidy on gas stations' automotive oil prices by estimating as done in Alpert, Powell and Pacula (2018) the following event-study specification,

$$p_{st} = \alpha_s + \gamma_t + n_s^{Pre} \cdot \delta_t + \epsilon_{st} \tag{2}$$

where p_{st}[8] denotes the retail price of the diesel, at gas station s, on the day $t \in \{\tau - 30, \tau + 30\}$, where τ is the date of the subsidy's introduction and $t = 1, ..., 30$ is the length of the adjustment period considered. The number of competitors before policy n_s^{Pre} is interacted with a full set of year fixed effects. The model includes gas station and day fixed effects, which capture station-specific characteristics as well as the macroeconomic shocks that affected the whole economy. Finally, ϵ_{st} is the random disturbance term, which captures the influence of other unobserved variables. I take into account that ϵ_{st} can be heteroskedastic, as well as spatially and temporally correlated and so I use two-way clustering. Additional variables could be considered in this equation, as discussed in the Appendix under the subsection Alternative specifications.

The coefficients of interest are the full set of δ_t estimates, which I will show graphically, normalizing the 1st of April coefficient to zero. This set of estimates identifies the differences in prices across gas stations with higher and lower initial levels of competition (as measured by the number of competitors in the local market) each day. Since we expect that the number of competitors will increase the pass-through of the subsidy, we expect the coefficients to decrease and be more negative after the 1st of April.

[8] It is possible to add logarithm to prices to normalize the distribution of the variable and interpret the coefficients as percentage changes.

The identifying assumption is $E(\epsilon_{st}|X) = 0$, where X is the matrix of all covariates. This assumption is reasonably met for at least two reasons: First, the policy was unexpected so agents did not have time to change their behavior. Second, even though the location of a gas station is endogenous (and thus the number of competitors n_s as well); we are interested in the differential in prices for a given number of competitors on a given day post policy.

Next, we reparametrize the model to estimate the average effect of the subsidy using a trend-break specification. This specification is less flexible than equation 2 but provides coefficients that are easier to interpret. The equation is the following,

$$p_{st} = \alpha_s + \gamma_t + \delta_1(Post_t \cdot n_s^{Pre}) + \delta_2(t \cdot n_s^{Pre}) + \delta_3(Post_t \cdot (t-\tau)n_s^{Pre}) + \boldsymbol{Z}_{st}\beta + \epsilon_{st} \tag{3}$$

where $Post_t$ is an indicator that turns on on April 1 and later and t is a linear time trend. This specification allows for both a level shift and trend break beginning after the introduction of the subsidy. We add $\boldsymbol{Z}_{st}$ which is a vector of controls such as daily traffic in the area or cost variables that change every day and are specific to the gas station. The parameters of interest are $\delta_1+\delta_3(t-\tau)$, where $t-\tau$ is the number of days that have passed since the introduction of the subsidy.

In both 2 and 3 there are a number of design choices that can potentially affect the results. In the Appendix, I explain how I provide robustness checks for them.

VI. Conclusion

In this study, I examine how an unexpected and exogenous introduction of a 20 cents subsidy is passed through consumers in markets with different numbers of retailers. To estimate the causal effect of the number of competitors on the pass-through we take advantage of an exogenous shock, the subsidy, and exploit the variation in the number of competitors of gas stations pre-policy. To do so, I propose two different specifications: The first one is a flexible event-study that allow us to see the differential effect of competition every day after the introduction of the subsidy. The second one is a less flexible trend-break model but enables us to estimate the average effect of the subsidy accounting for different levels of competition.

There are a number of potential directions for further research. Firstly, since the subsidy has been introduced for a limited time and will end on the 31 of December, we can analyze if the behavior of the pass-through is similar from when the subsidy is introduced to when it is removed. This analysis would contribute to the "Rockets and feathers" literature that says that after the removal, gas stations will increase prices more (and faster) than what they lowered them during the subsidized period. Secondly, as shown in the Appendix, it is possible to add more characteristics (interacted with time fixed effects) to the main specification. The literature has provided evidence that is important to account at least for the brand and ownership of the gas stations. Thirdly, it is worth exploring how feasible it would be to exploit variation across borders (possibly with Portugal) to see how competition between gas stations with different costs is related with the pass-through.

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Appendix

A1. Robustness checks

There are a number of specification choices in equations 2 and 3 that can potentially affect the results. I will provide robustness checks for three of them: (1) The 30-day adjustment period is chosen so that it is close enough to the date of the introduction of the subsidy, but is also long enough for almost all of the gas stations to have changed their prices. For the second specification, the choice of the interval can affect the results so I will try different values. (2) I will try different driving minutes to define the travel-time isochrone that establishes the market. Since most studies use as a proxy for competition the number of gas stations in a radius between 1 and 15km (Euclidean distance), I will also try different distances in kilometers. (3) As a side note, the average pass-through on a given date depends on two margins. The extensive margin is the number of gas stations that have adjusted their price by a given date. The intensive margin is the size of the price increase for stations actually changing their prices. Accordingly, we can use the specified equations to estimate the "average" pass-through or the "conditional" pass-through ("conditional on starting to adjust"), using respectively all the data or only the data for firms that have changed their prices at least once by a given date. For long enough adjustment periods, the two definitions coincide, as all stations have adjusted their prices. Nevertheless, as seen in figure A4, gas stations update prices quite often.

A2. Alternative specifications

Specification adding more variables

It is possible (even necessary) to add additional variables to equation 2. As seen in the literature review and in the evidence provided in the structure of the Spanish retail fuel market, it seems important to take into account the brand of the station and of its competitors. One possible solution is,

$$p_{st} = \alpha_i + \gamma_t + (n_s^{Pre} + \boldsymbol{Z}_s^{Pre}) \cdot \delta_t + \epsilon_{st} \tag{A1}$$

where $\boldsymbol{Z}_s^{Pre}$ could contain variables such as the brand of the station. Additionally, instead of n_s^{Pre} we could use $n_s^{Pre} = \sum_{c=1}^{C} \beta_c n_c^{Pre}$ where c indexes the different classes of gas stations such as vertically owned, independent or low cost.

Specification with a control group

If we had a control group such as gas stations or products not exposed to the subsidy, we could use an alternative specification as in Genakos and Pagliero (2022):

$$p_{ksmt} = \alpha_0 + \gamma_t + \beta ks + \rho(n_m^{Pre}, \boldsymbol{Z}_m^{Pre}) \cdot S_t + \epsilon_{st} \tag{A2}$$

where m is the market, S the indicator for the subsidy, k the index that differentiates the treatment from the control group and $\rho(n_m^{Pre}, Z_m^{Pre})$ is a linear function $\rho(n_m^{Pre}, Z_m^{Pre}) = \rho_0 + \rho_1 n_m + \rho_2 \boldsymbol{Z_m}$ of the number of competitors n_m and other local market characteristics $\boldsymbol{Z_m}$ pre-policy that capture the subsidy pass-through such as population density, household income and rental prices.

A3. Figures

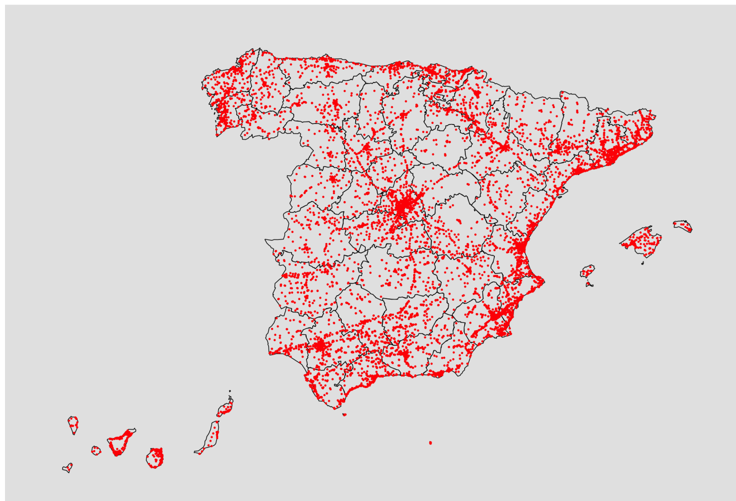

Figure A1. : Geographical distribution of Spanish gas stations

Note: Dots are Spanish retail gasoline stations. We can see that gas stations tend to be more concentrated around major roads and cities.
Source: Secretariat for Energy (stations); National Statistical Institute (state boundaries).

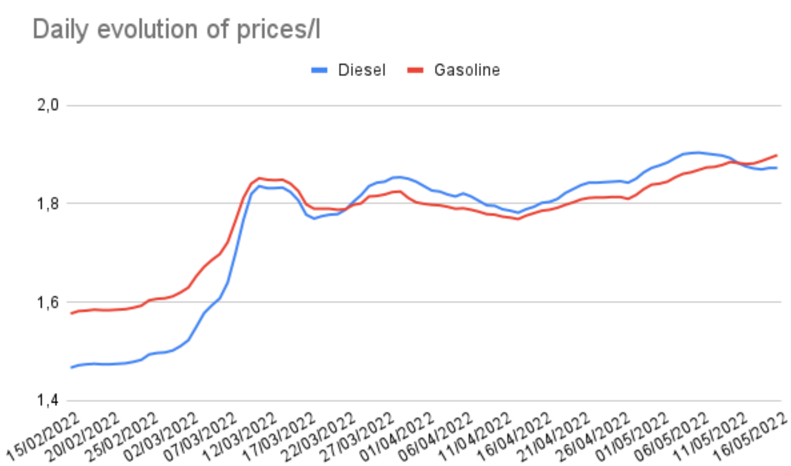

Figure A2. : Daily evolution of prices in the Spanish market

Note: Automotive fuel prices increased rapidly after the start of Ukraine's war (Feb 24) and they stabilized slightly before the introduction of the subsidy in the 1st of April.
Source: Secretariat for Energy

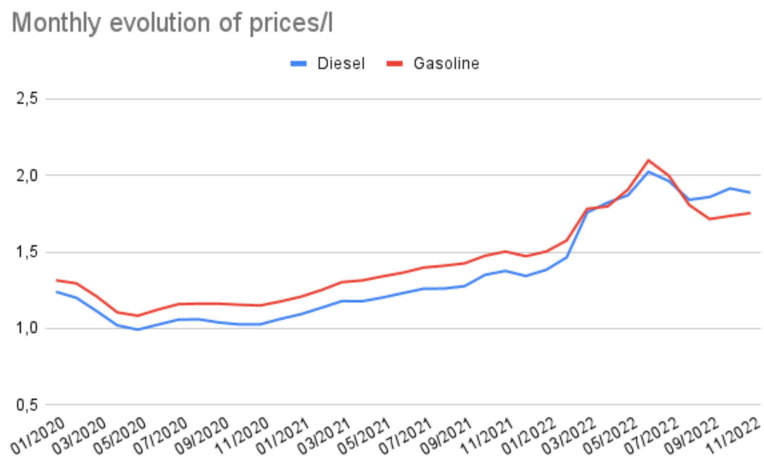

Figure A3. : Monthly evolution of prices in the Spanish market

Note: Automotive fuel prices have been increasing the last couple years and this trend accelerated during the first part of 2022.
Source: Secretariat for Energy

Figure A4. : Prices variation in gas stations

Note: As of November 30th before midnight, many stations had updated their prices within the last day and there were very few stations that had not changed their prices in the last four days.
Source: Secretariat for Energy and author's own calculations