Price Comparison and Pricing Strategies
A Case Study: the Italian Motorway Refuelling Market

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Abstract

The availability of price information is crucial in shaping market competition. Policy interventions aimed at informing consumers about prices and making possible price comparison have the potential to lower search cost and empower consumers. This might in turn trigger competition among retailers that compete to attract informed (and active) consumers. This paper studies the implementation of a consumer policy aimed at facilitating fuel price comparison on Italian toll motorway. We empirically test the effect of introducing price comparison on the price final consumer face.

Very preliminary version

Key words: Consumer Policy, Treatment Evaluation, Price Dispersion, Gasoline Market, Price Comparison

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1 Introduction

Availability of price information plays a crucial role in shaping market competition. There are several reasons why firms might not want to provide price information to the market and why consumers might not search all the available prices. Firms might find it profitable not to disclose price information as to retain market power and charge higher prices to captive consumers. On the other hand, consumers might not search for prices because they entail positive search cost and might settle to buy a product at an higher price even though the same product was on sale at a lower price from another retailer. For instance Diamond (1971) describes a situation in which consumers are uninformed about prices and have positive search cost. Firms sell an homogeneous product and have identical marginal cost. If consumers visit randomly the first retailers then it is optimal for the firms to charge the monopoly price and for the consumer to search only one firm. This result is defined as the Diamond Paradox as we just need the presence of a positive (possibly very low) search cost as to make optimal for the firms to charge the monopoly price.

Such a situation describes extremely well the market under study in this paper, the (Italian) motorway refueling market. A market that each year satisfy more than 10% of all the automotive refueling needs in Italy (Unione Petrolifera 2006, 2007). In such a market retailers (firms) do not have any incentive to supply price information to consumers and consumers face search cost (mostly in terms of cost of time) that make it optimal for them to just shop randomly at the first retailer.

In April 2007 a law approved by Italian parliament (Law 2 April 2007 n.40) provided some guidelines to motorway concessionaire about some remedies to put in place as to increase price information and make possible price comparison, as to foster price competition among retailers.

An highway concessionaire Autostrade per l'Italia, the main Italian toll-motorway concessionaire, in July 2007 implemented such measures on its own network as to offer a service to its customer, before setting off for summer holidays. The consumer policy intervention consisted in: 1) providing a price comparison website were drivers could consult offered fuel prices before setting off; and most importantly 2) the installation of roadway price comparison panel as to compare the available prices at the next four consecutive refuelling stations. The implementation of such a policy was welcomed by

consumer association that since long time had demanded the deployment of such comparison devices, and expected savings of up to 8 euro cents per liter were foreseen[1].

In this paper we use econometric methods, typically used in the program/treatment evaluation literature, to empirically estimate the impact of the price comparison policy, on the service stations that were required to comply to it. We take as outcome variable of interest the final price paid by consumers and we estimate the effect of price comparison on price levels.

To perform the empirical analysis we collect the price information exploiting the availability of the price comparison website. We then exploit some feature of the strategy used for the deployment of the roadway price comparison panels, which happened in stages, to identify the effect of the intervention (treatment).

Our identification strategies are based on a *matching on observables* estimator for the first stage of panel deployment; and on a *difference in difference* estimator for the second stage of panel deployment.

In the empirical analysis we do not find evidence that price comparison panels had the power to lower consumer prices. On the contrary we find evidence that price comparison panel might be associated with slightly higher prices. We also find evidence that service stations concerned by the policy intervention change their prices more frequently than station unaffected by the policy change, but still with no effect on final consumer price.

2 Related Literature

This paper mainly relates to the growing literature that looks at the persistence of price dispersion, even for homogeneous products,.in today consumer markets. Such a literature revamped during the last decades and looks with great attention at the role that available information technologies can play in solving long term market information problems. Indeed, after the mass adoption of internet by consumers in the late nineties and the success of online shopping economists looked with increased attention at the dynamics of online prices. In particular internet was thought of having reduced if not brought to zero the search cost entailed by consumers when comparing prices (The Economist, November 20 1999, cited in.Baye, Morgan, Scholten 2004). This should have in turn been reflected in reduced price dispersion, at

[1] Carlo Rienzi for CODACONS (Coordination of the Assotiations for the Protection of Consumers), 17 July 2007, ANSA news

least in online markets. Since then several papers attempted to test whether online markets were indeed close to perfect competition as it was originally thought (among these papers Brynjolfsson and Smith 1999, Ellison and Ellison 2001, and Baye Morgan Scholten 2004). For instance, Baye Morgan Scholten in their paper analyzes prices of over 1000 products over a period of eight months, recording more than 4million price information. In their paper they empirically study both the hypothesis of price dispersion and of price convergence. However, they don't find evidence of price convergence. During the eight months under study the gap between the two lowest prices did not significantly get smaller.

Thus not even when online consumers have access to a clearinghouse, a platform on which firms post their prices and consumers at once can get information on all the prices, we observe price convergence and the law of one price does not hold.

In our paper we study a similar technological platform but this time intended for road refueling and not for online shopping. Thus we test what is the potential for information technologies when they are applied to real market (vs the online virtual marketplace).

As the other studies finds other consideration than prices have to play a role in consumer considerations, even for highly standardized goods, and persistent differences between informed and uninformed consumers are still the key to understand price dispersion.

3 Case Study Framework

In this section we give an overview of the case study. The scope of our analysis is to evaluate the effect of a consumer policy, implemented in a specific market (motorway[2] gasoline refuelling) taking as given the market structure in place. This section first describes the policy and its practical implementation. Then, it briefly describes the Italian motorway refuelling market with the purpose to explain the environment under study, motivate the relevance of our case study and collocate it in the wider scenario of consumer policy evaluation and retailer gasoline market competition.

[2]In this paper we use the words "motorway" and "highway" interchangeably to refer to pay toll high capacity roads designed to carry fast motor traffic.

3.1 The Policy Prescription

In early 2007 the Italian government, through a decree-law[3], committed to foster competition and increase consumer protection in some consumer sensitive markets, among which the gasoline market[4]. The parliament then, some months later, approved the government decree and turned it into law (Law 2 April 2007 n.40[5]). From Art.2, of the law, (the one regulating gasoline market) we can read the objective of the legislator as follow: (1) foster competition, and (2) price transparency; (3) guarantee an adequate level of knowledge about cost of service, and (4) facilitate the comparison of alternative offers. Although, the policy objective are stated clearly the law is not so clear about the measures to be taken as to reach the proposed objectives. Indeed, the law limits only to recommend the dissemination of information about prices (even in comparative form) using the already available channels or by predisposing new ones. The law then delegates to an Interministerial Committee of Economic Planning (CIPE) the definition of the specific guidelines. Accordingly, the CIPE, in July 2007, published its guidelines were it prescribed concessionaires of main national roads (pay-toll or not) to predispose a price comparison information system. Nonetheless, also the CIPE guidelines delegated to a forthcoming act from the Ministry of Transport the definition of the exact procedures to follow.

In the mean time, in anticipation to both the CIPE guidelines and the exact ministerial specifications, *Autostrade per l'Italia* (henceforth ASPI), the largest Italian pay-toll motorway concessionaire, decided to implement the proposed price information measures before the 2007 summer holiday (taking place usually in August, when million of drivers use toll-motorways to reach their holiday destination). As it appears clear from ASPI press releases of the time the decision to act in advance of further regulation or specification was to offer an information service to their customer. This decision has indeed been presented, and marketed, directly by ASPI, within the category of *Customer Information Services* together with the decision to install information panel about traffic conditions and the decision to offers several other customer oriented products to facilitate (and incentive) motorway driving[6].

[3]Decree Law 31st January 2007 n.7

[4]Other markets considered were: Fixed Line and Mobile Phone, Internet Services, Car Insurance, Mortgages, Airline Tariffs, and "best before date" in food products.

[5]Law 40/7 henceforth

[6]ASPI, both during the summer period and other period of the year launched several customer oriented initiatives (for instance free coffe between 00.00-05.00, traffic information in English, dedicated area in stopping area for babies and pets, help in travel planning). Source:Press conference presentations: "Via Libera all'estate" 2007; "La via

There is no evidence that ASPI received particular pressures from public bodies (i.e. Government or parliament) to implement the price information policy, as at January 2009 it is still the only highway concessionaire to have acknowledged Law 40/7 and complied to it [7]. We take these facts as evidence that the ASPI acting in the design and implementation stage was mostly independent and driven by internal company considerations.

In practice what ASPI did during the months between April and July 2007 was: 1) First, to create a software platform that stations[8] managers could use to communicate, in real time, the fuel prices offered at their premises; 2) Second, post these prices (Figure 2, Appendix) , catalogued by motorway code, kilometer and direction, in an apposite section within the ASPI website (www.autostrade.it); 3) Finally, they started to install physical price comparison panels[9] (like the one in figure 3 and 4 Appendix).along their motorway network

Thus, the two price comparison measures adopted are:1) Price comparison website; and 2) Physical price comparison panels. Although both measures offer the same type of informative content they differ under some dimensions. The comparison website is accessible only through an internet connection (thus there is no simultaneity between information and purchase[10]), lists all the stations on the ASPI network, but it entails some positive search cost (be aware of the service, time to open the browser, locate the desired highway and pool of stations). On the other hand, the road comparison panel only lists 4 consecutive stations, it is available for free to everyone (driving by), it entails almost no search cost[11], and the price information and the purchase decision can be potentially simultaneous[12]. Given these characteristics we

per l'estate" 2008; Website www.autostrade.it

[7]Eventually it happened that the specifications adopted by ASPI do not match the one eventually approved in the CIPE guidelines of July 2007. The CIPE specifications set a maximum of 3 consecutive stations for each comparison panel (while ASPI panel has 4 consecutive stations). Moreover ASPI panel mark with an highly visible green dot the cheapest station and this is not required by CIPE guidelines.

[8]We use the words "station", "refueling station", "service station", "retailer" , "filling station" interchangeably to refer to a facility that offer the refueling service.

[9]We use the words "physical" or "road" comparison panel to refer to a tangible price comparison device installed next to the roadway.

[10]Although recent development in mobile technologies make it possible to browse the web also on the move

[11]There could be an attention cost. To process the information on the panel the driver has to divert some of his cognitive ability from driving to the acquisition of the informations. Still we assume this cost is a fraction of the cost required to access the online version.

[12]The stations listed on the panel are usually within a distance of 2 to 100 km.

assume that the latter measure (the road panel) has the highest potential to disseminate price information and provide price comparison among close substitutes.

The two measures also differ in the way they have been introduced. Indeed, shortly after the creation of the software platform the website comparison was already online covering all the refuelling stations on the ASPI network. On the other hand, the deployment of the road panels could not be as instantaneous. It was indeed a long process that started in summer 2007, with only few panels installed, and came to an end in late 2008 when eventually all stations on the ASPI network were covered by the road panels. This timing difference implied that some stations were required to post their prices both on the online comparison website and on the road comparison panel since July 2007 while, at the same time, some other stations only had to post their prices on the comparison website, and were covered by road comparison panel only at a later stage.

In our analysis we argue that we can exploit this timing difference to estimate the impact of the introduction of the physical price comparison panel. To do that we exploit the price comparison website, for the purpose of data collection[13]. Then we use information about the timing of deployment of new road panel as to identify the effect of the policy. The following section describes ASPI deployment decision (of road comparison panels) and it explains how we can exploit it to estimate the impact of this price information measure.on market prices.

3.2 ASPI Policy implementation

Differently from the price comparison website the deployment of the road price comparison panel was not simultaneous for all the stations on the ASPI network. Institutional and physical constraints together with corporate decisions commanded that the deployment took place in several stages. As we discussed above, ASPI had since the beginning all the intention to deploy the price comparison panels as soon as possible on its network. However, it was not possible to install all the panels in such a short time because of limitation imposed by procurement law. Indeed, concessionaire of pay-toll highways are required to issue a call for tender, with European wide publicity, for works with starting value higher than Euro 221,000. Therefore ASPI

[13]The introduction of the price comparison website was simultaneous for all the stations on the ASPI network. We assume the effect of the website is the same for all the station and the estimate we find take as baseline the case in which prices are posted on the web.

decided to split the deployment in two stages: First stage, deploying only 10 panels as to overcome the limitation imposed by the public procurement law; Second stage,for the remainder of the project, issue a call for tender, with European wide publicity, assign it and completing the deployment to cover all the ASPI network. For the purpose of our analysis we were able to identify two clear waves (or phases) of deployment. The first wave took place in July 2007 in which all the first 10 panels were installed; the second wave took place in July 2008 when other 24 panels were installed (Table 5 shows the panel position and time of deployment). We then exploit these two waves to empirically test the impact of the introduction of this price information remedy.

3.2.1 Phase 1- A Quasi Experiment?

During the first phase only 10 price comparison panels were installed, covering 38 service stations As we said above this resulted as an outcome of the trade-off between the limitations imposed by the institutional constraints and ASPI commitment to offer an information service to its customers before the 2007 summer holiday. Given the low numbers of panel installed ASPI had to make a location decision for these first panels. Such location decision was not random. Indeed, the objective was to expose the highest number of customer to this new service. Hence, ASPI targeted the highway sections[14] with the highest road traffic levels. These turned out to be the outbound highway sections close to the largest cities along the ASPI network. The cities targeted in the first wave of deployment are Naples, Rome, Florence, Bologna and Milan. Although not random, the location decision, in this first wave of deployments, was thus based on an observables (the traffic level, and possibly the outbound direction). However as long as we find other highway sections with similar traffic levels and market conditions we can argue that conditioning on the observable traffic level the decision to *treat*[15] some service station, instead of others, was indeed random. In the empirical analysis section we exploit this feature and use a *matching on observable* estimator to estimate the impact of the policy during the first phase.

[14] We use the words "section" and "segments" interchangeably to refer to a part of motorway between an entry point and the first exit point on the same direction. Usually there is never more than one service station for a single segment. Usually for each stations on one segment there is one on the opposite segment, on the opposite side of the motorway.

[15] We adopt the treatment evaluation terminology where we refer to treated units whenever we mean those units that are directly affected by the policy. In our case treated stations are those stations that are required to post their prices on the road comparison panel.

3.2.2 Phase 2

After July 2007 no other panel was installed until July 2008 when the second wave of deployment started. As mentioned above the second phase started only after the assignment of the full completion procurement, for which ASPI had to issue a call for tender with European publicity. The aim of the second phase was to finish the project started in 2007 and cover all the ASPI network with road price comparison panels (a total of 53 panels were planned) within the end of 2008. Of this second phase we analyze a specific wave of deployment that took place in July 2008 just before the summer break. In this wave a total of 24 road panels were installed (concerning other 65 stations) bringing the total number of active price comparison panels to 34 (concerning a total of 103 stations). Again our objective is to estimate the impact of the introduction of these panels. Differently from the first wave at this stage we do not know the process behind the selection of the new panel location. Thus we cannot use the matching on observable estimator that we use in the first phase estimation. However for the second wave we have available a richer set of information. We indeed recorded the daily prices, for all stations on the ASPI network, since July 2007. Thus once the second wave took place we are able to compare the prices before and after the installation of the new panels (something we could not do for the first phase due to lack of before price information) and therefore estimating the impact of the road panels on the new treated stations. In the empirical analysis section, given the data available we define and use a *difference in difference* (DID) estimator to estimate the effect of the policy change.

3.3 The motorway refuelling market

This sections provides some information about the Italian highway gasoline market. It is beyond the scope of this paper to illustrate in details and model the market structure in place and their implication for our results. We take the market structure as given and we simply assess the effectiveness of the introduction of what can be seen as a consumer market remedy. That in our case takes the form of a road price comparison panel. We remain agnostic about the role of each players (retailers, oil company, highway concessionaire) in the reaction to the treatment as we are only interested on the effect on the final price paid by consumers. Still this section offer an overview of this specific market as to guide us in interpreting and evaluate our findings.

In this paper we study the Italian motorway refueling market and more precisely the price competition between retailers located on the pay-toll high-

ways. In Italy there are more than 6500 Km of pay-toll highways and although this network only accounts for the 2% of the national road surfaces, its roads sustains about 25% of the national transportations needs[16]. ASPI is the main pay-toll highway concessionaire and has concession for roughly 3000 Km (almost half of the entire national network). Its network covers almost all the country with exception of very few regions (Sardinia, Sicily, Calabria, Trentino Alto Adige) On Italian highways there are more than 450 service stations (of which 210[17] on the ASPI network) that sell a range of fuel products (typically: unleaded, premium unleaded, diesel, premium diesel). The stations operating on the highways represent only the 2% of the total service stations operating nationwide, however they supply more than 10% of total fuel consumption (respectively 6% for unleaded and 15% for diesel fuel) (Unione Petrolifera 2006 2007). By volume the most sold fuel on the highway is diesel that accounts for more than 75% of total fuel supply (Unione Petrolifera 2007).

The range of fuels sold by each filling stations is considered homogeneous (for instance oil companies even share refineries in some cases). That is, within each category of fuel, products offered by different brands are qualitative the same, the only differences that might arise come from brand differentiation not related to the quality of the fuel (advertisement, corporate social responsibility, loyalty programme).

There are eight major brands that operates on the Italian highways: AGIP, ESSO, ERG, SHELL, Q8, TOTAL, API/IP, TAMOIL (differently from the ordinary roads on the highways there are very few "independent" retailers[18]). All these competitors are vertically integrated firms that are active at every stage from the production to the distribution process. For what concerns the end market they all can rely on an extensive network of service stations distributed all over the country. Such stations can be directly owned by the oil companies or given in concession to third parties that owns and manage them.

The price setting happens in usually in two stages. In the first stage the oil company indicates to the station manager a "suggested price". At the second stage the station manager can discretionally change that price, within a range imposed by the oil company. This range is implicitly determined by

[16] Source AISCAT Association of Italian Highway Concessionaire, www.aiscat.it

[17] year 2007

[18] Usually known as "pompe bianche" (white pumps). These independent retailers buy the fuel at the wholesale market, directly from refineries, and then sell it. They are usually characterized by very low expenditure in marketing or branding and are popular for offering lower prices or discounts

two contractual conditions: the lower bound is given by the price at which the station manager buys the fuel (assuming they do not sell at a loss); the upper bound is usually a ceiling on the price the station manager can practice (usually determined by the oil company in relation to the "suggested price").

Thus the station manager's freedom in setting prices appears to be somehow limited, although oil companies seems to sustain that at the station level managers can still pursue an independent pricing strategy (Autorità Garante del Mercato b). Nonetheless oil companies retain powerful instruments to influence these possible independent strategies (i.e. the suggested price and the contractual relation linked to it). Indeed by looking at past publications of "suggested prices" [19](not anymore available after a recent Antitrust ruling) it appears clear that although oil companies publish a reference "national suggested price", for all the category of fuels and different types of service (self-service vs full service), they also set a variety of price differentials (to be applied to the reference price) targeting smaller groups of stations (usually defined by location) It is not rare that oil companies set a suggested price almost for each single station (this is exactly the case for some stations located on the highways). However, for the sake of our analysis we are not too concerned about the actual shares of power in the pricing decision. As we have access to the price posted by the station manager (that in turn reflects the prices asked at the pump) we only focus on the final price as it has all the information we need to perform our study.

4 Case Study Analysis

In the following sections we first describe our sample, we then present some descriptive statistics on the refueling market, and then we employ econometric techniques to estimate the impact of the price comparison policy.

4.1 The Service Station Sample

To conduct our analysis we collected information on 178 service stations (about 40% of total Italian motorway service stations and 85% of ASPI service station) operating on the ASPI network. These stations were selected for two reasons: 1) availability of price information; 2) location. As we have already mentioned, we collected the daily price information directly from the ASPI website[20]. Since ASPI was the only highway concessionaire to post

[19] Available at on the Staffetta Quotidiana an energy sector magazine

[20] We programmed a "spider" that every day downloaded price information from ASPI website (www.autostrade.it)

daily prices online we had to restrict our analysis only to this subsample of Italian service stations. For what concern the location, among the sample of all the service stations along the ASPI network, we selected only those located in places relevant for our analysis (i.e. either they were treated stations or had the potential of being included in the control sample).

However in the empirical analysis we will not use all the 178 stations indeed depending on the estimation technique we use and depending on tlilt(a)108(h)11()12(e)-

Service stations located along the toll motorways, on average, sell almost three times more unleaded fuel and eight times more diesel fuel compared to the average station located in a non toll street (Table 1). This could be taken as evidence that stations along the motorway can experience higher variations in total profits due to small variations in final price.(holding constant the demand). However, stations along the motorway are usually of bigger size and have also to remunerate the motorway concessionaire, in addition to the oil company and both this factor might depress the size of final profits.

Table 1: Average Fuel Sales per stations 2006 (ml litres)

location	toll motorway	all other
service stations #.	461	21989
Unleaded	2.22	0.73
Gasoline	6.19	0.74
Total	8.41	1.47

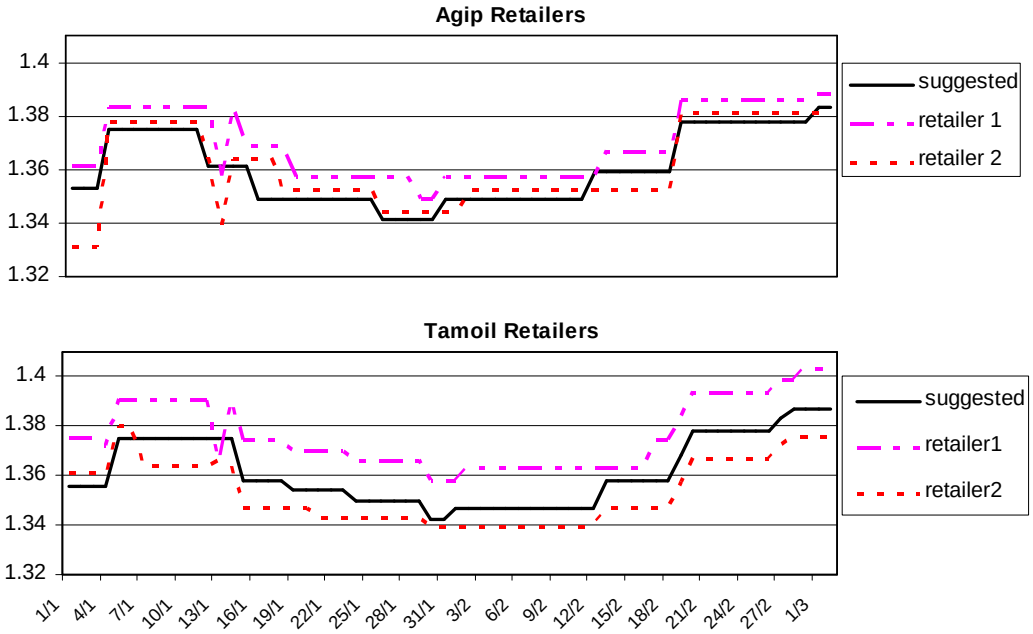
Source: elaboration from Unione Petrolifera 2006, 2007

If we look at price levels we can observe a peculiar characteristics of the retail refuelling market: prices seldom move at the station level. For instance if we plot the retail prices against the oil company "suggested price" (the price that should reflect variation in costs) we observe that prices at stations level follows almost one to one the variations in the suggested price without having significant independent movements. Figure 1 shows this relation, over a period of two months, for two representative AGIP and two Tamoil retailers, where the two solid lines are the prices set by the oil companies and the other two lines are the retail prices . From the figure it seems that once the oil company suggested price change the retailer fix a margin (positive or negative) and keep the price fixed until a new movement in the suggested price take place.

Thus, differently from other papers that have looked at the refuelling market (Øystein and Frode, 2008), we do not observe significant (non-cost related) price variation neither within the same day nor within the same week. For instance we have also checked (Table 6 Appendix) if price changes happen systematically on a specific day of the week. We found that on average, over the period we consider, 84% of the times stations do not change prices, 9% of times there was a price increase and 7% of the times there was a price decrease. The other evidence we found is that almost no station increases the price on a Sunday. Whereas it does not seems there is any preferred day for a price increase or a price reduction.

Table 2 (below) presents some descriptive statistics about the sample of

Figure 1: Suggested and Retailer Price Variation



service stations. We can see that during the first wave of panel deployment about 21% of service stations are treated whereas after the second wave a total of 62% of station are treated.

Agip appears to be the predominant brand with almost 30% of service stations with that brand. Tamoil is the second brand with a share of 20% and Esso follows closely at 16%. The majority of the stations in our sample are located along the two main ASPI motorways the A1(33%) and the A14 (30%). About the geographical distribution we can see that the majority of service stations are located in the Centre (43%) another 37% are located in the North and the remaining 21% is located in the South of Italy.

On average stations in our sample have more than twenty thousand vehicles transiting on their segment of the motorway every day (although only a fraction actually stops at the station premises). About 76% of these transits are made by light weight vehicles (cars or vans) and the rest is made up by heavy weight vehicles (trucks). However stations differ widely in their average transits and the transit distribution looks very right skewed.

Table 2: The Service Stations Sample

outcome var.	Mean[1]	Std. Dev.	outcome var.	Mean[1]	Std. Dev.
treat. wave 1	0.21	0.41			

than 2 euro cents among the different retailers on a 100 Km interval. This imply a maximum potential savings of less than 1 euro for a typical car refill of 40 liters.

We can then compare our results with those of other studies. If we look at the average range of price dispersion on another toll motorway [25] we found estimates very similar to ours. On the other hand if we look at price range estimates for service stations operating in normal road we found a much higher price dispersion. This dispersion goes from a lower bound of 4 euro cents per liter (a savings of almost 2 euros for a 40 liter refill) if we look at data from ISTAT (Italian National Institute of Statistics) [26]; until an upper bound of more than 10 euro cents a liter (savings of about 5 euros for a 40 liter refill) if we look at a report from the FIGISC(Italian Federation of the Refilling Service Station Managers).

Thus we can conclude that on average customers on a toll-motorways can expect to find a lower price dispersion (lower scope for savings) than the one they can otherwise find on normal road.

Another price comparison we might be interest in is to compare the level of fuel prices on the highway and on the urban area. This to possibly say something about the possible degree of competition we can expect between service stations on the urban area and those on the highway. Table 8 (Appendix) presents the mean price for unleaded and diesel fuel in five provincial area (Milan, Bologna, Florence, Rome, Naples). The mean price level is reported for both the service stations operating on the toll motorway and for those operating on normal streets. By comparing the means we can observe that the average price level is higher among the motorway service stations. However there is a significant overlap between the two price distributions (for both unleaded and diesel fuel). Thus there seems to be scope for competition between motorway and normal street refilling[27]. For instance retailers operating on motorway could use the price comparison panel as to attract frequent travellers by offering a price comparable or lower to the prices available on normal roads.

[25] A22, managed by Autostrada del Brennero SpA. On the website http://www.autobrennero.it/ they publish a weekly report on fuel prices.

[26] ISTAT collects this data to produce its price inflation indexes.

[27] Moreover the mean for normal street retailers might be underestimated. Indeed we could only get price information about the twenty cheapest service stations operating at the province level.

4.2.2 Motorway use and Customer attitude to fuel refill

In this section we provide some evidence about the average use[28] of the motorway and customers attitude to self service refilling. During the year 2007 the average travel on the ASPI network was 80 Km long. Respectively 75 Km for light weight vehicles (that represents the 80% of total transits) and 99.7 Km for heavy weight vehicles. During the year the traffic level seems to be quite constant (except for a peak of light weight travels in August) A substantial share of trips, 1/3 for light and 1/4 for heavy weight vehicles, is less than 25 Km long and these trips are mainly concentrated around the metropolitan areas on both inbound and outbound directions.

For what concerns the drivers refilling habits we can get some information from two surveys published by ACI (Italian Automotive Club). These studies report that about 40% of drivers favour self service refilling always or often while another 33% opt for the self service only occasionally. The lower price of the self service seems to be determinant in the choice of the service for about 45% of the respondent whereas the rest favoured it for its flexibility. The same studies also provide some information about the customer loyalty and the choice of the service stations. They report that proximity and lower price are the two determinants for the choice of the refilling station. In the urban area most of the drivers always refill from the same station whereas when outside the urban area there is no fidelity to the single service station but there is some brand loyalty..

4.3 Econometric Analysis

In this section we use econometric techniques to estimate the effect of the introduction of fuel price comparison panels. In particular the interest is in estimating the average effect of the policy on the retailers that are required to post their prices (i.e. *average treatment on the treated ATT*). Following the *potential outcome* framework (widely used in treatment evaluation literature), we are interested in estimating the impact of a binary treatment ($D = 1$ post price; $D = 0$ do not) on a continuous scalar outcome of interest Y (i.e. fuel price per liter). For each individual retailer i, $i = 1, ..., N$, we can define the two following potential outcomes: $Y_i(0)$ if the retailer i does not post her prices; $Y_i(1)$ if the retailer i post her prices. If both outcomes were observable, and we were interested in computing the effect of treatment

[28] Data come from two surveys: Autostrade per l'Italia 2007, Conference Presentation "Estate 2007. "Via libera in sicurezza "; and Autostrade per L'Italia 2008, Conference Presentation "La via per l'estate. Le vacanze iniziano in autostrada".

on treated units, we could just compare $Y_i(1)$ and $Y_i(0)$ for each treated retailer i. However, at any given point in time, only one outcome realizes for each retailer i and such a comparison is impossible. For instance for all the treated retailer only the outcome $Y_i(1)$ is observed and for the non-treated retailers only the outcome $Y_i(0)$. To overcome this impossibility we use a *matching* and a *difference in difference* estimator and below we explain how we implement them to estimate the ATT.

4.3.1 Phase 1-Matching on Observables

During the first phase the treated group consists of only 38 stations and the non treated group of 140 stations. Regarding the data available for this stage we have: daily, station level, price information for 206 days; average daily transit data, for each segment of the motorway on which stations are located; and some local geographical and demographic characteristics. The daily prices available do not cover the period before the start of the policy thus we cannot implement any sort of before after estimation that are typically performed in treatment evaluation literature. Still the time dimension of the (price) dataset let us monitor the retailers' reaction to the policy over time.

As we mentioned above, the location choice for the first ten price comparison panels was not completely random. Therefore if we simply compare the price level of the treated and non-treated group (possibly controlling for some observables), the resulting estimates would be biased. For the estimation of the treatment effect we adopt a different identification strategy using a matching estimator. The use of matching was directly suggested by the *rule* that ASPI followed in the deployment of the first ten price comparison panels. Such a *rule* says that they targeted the outbound city motorway segments with the highest levels of traffic as to maximize the number of customer that could see the panel. Thus the selection choice was based on some observable characteristics and our decision to implement a matching estimator followed naturally.

Matching estimator requires the *unconfoundedness* assumption (1), that state that assignment to treatment is determined by observable variables and conditioning on these variables assignment to treatment is random. This implies that conditioning on the covariate X the selection into treatment is not correlated with the outcome Y.

$$Y(0), Y(1) \perp D|X \tag{1}$$

This assumption is untestable (Imbens 2005) and in the next sections we argument when we think this assumption holds in our setting depending on

the covariates we include in the vector X. The other condition we need for matching is the *overlap* or *matching assumption* (2).

$$0 < \Pr[D = 1|X] < 1 \tag{2}$$

Assumption 2 states that conditioning on the observables X the probability of receiving the treatment ($D = 1$) is greater than 0 but less than 1. This assumption states that for a given value of X there are at least some observations from both the treatment and control group. This is crucial for matching and ensures that for every treated observation there is a matched non-treated observation with the same observables.

We use the simple matching estimator (3) proposed by Abadie and Imbens (2001) and compute it on STATA using the command[29] provided by Abadie, Drukker, Herr, and Imbens (2003).

$$ATT = \frac{1}{N_1} \sum_{i:W_i=1}^{N_1} \left\{ Y_i - \widehat{Y_i(0)} \right\} \tag{3}$$

This estimators computes the average, across all treatment units i ($i = 1, ..., N_1$), of the difference between the observed outcome Y_i and the estimated counterfactual $\widehat{Y_i(0)}$, where the counterfactual $\widehat{Y_i(0)}$, for each treated unit i, is given by:

$$\widehat{Y_i(0)} = \frac{1}{M(i)} \sum_{m=1}^{M(i)} Y_m \tag{4}$$

that is $\widehat{Y_i(0)}$ is the average outcome of the $M(i)$ (untreated) units matched with the treated unit i (where $M(i) > 0$).

In our analysis we define three distinct matching strategies depending on the observables we, in turn, include in the conditioning vector X. The main problem we face in our empirical analysis is the small size of our sample, both for the treated group and the potential control group. This limits the number of covariates we can include in the vector X. Indeed as we increase the number of covariates in X the overlapping condition fails to hold as it becomes increasingly difficult to find a match for each treated unit. Thus taking into account the size of our sample we can only match on few observables. Still we argue that in our setting very few observables are correlated with the treatment decision (essentially average transit level). Nonetheless, there might be several omitted observables that might be correlated with

[29] STATA command nnmatch see Abadie, Drukker, Herr, and Imbens (2003)

the outcome variable but, we argue, if we perform a careful selection of our control group we can control for it.

Table 3: Matching Results

Matching	Outcome[1]	ATT (euro cents)	T stat	
Specification 1	unleaded	-0.38	-2.10	***
	diesel	0.04	0.34	
Treated=38	change unl	3.13	2.02	***
Control=92	change dies	4.52	2.83	***
Specification 2	unleaded	-0.05	-0.39	
	diesel	0.16	0.91	
Treated=20	change unl	1.82	0.90	
Control=20	change dies	3.32	1.65	**
Specification 3	unleaded	-0.30	-1.27	
	diesel	0.08	0.50	
Treated=38	change unl	2.17	1.00	
Control=25	change dies	4.28	1.81	**

[1] Outcome variables: unleaded and diesel refer to average price level, average across time day1 day 206 change unl and change dies percentage of days in which a price change happened

*** significant at 5% level ** significant at 10% level

Matching Specification 1 In the first matching specification we only condition on one variable: the average daily transits on a specific motorways segment. In chart 6 (Appendix) we can see how the overlapping assumption is satisfied when we restrict our analysis to those segments with more than twenty thousands average daily transits. The assumption is that for service stations on motorway segments with similar transit levels the selection into treatment, made by policy maker, was random. In this strategy we assume that other observables do not affect neither the selection into treatment nor the outcome variable. For instance here we do not control for the fact that all treated stations are located on segments of the motorway on the city outbound direction, whereas within the control group, some stations are located on city inbound sections, some on city outbound sections and some other far from urban areas. Here the assumption is that motorway refilling stations make price settings decision that are not influenced by their location relative to main urban areas, their price setting decision only depends on the average vehicles that transit by their premises. Also we are not considering

other observable like brand or geographical position[30], as we assume these do not play an important role once we control for average transit level. Table 3 presents the results of the matching estimator. We present the effect of treatment on the treated for four outcome variables of interest. The first two *unleaded* and *diesel* refer to the average price level for unleaded and diesel fuel. The other two variables *change unl* and *change dies* are a measure of the frequency of price change at the retailer level.

From this first specification we can see that the introduction of the price comparison panel seems to have no statistically significant effect on diesel price whereas it seems to be associated with a (statistically significant) decrease in unleaded fuel price of 0.4 euro cents. If we compare this figure with the average price dispersion we expect to find on a motorway we can see that this effect account for roughly 20% of the observed price dispersion. However for the final consumer such a results would be reflected only in a potential savings of less than 20 euro cents for a typical refill of 40 liters, a savings that does not seem to have a great potential in attracting customers, not even the most price sensitive. Also we find a positive, and statistically significant, ATT for the two price change variables. Thus it seems that retailers that post their prices on the price comparison panels change their prices more frequently (respectively 3% more for unleaded and 4.5% more for diesel).

The above results are based on comparisons of individual retailers' Phase 1 average prices. However, comparing the mean might not be the best measure as in the aggregation over time we might lose the price differentials that characterize the day to day competition. Thus we estimated the ATT also for all the 206 days in the Phase 1 sample. Figure 7 (Appendix) shows these estimates and the respective interval of confidence (at the 95% confidence level). From the chart we can see that there is not even a single day in which we can reject the null hypothesis that the ATT is equal to zero. This evidence suggest us to be careful when interpreting the estimates obtained when looking only at the average price.

Matching Specification 2 In the second matching specification we adopt a different matching strategy. Here the aim is to pick, for each treated station, an untreated station that can be as close to a *clone* as possible. This reduces the dimensionality of our control group and treatment group however we hope to gain in the precision of our estimates, if we select a good clone. Our strategy is to match each treated station with the respective untreated

[30] We do control only for five regions since we know they have a special tax regulation for unleaded gasoline, but not for diesel.

station located exactly on the opposite side of the motorway[31]. By doing so when we difference the fuel prices we hope to difference out all possible local market condition that might enter the price setting decision. Stations located on opposite sides indeed face the same labour market condition, have similar geographical characteristics and have very comparable transit levels. Essentially this matching strategy leaves out only two potential sources of heterogeneity: brand differentiation and type of traffic (inbound vs outbound). We are less concerned by not controlling for brand differentiation as we do not find evidence that retailers brand is associated with price differences once we control for stations and locations effects. Moreover as we mentioned above only a small fraction of customers seems to base their purchasing decision on brands when driving outside an the urban area and this might hold even strongly when the purchase is on a motorway. It is the latter source of unobserved heterogeneity (inbound vs outbound) that concerns us the most. Indeed, we could argue that the flow of traffic going out of a large urban area has different characteristics from the flow of traffic entering. Still, from the evidence we presented we can infer that most of the vehicles going into (out) the urban area, at a certain point in time, are also the same vehicles that will leave (enter) the urban area at a later point in time. This holds both for long distance travels and also for local travels. Thus we can say that, although at different point in time, most of the potential customers of a refueling station are also potential customer of the refueling station on the opposite side of the motorway. We can also rule out the possibility that local motorway traffic does not refill on motorway stations. Indeed we provided evidence that there is an overlap between the motorway price distribution and the urban area price distribution. Hence the price comparison panel could even be used by retailers as to attract an higher share of these frequent drivers than can promptly, and at a zero cost, compare the prices available on the motorway with those available on the urban area.

Thus if we are confident that refuelling stations located on opposite side of the motorway face almost exactly the same market conditions we can be confident we have found almost a clone for each treated stations.

From table 3 we can see that, given this matching specification, we do not find any statistically significant effect of the price comparison panel for three of the four outcome of interest. Indeed we only find a significant effect (at 10% significance level) for the frequency of change of diesel fuel price, where treated stations change diesel price 3% more times than untreated stations.

Also, we do not find any statistically significant effect if we look at the

[31] Some treated stations are excluded because we find occurences were opposite stations are both treated

daily estimates (Figure 8 Appendix) over the 206 days period under analysis.

4.3.2 Matching Specification 3

In the third and last matching specification we match treated and control units under two dimensions: the average transit level and the outbound direction (exactly the two observable on which policy maker, ASPI, based her selection decision). In practice here we make the assumption that, even though two opposite refueling stations face some similar market conditions, they face a completely different demand given by the direction of the traffic flow. Thus potential customers driving toward (outward) the urban area have different characteristics. In addition, we also control for transit levels as this is the observable that mostly driven the selection into treatment. The use of two conditioning variables has the effect of drastically reducing the control group below the size of the treatment group.

If we look at the estimates of the ATT for the average price level we do not observe any statistically significant effect neither when we compare the average prices (tables 3) nor when we look at the daily estimates (Figure 9 Appendix).

Again we only found a statistically significant ATT (at 10% level of significance) for the frequency of price changes. Where again we find that treated stations seem to change diesel prices 4% more than untreated stations but with no effect on price level.

4.3.3 Phase 2-Difference in Difference

During the second phase of panel deployment another 24 panels were deployed along the ASPI motorway network (as of summer 2008). This time (apparently) no clear rule was followed in the location decision as at this stage the objective was to finish the work started in Phase 1 (summer 2007) and treat all the stations of the network. Since we started collecting price information from October 2007, once the new price comparison panels were turned on we found ourselves with the data to perform a before after estimation. Indeed in the second phase we can fully exploit the time dimension of our dataset and estimate the impact of the price comparison panel on the new wave of treated stations. Differently from the first phase in the second phase the selection decision was not based on any observables that we can exploit, however this does not concerns us since the time dimension let us compare the same units, although at different point in time. We thus use a *difference in difference* estimator to estimate the ATT.

If we denote with Y_{it}^{G} the outcome of a unit i, that belongs to the group

$G = \{treat, control\}$, at time $t = \{0, 1\}$ then we can define the following differences:

$$Y_{i0}^{treat} - Y_{i1}^{treat} \tag{5}$$
$$Y_{i0}^{control} - Y_{i1}^{control} \tag{6}$$

where the difference 5 is the change in outcome, over time, for a treated unit and difference 6 is the change in outcome for a control unit. If we take another difference as in 7 we can define the difference in difference estimator as:

$$\delta_{DID} = Y_{i0}^{treat} - Y_{i1}^{treat} - \left[Y_{i0}^{control} - Y_{i1}^{control}\right] \tag{7}$$

Thus by taking the first two differences we control for the group specific effects and by further differencing we control for the time specific effects that are common for both groups leaving out the effect of treatment on the treated group.

We estimate this effect using the following OLS regression:

$$Y_{it}^{G} = \alpha + \beta G_i + \gamma t + \delta(t * G_i) + \epsilon_i \tag{8}$$

where the parameter δ is our parameter of interest as it identifies the average effect of treatment on the treated. A crucial assumption for the unbiasedness of this estimator is the *parallel-trend assumption* that is the time trend is the same across the treatment and control group and it is equal to γ.

To estimate the ATT we thus have to define a treatment and control group. We include in the treatment group all the refueling stations that received the treatment at the beginning of Phase 2, and had not received the treatment in Phase 1, this group consists of 65 refueling stations. As a control group we select the 38 stations that received the treatment in Phase 1. Although these stations are actually receiving a treatment in Phase 2 they were already receiving it in Phase 1. Thus for these stations we expect no change to occur once the treatment is extended to the next 64 stations[32]. Since control stations were already treated we assume that any change we find between period 1 and 2 are attributable to the time trend. As a control group we could not use the other 75 ASPI stations we had in our sample.

[32] Actually there could be some general equilibrium effects however we have to assume away any implication of general equilibrium and assume that units are independent.

Indeed these latter stations were supposed to receive the treatment anytime in the months between August and December 2008[33].

Table 4 presents the results of the *difference in difference* estimation. The first two columns report the results from two regressions where we regressed the dependent variable (daily unleaded and diesel price in euro cents) on the period, group and treatment dummy, controlling for clustering. Instead, in the third (and fourth) column the dependent variables is average detrended unleaded (diesel) price (in euro cents).

From the results we can see that from period 0 (pre August 2008) to period 1 (after August 2008) on average unleaded became cheaper and diesel became more expensive. We do find statistically significant groups effect with the treated group on average charging more for unleaded (roughly 1 euro cents more) whereas for diesel there is not a statistically significant difference between the two groups. For what concern our parameter of interest the ATT, we find that it is positive and statistically significant (at 5% significance level) Thus it seems that the introduction of the price comparison panel is associated with an increase in both unleaded and diesel price at the treated refueling stations. Respectively, on average, unleaded costs about 0.75 euro cents more and diesel costs around 0.45 euro cents more. Thus it seems that the introduction of the policy instead of lowering price for final consumers had the effect of raising it (although of a small magnitude, 30 euro cents more for a 40 liter unleaded filling and 20 euro cents more for a 40 liters diesel filling).

Table 4: Difference in Difference Results

	1)	2)	3)	4)	5)	6)
N	22864	22864	216	216	216	216
Dep. Var	unleaded	diesel	avg unl	avg dies	change unl	change dies
Phase	-0.72	0.87	-0.50	0.60	0.11	0.10
	(-7.84)	(9.31)	(-1.55)	(3.28)	6.13	(4.66)
Group	0.99	-0.09	0.88	-0.26	-0.07	-0.09
	(4.37)	(-0.56)	(3.12)	(-1.62)	(-4.31)	(-4.75)
Treatment	**0.68**	**0.37**	**0.78**	**0.55**	**0.04**	**0.05**
	(3.38)	**(1.89)**	**(1.95)**	**(2.41)**	**(1.81)**	**(1.84)**
cons	138.03	131.96	-1.49	-1.89	0.22	0.27
	(927.17)	(1725.57)	(-6.53)	(-14.56)	(16.91)	(17.98)
t-stat in parenthesis						

[33]We could have used them as control only if we had known exactly in which day the price comparison panels for these stations were turned on.

Table 4 in column 5 and 6 also present the difference in difference results for two regressions in which the outcome variable of interest is the average frequency of price change (respectively for unleaded and diesel fuel). Before we found that during Phase 1 the treated units changed diesel price more frequently (around 4% more than control units). Also in Phase 2 we find similar results. Both diesel and unleaded price seems to vary more often after the treatment occurs (respectively 4% and 5% more, statistically significant at 10% level).

5 Conclusion

This paper studies the introduction and the effect of a consumer market intervention aimed at helping consumer obtaining price information and make price comparisons. This policy intervention targeted fuel prices and was implemented on the Italian motorway network managed by Autostrade per l'Italia SpA (ASPI), the main Italian motorway concessionaire, with a network of roughly 3000 Km. At the end of the intervention around 200 refueling stations, operating on ASPI network, were concerned by the policy that required them to post their fuel prices (self service unleaded and diesel fuel) both on an online price comparison website and on some 53 road price comparison panels.

We exploit some feature of the deployment strategy adopted to install the road price comparison panels as to estimate the effect of this latter intervention. While we exploit the availability of the price comparison website as to collect the daily price information that we later use in the empirical analysis. Of the deployment process of the 53 road comparison panels we can identify two clear waves of deployment: the first in July 2007 were 10 panels are installed on motorway sections with high level of traffic (affecting 38 service stations); and the second in July 2008 were other 24 panels are installed (affecting other 65 stations).

We use two different estimation methods, one for each wave of deployment, to identify the average effect of the intervention (treatment) on the concerned stations (treated stations). For the first wave of deployment we argue that selection on observable is in place. We thus use a matching estimator to identify the (sample) average effect of treatment on the treated (ATT). We adopt three different matching strategies depending on which observables (and unobservables) we think affects the selection into treatment and/or the outcome of interest as to control for observed and unobserved heterogeneity between our treatment and control group. For the second wave

of deployment we do not find evidence of selection on observable. Rather, treated stations seems to be picked without a specific rationale. However, since our dataset let us perform a before after comparison (not possible for the first phase) we use a difference in difference estimator to compute the ATT. We define a treatment group and a control group and assuming that the parallel trends condition is satisfied we estimate the effect of the policy for these new treated stations.

From the empirical analysis we found that contrary to the policy maker expectations the introduced measure had very little power in reducing final consumer prices. Indeed if before the introduction of the policy some consumer association were forecasting possible savings of about 8 euro cents per liter, we found a contrasting evidence. Our evidence suggests that on average the first ten panels seem not to have had any statistically significant effect in lowering the final price to consumers. If we turn our attention to the second wave of 24 road comparison panels we even find a statistically significant increase in price of almost 1 euro cents per liter.

The only effects that the road comparison panels seems to have is that treated retailers change more often the posted price (around 4% more than an untreated retailers).

Motorway refueling market has all the characteristics to be a market in which fuel retailers enjoy some degree of market power as consumers typically make uninformed choices (prices information usually takes place only at the station premises) and it is costly to search more retailers (more costly than in urban areas). Thus, this intervention could have had the potential to *activate* consumers and in turn activate price competition between retailers. However this study does not find any evidence that consumers have benefited from such a policy.

Several reasons could explain why such a policy failed to achieve its objective. For instance, although there are many independent retailers the major oil companies, through contractual relationship, might limit the scope of price competition at the retailers level and actually impose their own prices. On the other hand it could also be the case that even in a competitive settings the maximum savings that a consumer can achieve are too limited to trigger an active market search for a low price (for instance even a savings of 8 euro cents per liter, the one hoped for by consumer association, would mean a saving of only 3,2 euro for a 40 liter refill). Or it could also be the case that it takes time before consumers learn how to use these market remedies and therefore it takes even more time before the retailers observe the implication of such intervention on their business.

Hence, further research is needed to understand why this policy did not work in these early stages and how it can be tweaked to benefit consumers the most.

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A Appendix

Table 5: Panel Location

Phase	id	Highway id	Km	direction
Phase 1	disp01	A1 Milano-Napoli	9.30	south
	disp02	A1 Milano-Napoli	183.35	south
	disp03	A1 Milano-Napoli	307.55	south
	disp04	A1 Diramazione Roma sud - GRA	17.14	south
	disp05	A1 Milano-Napoli	748.75	north
	disp06	A1 Diramazione Roma nord - GRA	9.90	north
	disp07	A1 Milano-Napoli	259.70	north
	disp08	A1 Milano-Napoli	177.00	north
	disp09	A8 Milano-Varese	2.00	north
	disp10	A14 Bologna-Taranto	38.90	south
Phase 2	disp11	A1 Milano-Napoli	79.80	north
	disp12	A8 Milano-Varese	13.15	south
	disp13	A4 Torino-Trieste	19.20	est
	disp14	A13 Bologna-Padova	104.85	south
	disp15	A13 Bologna-Padova	0.82	north
	disp16	A14 Bologna-Taranto	95.60	north
	disp17	A1 Milano-Napoli	340.30	north
	disp18	A11 Firenze- Pisa Nord	0.15	west
	disp19	A11 Firenze- Pisa Nord	81.15	est
	disp20	A1 Milano-Napoli	432.07	north
	disp21	A1 Milano-Napoli	515.80	south
	disp22	A1 Milano-Napoli	516.00	north
	disp23	A16 Napoli- Canosa	2.58	est
	disp24	A16 Napoli- Canosa	53.45	west
	disp25	A14 Bologna-Taranto	498.15	north
	disp26	A14 Bologna-Taranto	468.20	south
	disp27	A14 Bologna-Taranto	411.77	north
	disp28	A14 Bologna-Taranto	359.75	south
	disp29	A14 Bologna-Taranto	293.57	north
	disp30	A16 Napoli- Canosa	131.60	est
	disp31	A16 Napoli- Canosa	158.46	west
	disp32	A14 Bologna-Taranto	664.00	south
	disp33	A14 Bologna-Taranto	703.56	north
	disp34	A14 Bologna-Taranto	555.43	south

Source: Autostrade per l'Italia

Table 6: Relation between day of the week and price change

Day	Obs.	Price Increase		Price Reduction		No Price Change
		N.	mean	N.	mean	N.
Monday	1320	113	0.014	46	-0.008	1161
		(9%)		(3%)		(88%)
Tuesday	1320	149	0.010	110	-0.006	1061
		(11%)		(8%)		(80%)
Wednesday	1320	185	0.008	112	-0.007	1023
		(14%)		(8%)		(78%)
Thursday	1320	152	0.011	49	-0.006	1119
		(12%)		(4%)		(85%)
Friday	1320	81	0.013	68	-0.008	1171
		(6%)		(5%)		(89%)
Saturday	1320	124	0.011	141	-0.007	1055
		(9%)		(11%)		(80%)
Sunday	1320	19	0.007	98	-0.014	1203
		(1%)		(7%)		(91%)
total	9240	823		624		7793
		(9%)		(7%)		(84%)

Table 7: Price Differentials

Source	Fuel	Service	Road	Range (€ cents) (Max-Min)	Avg. Save (€) 40 liters refill	Period
ISTAT[1]	Unleaded	self	non-toll	4.2	1.69	10/07-10/08
ISTAT	Diesel	self	non-toll	4.7	1.88	10/07-10/08
ISTAT	Unleaded	full	non-toll	3.5	1.40	10/07-10/08
ISTAT	Diesel	full	non-toll	3.9	1.55	10/07-10/08
FIGISC[2]	Unleaded	full	non-toll	11.3	4.53	19/02/2008
FIGISC	Diesel	full	non-toll	13.1	5.22	19/02/2008
PrezziBenzina[3]	Unleaded	self	non-toll	5.4	2.16	20/11/2008
PrezziBenzina	Diesel	self	non-toll	6.1	2.44	20/11/2008
A22[4]	Unleaded	self	toll	1.6	0.64	28/04/2008
A22	Diesel	self	toll	1.6	0.64	28/04/2008
A22	Unleaded	full	toll	1.7	0.68	28/04/2008
A22	Diesel	full	toll	1.6	0.64	28/04/2008
ASPI subsample[5]	Unleaded	self	toll	1.9	0.77	06/02/2008
ASPI subsample	Diesel	self	toll	1.7	0.66	06/02/2008

[1] ISTAT (Italian National Institute of Statistics) monthly price collection;

[2] FIGISC (Italian Federation of the Refilling Service Station Managers) La distribuzione carburanti: libro bianco sulla concorrenza, 3/4/2008

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[4] Pay toll motorway (313 Km long) managed by Autostrada del Brennero SpA. Publish weekly price report on www.autobrennero.it

[5] Sub sample of ASPI service stations

Table 8: Price Comparison Motorway Price Vs Normal Street

	Unleaded				Diesel			
	Normal road[1]		Motorway[2]		Normal road		Motorway	
Province	mean	s.e.	mean	s.e.	mean	s.e.	mean	s.e.
Bologna	1.177	0.005	1.194	0.004	1.171	0.005	1.188	0.004
Firenze	1.174	0.005	1.190	0.007	1.166	0.005	1.183	0.008
Milano	1.166	0.003	1.193	0.004	1.159	0.003	1.186	0.004
Napoli	1.235	0.009	1.240	0.005	1.209	0.014	1.208	0.006
Roma	1.173	0.002	1.188	0.004	1.165	0.002	1.178	0.003

[1] Mean computed over the twenty cheapest service stations (at the province level).

Data are self reported by users on the website www.prezzibenzina.it

[2] Mean computed at the province level for the service stations in our sample operating on the ASPI motorway

Figure 2: Screenshot ASPI price comparison website (source: www.autostrade.it)

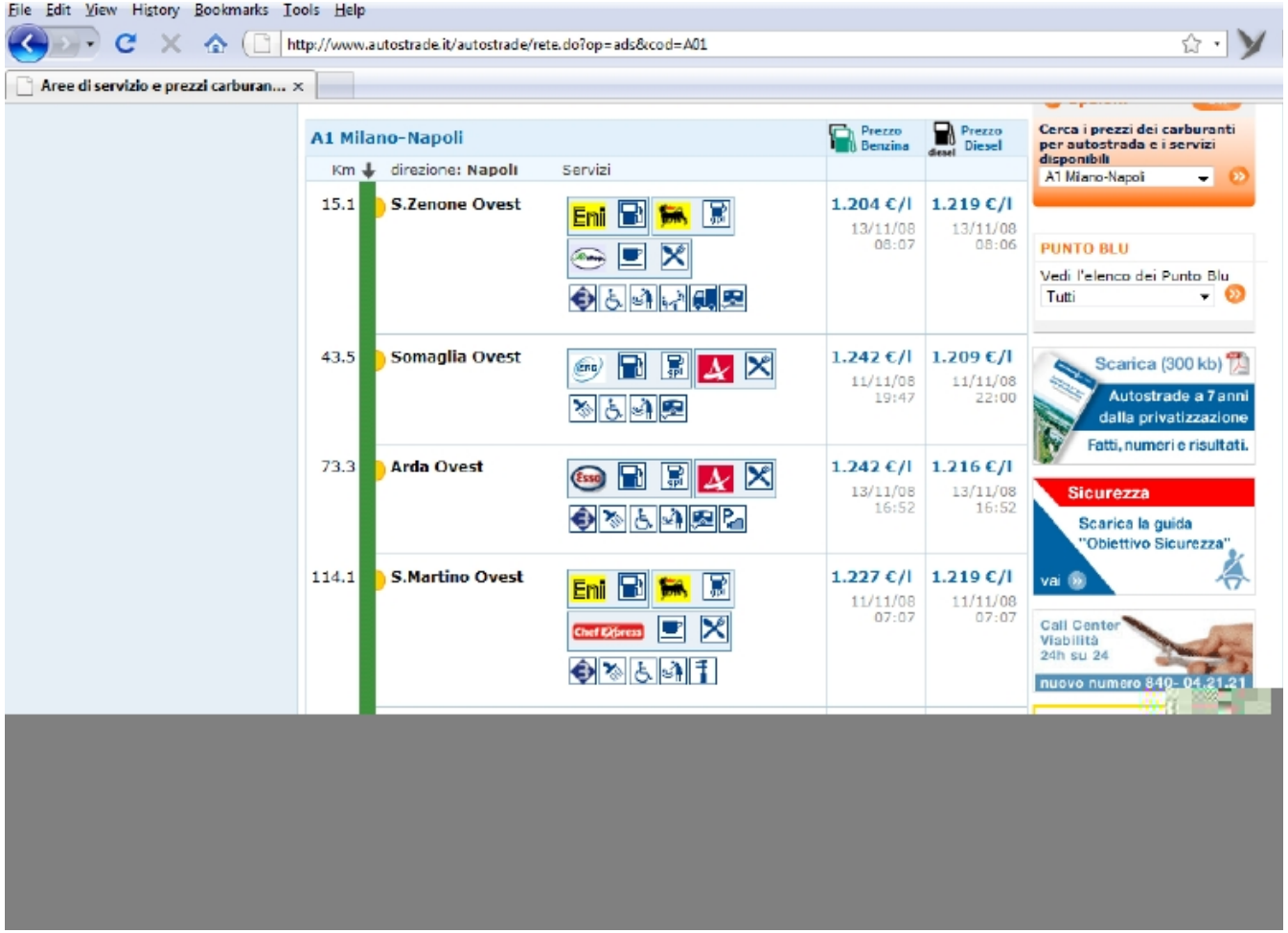

Figure 3: Price Comparison Panel (source: www.autostrade.it)

Figure 4: Example of Panel Station Location

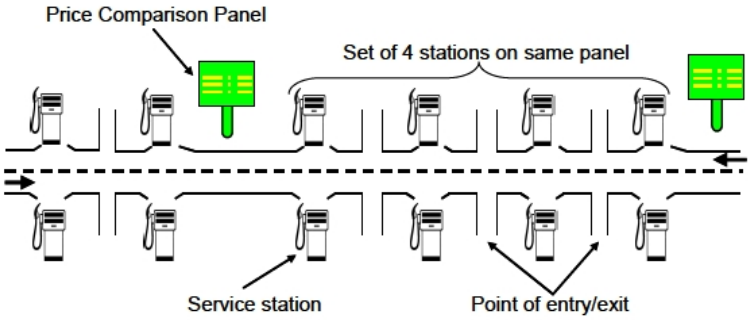

Figure 3 shows the design of price comparison panels installed along the ASPI motorway network. As we can see from the figure, the panel post the brand and prices (self service unleaded and diesel fuel) of four consecutive stations. The stations are ranked by distance to the panel (with the closest being first) and the cheapest station is highlighted by a green dot next to its price. ASPI officials, when enquired about the panel design, reported that the decision to post only four prices is an outcome of a trade-off between posting many prices (as to offer more information, but with come physical constraints) and assuring a minimum level of comparison among brands. Since on the ASPI network there is a maximum of three consecutive stations all from the same brand they then adopted the 4 stations design. Both in the design stage and in the location decision the managers of the gasoline stations were not involved. They are only responsible for the communication of the

prices through the software platform (that serves both the price comparison website and for the price comparison panel).

Figure 5: Italian toll-motorway network (source: www.autostrade.it)

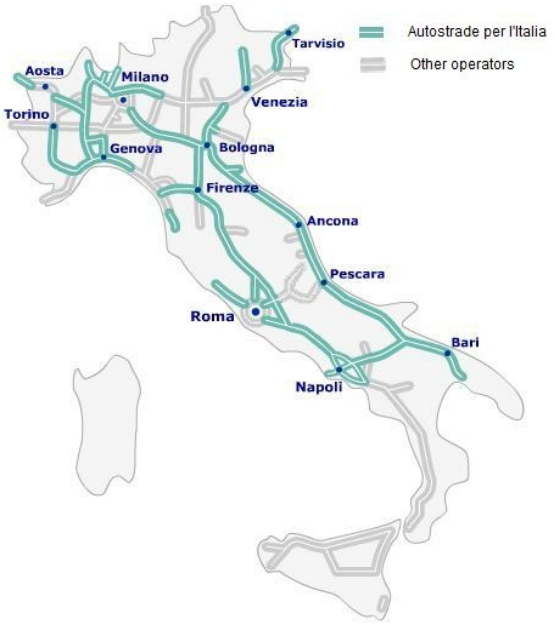

Figure 6: Selection into treatment and transit variable

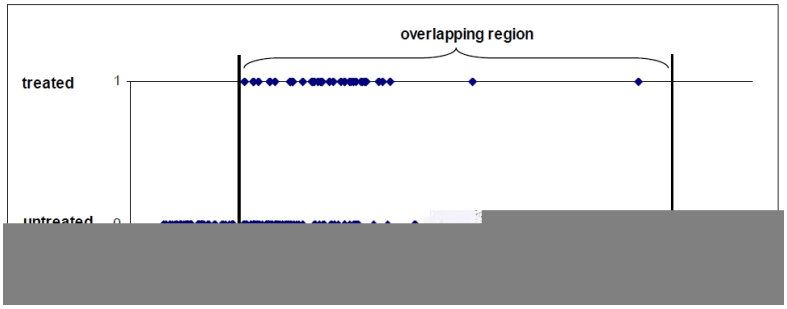

Figure 7: Matching on Average Transit Variable

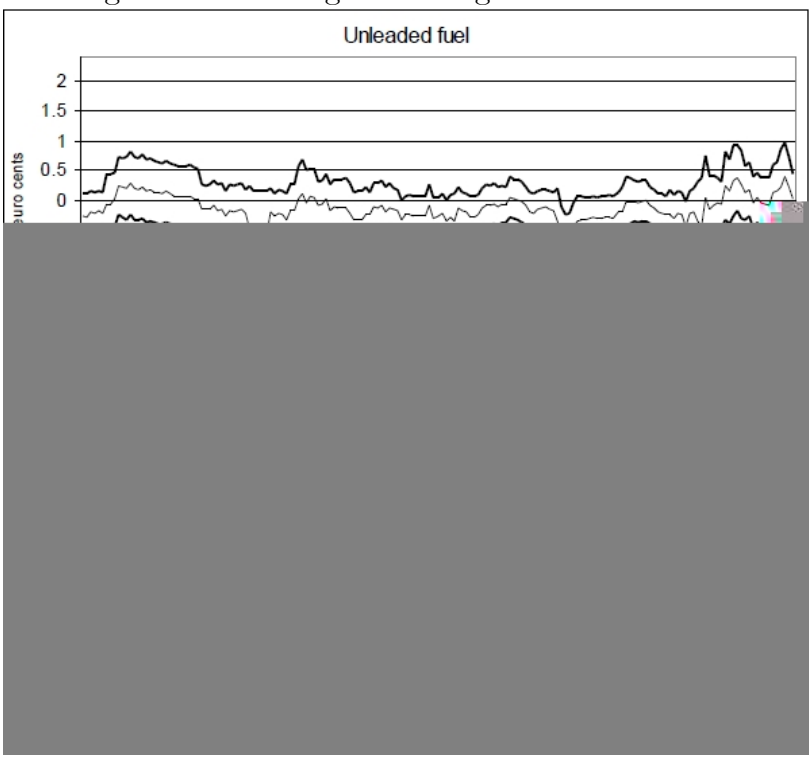

Figure 8: Matching service stations on opposite side

Figure 9: Matching on Average Transit Variable (only outbound Stations)