

Giancarlo Fiorito - Institute for Environmental Science and Technology, Universitat Autònoma de Barcelona, Bellaterra, Spain

Lorenzo Borghi - Università di Roma La Sapienza, Italy

Italian motor fuel prices - The wide view

1. Introduction

The road transportation sector is recognised as one of the main contributors of greenhouse gas emissions (IEA 2015). In Europe it has been recently estimated that about 400.000 premature deaths are attributable to particulate matter PM2.5 (EEA 2015), while road accidents represent the primary risk of death for children aged 5-17 (WHO 2015). Within Europe, Italy is a highly motorized country: with 621 cars per 1000 inhabitants (Eurostat 2012) it ranks at the top of motorization rates. 95% of its goods are transported by road, while its approximately 20,000 fuel retailers have a minimum average fuel delivered (*Figure 1*). The “Price Transparency Law” (Legge n. 99, 2009, Art. 51) sets the compulsory communication of fuel prices from every road fuel retailer to *Osservaprezzi Carburanti*, or *Fuel Price Observatory* a web platform developed by the Ministry of Economic Development (MISE) to increase transparency and competition.¹

So far the only official fuel price statistics in Italy are the weekly national prices released each Monday by MISE Energy Department elaborated from a sample of oil companies and retailers’ prices, weighted by past year fuel sales; the resulting price is the official price of European Commission’s *Oil Bulletin*². In this context, the *Observatory* dataset represents an alternative information source (census data) enabling a deeper insight on the degree of competition at the local scale. Recent research used *Observatory* open data to describe pricing behaviour at the local level (Alderighi and Baudino, 2015).

Here we describe the construction of an open-data archive fed by retailer communications to the *Observatory*, we analyze the main features of price distributions of gasoline and diesel (in self and served mode), LPG and methane (served mode only in Italy), distinguishing between branded and independent retailers over an 18 months period³.

The article is structured as follows: Section 2 gives a description of the database variables, data cleaning, and validation procedures, including an analysis of the price communication pattern; Section 3 discusses the fuel price distribution at the national level using a 3D graph of price empirical distribution over time, distinguishing between integrated and independent retailers. Section 4 focuses on price distribution in the five Italian macro areas, detailing the impact of independent retailers on price distribution. Section 5 discusses the results and provides some conclusions including suggestions for future research.

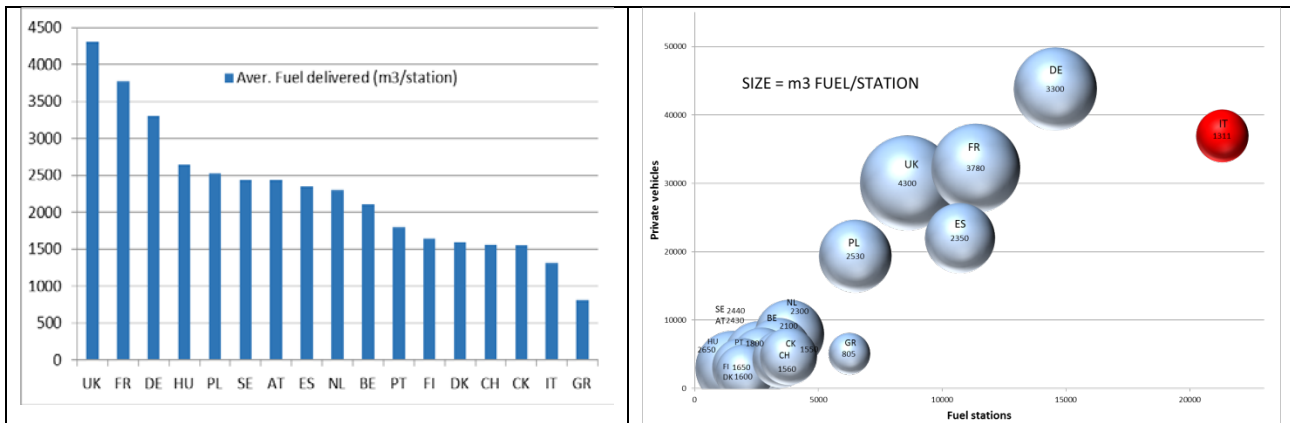
Figure 1. The European fuel retail sector

¹ The Law states that price communication for all motor fuel sold by the station must be in real time in case of increase and within seven days if stable or decreasing <http://www.parlamento.it/parlam/leggi/090991.htm>.

² Oil Bulletin price methodology:

http://ec.europa.eu/energy/sites/ener/files/documents/survey_oil_bulletin_data_collection.pdf

³ Branded retailers are: Eni, Esso, IES, IP-Api, Lukoil, Q8, Repsol, Shell, Tamoil, Total-Erg.



Source: elaborations from the Authors from Unione petrolifera (2013)

2. Data, models and measures

On the basis of the official Customs file containing the Register of the fuel retailer approved tanks in Italy, we estimate to cover on the period of analysis about 90% of the universe of the Italian fuel retailers. The *Observatory*, conceived to help consumer choice and enhance fuel sector competition, receives price communications from retailers and displays them on a website and an app for smartphones. The daily open data on the Ministry website include gasoline, diesel, LPG and methane prices for each fuel retailer, with brand, service mode, road type and area code as qualitative variables: 60.000 daily records on average, with each record corresponding to the last communicated price of a specific fuel and service mode of the single retailer; information on the date of communication and validity duration is also included.⁴

We performed a two-fold validation. First, we checked for outliers in terms of price level. For each specific fuel type and service mode we fixed, on the basis of historical records, two conventional upper and lower bounds beyond which the communicated price is considered unreliable. In such cases the record is removed from the analysis. The second validation step aims at ensuring that the analyzed prices are sufficiently up-to-date to avoid that an excessive delay results in an uncontrollable bias in the price dynamics. The daily price available in the open data archive is considered valid as long as the difference between the current date and the day of the last communication does not exceed 15 days for gasoline and diesel, 21 days for LPG and 60 days for methane. For methane, we verified that price communications were much less regular than other fuels because of the yearly contracts between retailers and gas distributors so, in order to have this fuel included in the analysis, we extended the price reliability range.

In the following subsection we provide some results about the overall actual compliance of retailers. Based on these figures, we conventionally set a validity time window larger than the one imposed by the current regulation, *i.e.* one week. The risk of applying strict compliance (by Law n. 99, 2009) being an under-representation of the price universe. Then, the time series is constructed by stacking each Monday price at 11AM resulting in a single file with dates comprised between Oct. 6, 2014 and Mar. 28, 2016. The database contains the variables listed in *Table 1*.

Table 1. Main variables in the price database

Variable	Description
<i>Date</i>	day/time of price
<i>Brand</i>	distribution company

⁴ There are two .csv files with prices valid at 8 AM and the retailers registry at the following link: <http://www.mise.gov.it/index.php/it/open-data/elenco-dataset/2032336-carburanti-prezzi-praticati-e-anagrafica-degli-impianti>. We decided to extract prices on Mondays at 11AM as more representative of the Monday price.

<i>fuel</i>	gasoline, diesel, LPG and methane
<i>self</i>	binary variable: 0 served, 1 self mode
<i>datevalid</i>	day/time price became effective
<i>id</i>	fuel station code
<i>tipo_impianto</i>	road type, highway, national, other
<i>istat</i>	city code

Also, since we wanted our analysis to follow the official territorial dimensions,

Macro-areas → Regions → Provinces → Local Work Systems → Municipality

we used the National Statistics Office (Istat) files to merge the city codes with the official shape files for the macro-areas, regions, provinces, local work systems (LWS) and municipality borders⁵.

2.1 Price communication patterns

Using an SQL procedure we extracted a different database with all price variations communicated from October 2014 to February 2016 in order to analyze retailer communications patterns. It is important to specify that “communication” means the insertion of a new price, not the confirmation of the previous one, the reason being that the database on MISE server, at the time of writing does not allow the retrieval of the bulk communications by fuel retailers. Such limitation is likely to become critical in periods of price stagnation for LPG and methane whose communications are often just price confirmations.

The time series of price variations are shown in *Figures 2-5*. They have a constant trend with remarkable fluctuations in correspondence of Easter, summer and Christmas holydays. This is likely due to the closing of small retailers on secondary roads during holydays. Fewer communications might also be due to (unobserved) increase in price confirmation. Gasoline and diesel self mode communications are constantly higher (between 3000 and 2000) than the served mode. This is expected since the law sets a priority for the self mode. LPG and methane communications (3000 and 1000 retailers respectively) are characterized by higher variability: the former shifts between 2500 and 1000 communications, while methane oscillates between 250 and 150 communications.

As we will see later, both gasoline and diesel prices distributions have very different shapes between self and served mode, which cannot be explained by the communication profile, since, as *Figure 2* and *Figure 3* show, there is a strong similarity in the communication pattern of the two service modes.

⁵ LWS are an intermediate administrative border (between province and city municipality) designed by Istat on the basis of daily commuting using census data; they represent the areas where people lives and work.

Figure 2. Time series of daily communications from gasoline retailers

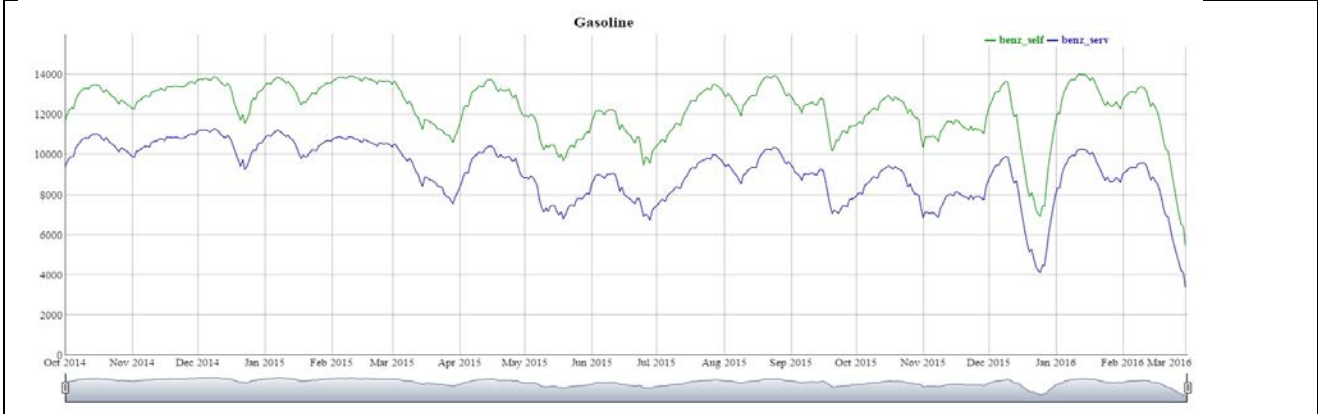


Figure 3. Time series of daily communications from diesel retailers

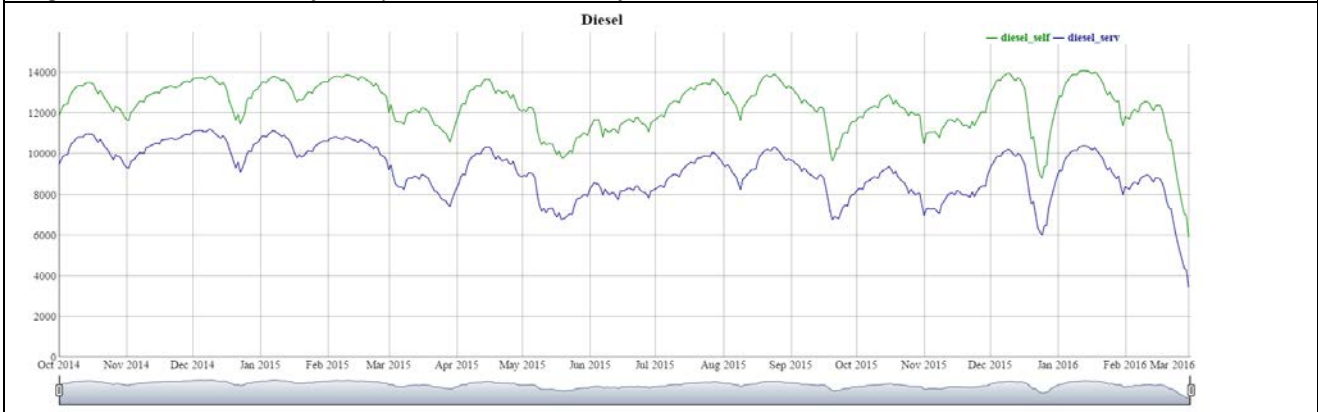


Figure 4. Time series of daily communications from LPG retailers

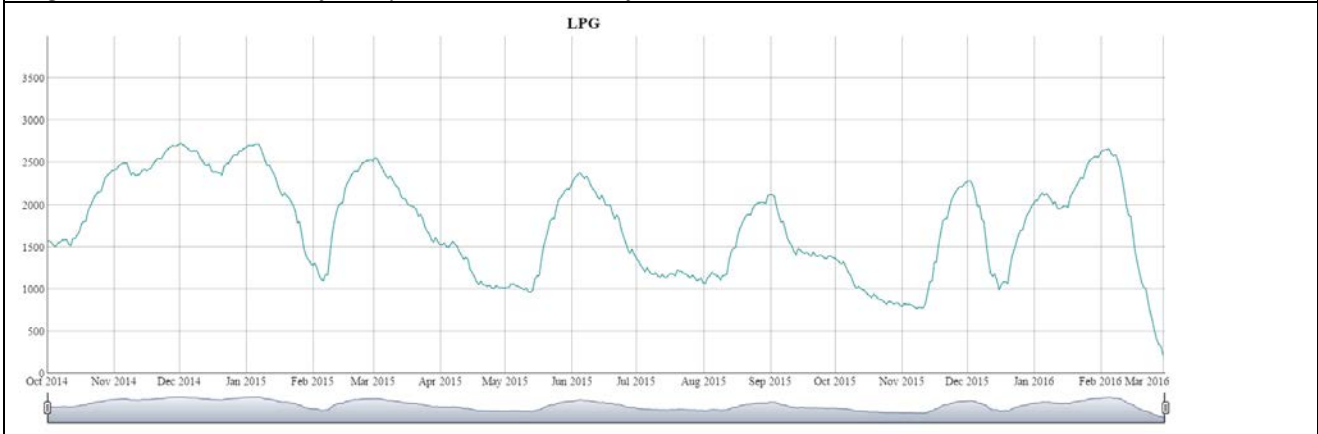
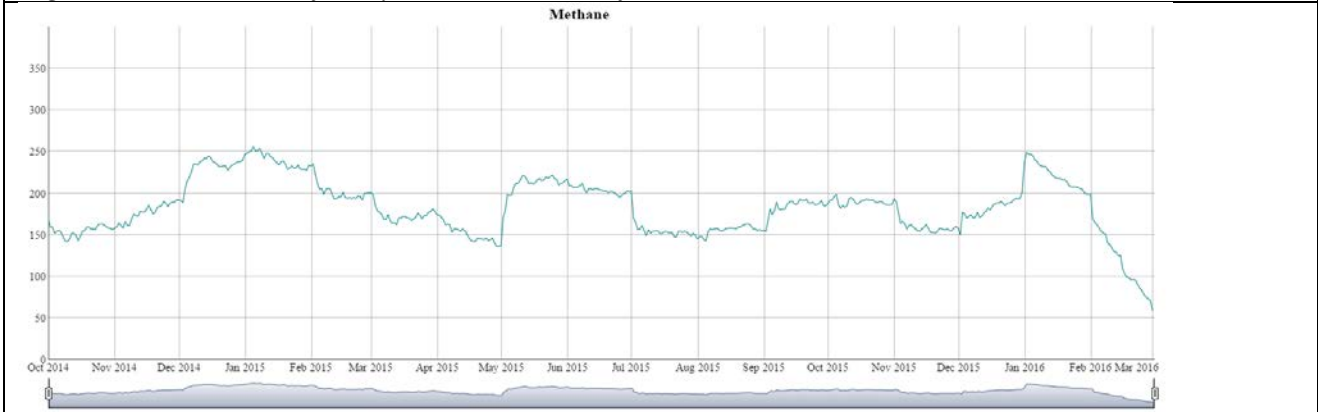


Figure 5. Time series of daily communications from methane retailers



Source: elaborations from the Authors.

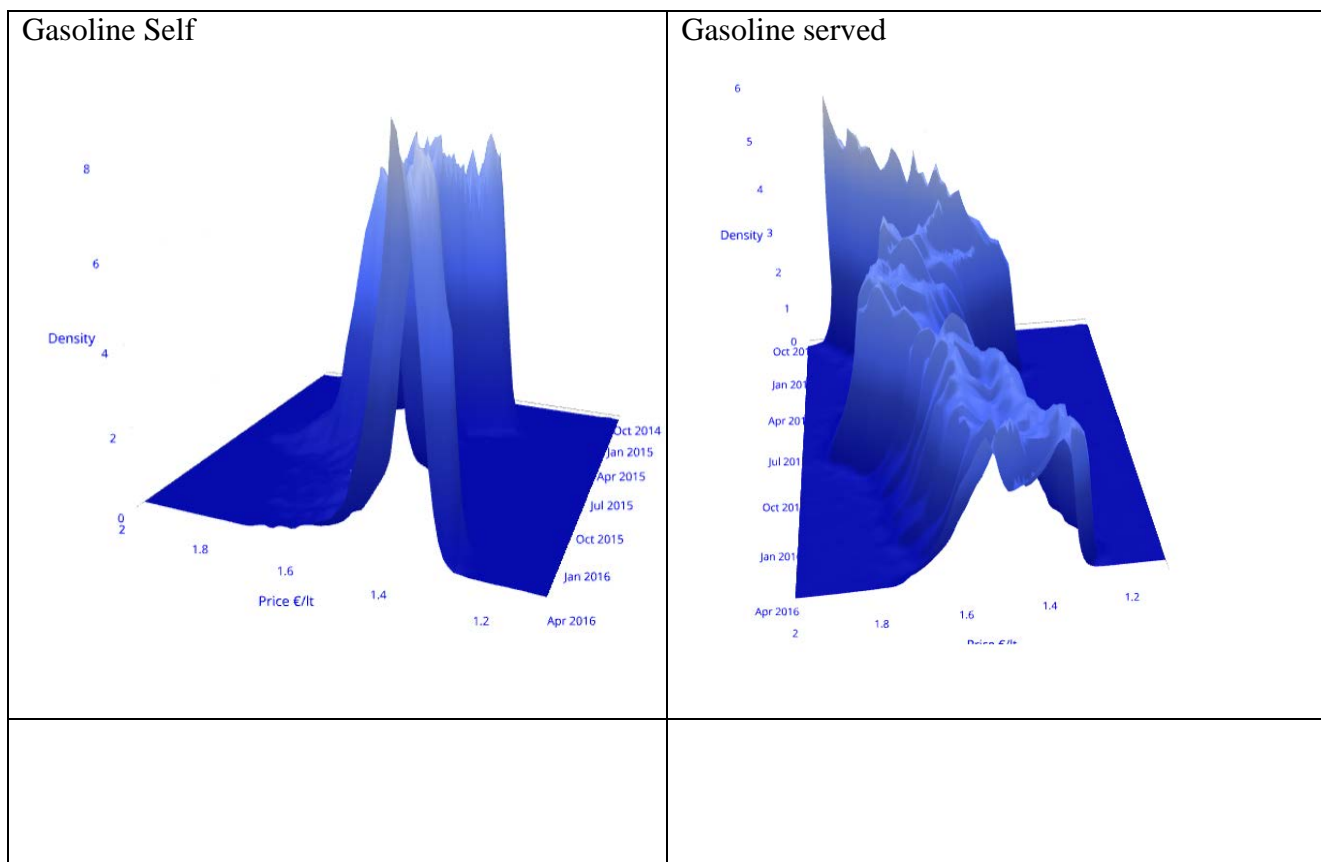
In the next section, we describe the empirical distributions of prices sequenced over time in a 3D animated object. The result of this involves more than 10^6 records elaborations and it is a novel visualization of the empirical price distribution over time. The dynamic price distributions can be represented at the national and local level, by brand or between branded and independent retailers. The following sections describe the analysis for the 6 types of fuels and service mode at the national level, for the five macro-areas (North-West, North-East, Centre, South and Islands) and for branded and independent retailers.

3. National fuel price distributions

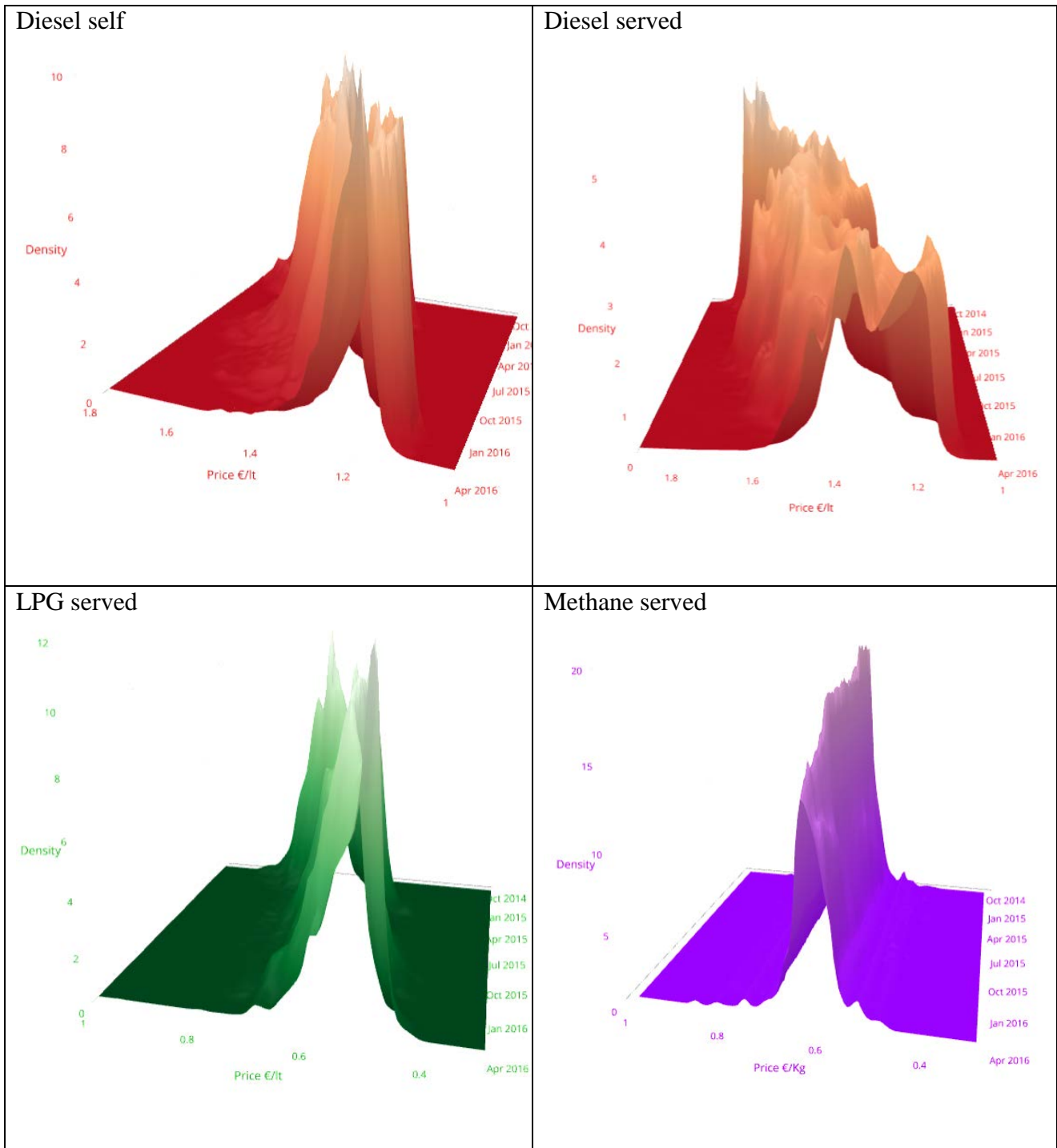
The first (R-written) procedure treats the prices of gasoline, diesel (self and served), LPG and methane at the national level, with the purpose to obtain a global dynamic view of the price distribution in Italy. More specifically, this procedure assembles and cleans the Monday data in a time series and it generates a representation of price empirical distribution over time, as shown in *Figure 6*. The distributions of the different fuel types and service mode show a general right asymmetry. Gasoline and diesel served prices are characterized by a multimodal distribution, indicating two or more price clusters, while LPG and methane have constant local modes due to higher prices in the Central and Southern regions⁶.

Served distribution low kurtosis is due to the ever-increasing occurrence of multimodality linked to an increase in interquartile difference (IQD) reaching 0.45 in 2016. On the contrary gasoline and diesel self-mode distributions are unimodal and very concentrated, with high kurtosis (ranging between 8 and 10) and low IQD (0.2€/lt.).

Figure 6. 3D Kernel Fuel price distribution (October 2014 – March 2016)



⁶ The interactive 3D kernel can be accessed at the following link <https://goo.gl/nCfaEe> ; for the videos see: <https://goo.gl/Npxy2M> .



Source: elaborations from the Authors

3.1 - Branded vs. independent retailers

In this section we analyze separately the price distributions of branded and independent retailers; the results being summarized in *Table 1*. Gasoline self price distribution is unimodal and concentrated around the mode with high kurtosis for both branded and independent retailers. The mode of the distribution of independent retailers is 0.15€/lt. lower compared to branded. The comparison between independent and branded retailers for served gasoline shows the branded distribution as more concentrated (leptokurtotic) around the higher price mode. Branded served gasoline is weakly bimodal, while the independent is multimodal: 2 or 3 straight modes indicating separate price regimes for the different areas of the country. Diesel-self price distributions are homogenous over time. For both branded and independent retailers the price means are 0.15 €/lt.

lower than those for served mode. Diesel-served has a multimodal distribution with low kurtosis. The average price for independent retailers is 0.12 €/lt. lower compared to branded. LPG distributions of branded and no-logo are unimodal and with local modes on both sides; average kurtosis of 12 confirms the strong concentration around the mode. The modes difference is around 0.15€/lt. Methane fuel price distribution shape remains the same in time, with high kurtosis; both functions have two local modes, the difference between the two being 0.19€/kg.

Table 1. National and macro area price distributions characteristics

Fuel	Self Mode	Area	Mode		Skewness	Kurtosis	IQD €/lt
			number	local			
Gasoline	Y	Italy	1	L	R	L	0,25
		N-W	1	no	R	L	0,23
		N-E	1	L	R	M	0,24
		C	1	L	R	L	0,26
		S&I	1	L	R	M	0,28
Diesel		Italy	1	L	R	M	0,3
		N-W	1	no	R	M	0,26
		N-E	1	L	R	L	0,24
		C	1	no	R	L	0,28
		S&I	1	no	R	M	0,34
Gasoline	N	Italy	3 to 5	R	L	M	0,3
		N-W	3 to 5	no	L	M	0,31
		N-E	2 to 4	R	L	M	0,32
		C	2 to 4	no	L	L	0,34
		S&I	3 to 4	R	L	M	0,36
Diesel		Italy	3 to 4	no	L	L	0,36
		N-W	2 to 4	no	L	M	0,28
		N-E	2 to 5	no	L	L	0,26
		C	2 to 3	no	L	M	0,35
		S&I	2 to 5	no	L	M	0,38
LPG	Italy	1	no	R	M	0,27	
	N-W	1	no	R	H	0,26	
	N-E	1	no	R	M	0,24	
	C	1	no	R	M	0,28	
	S&I	1	no	R	H	0,3	
Methane	Italy	1	L, R	no	H	0,2	
	N-W	1	R	no	H	0,18	
	N-E	1	L,R	no	H	0,16	
	C	1	L,R	no	H	0,21	
	S&I	1	L,R	no	H	0,23	

List of Abbreviations
N-W: north-west; N-E: north east; C: centre; S&I: South & islands
Self mode: Y: yes; N: no
Mode local: L: left; R: right
Skewness: L: left; R: Right
Kurtosis: L: low (3-6); M: medium (7-10); H: high (= > 10)

Source: elaborations from the Authors

In the next subsection we focus on gasoline and diesel in served mode; in order to explain the strong multimodality which characterizes their price distribution, we detail the price distributions of December 2015 for each Italian Macro area and we separate the distribution between branded and independent retailers.

3.2 Gasoline and diesel served distributions

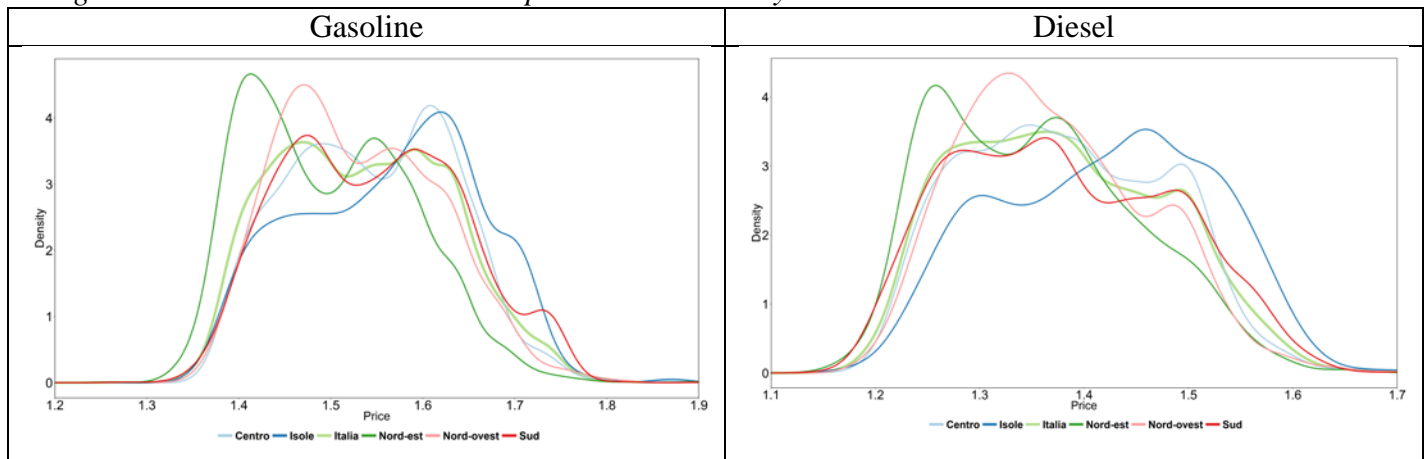
In order to explain the underlying factors leading to multimodal price distributions for the served mode, we plotted the December 2015 average price distribution by retailer for gasoline and diesel in served mode in the five Italian Macro-areas: North-west, North-east, Centre, South and Islands⁷. The Macro-area price distributions (see Figure 7) allow a better understanding, compared to the national distribution. In fact, at this analytical level it is possible to identify straightforwardly

⁷ December 2015 is obtained as average of Monday 7, 14, 21 and 28 retailers prices; the period is characterized by low prices and it is considered representative of the general served prices distribution multimodality.

the distribution's peculiarities, mainly due to geographical heterogeneity with large impact on higher aggregation levels.

A bimodal shape characterizes both gasoline and diesel distributions for all the macro-areas, although at different degrees. The two northern macro-areas are left skewed and bi-modal, while the remaining areas are rather right skewed; the South and the Islands are characterized by a multimodal distribution. This last peculiarity might be due to the higher heterogeneity (mountainous) of Southern Italian regions and, possibly, lack of competition at the local level.

Figure 7. Gasoline and diesel served price distribution by Macro-area ⁸

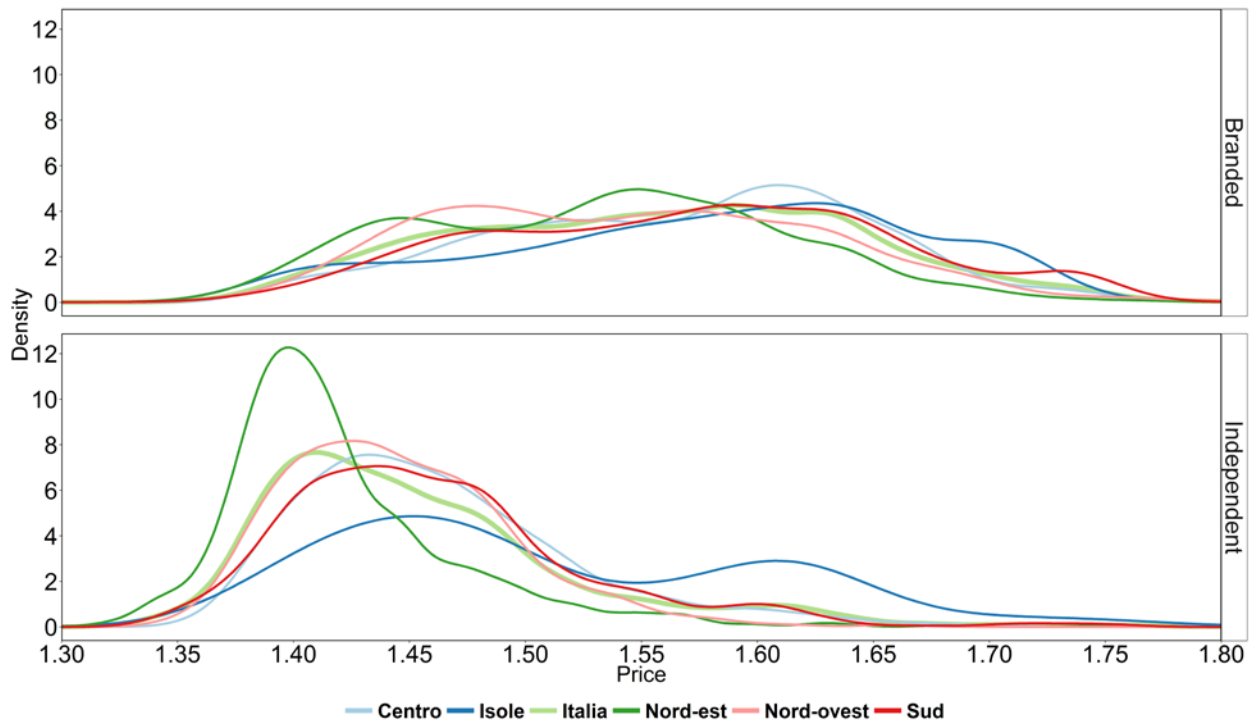


Source: elaborations from the Authors

The next step is to separate between integrated (“branded”) and independent retailers. Figure 8 and 9 show the integrated and independent retailers distributions for gasoline and diesel in served mode. In performing this analysis, we are conscious that the higher number of branded retailers compared to independent does have an impact on the overall dispersion. Indeed, the integrated retailer distribution is dispersed compared to independent. Nevertheless, besides the dispersion, branded price distribution has higher modal prices, it is bimodal in the North-west and North-east, suggesting two distinct price regimes. The distributions of independent retailers are left skewed and unimodal, with the exception of North-west and the Islands. Some explanations for these features can be found in the high gasoline excise in Liguria and the different logistics and costs between Sicily and Sardinia, respectively.

⁸ The interactive version for all Macro-areas and fuels can be accessed at the following link: <https://goo.gl/D1fDSg>

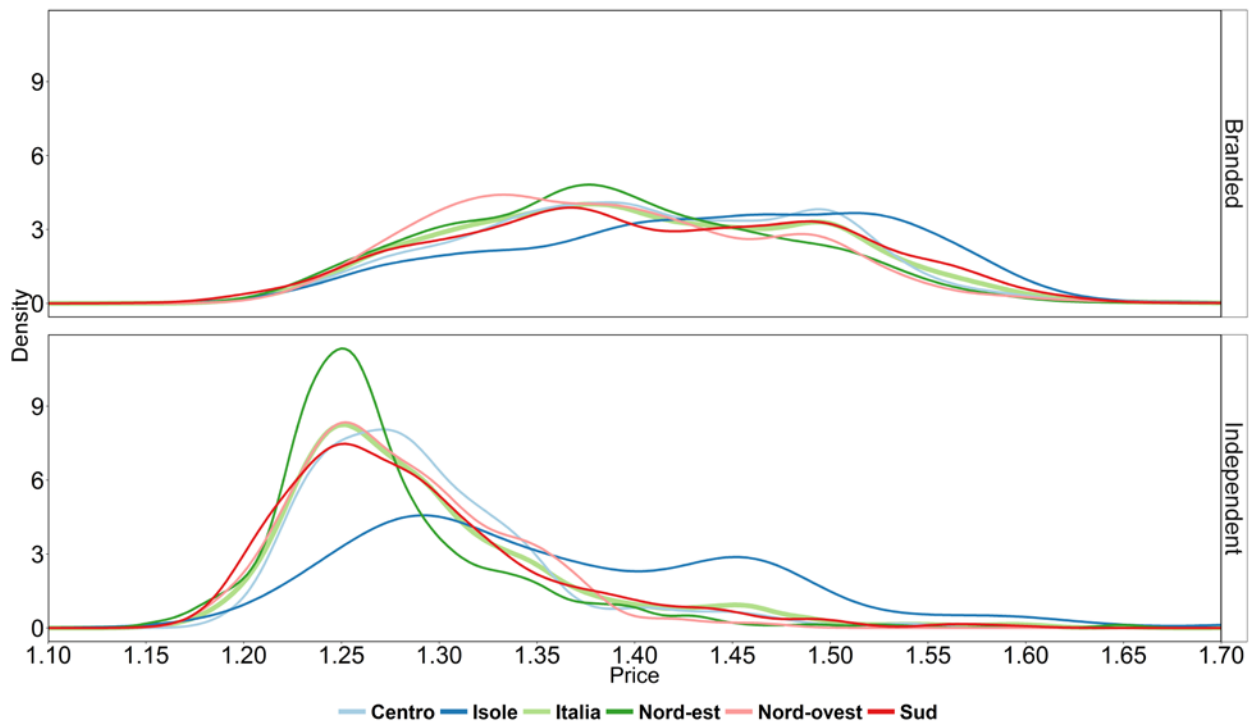
Figure 8 – Gasoline served price distribution by macro-area and company type



Source: elaborations from the Authors

The diesel distributions are similar to gasoline, with a major difference compared to gasoline for branded retailers in the South, where the empirical distribution shows a clear bimodality.

Figure 9 – Diesel served price distribution by Macro-area and company type



Source: elaborations from the Authors

4. Local fuel price distributions

In *Annex 1* we produce the price distribution of December 2015 for the 6 fuels/modes in the five Macro areas. Both in North-West and North-East the price distributions of gasoline and diesel in self mode are rather constant over time, unimodal and leptokurtotic; a right asymmetry characterizing gasoline and a left one diesel fuel. On the contrary, gasoline and diesel served distributions are multimodal. LPG distribution is unimodal with a right asymmetry and very concentrated around the mode; Methane is stable and concentrated, both in price level and distribution shape, with three local modes.

Concerning the Centre, the South and the Islands, the price distribution of gasoline and diesel in self mode are constant over time, unimodal and leptokurtotic, the two opposite asymmetries recorded in the northern Macro-areas are confirmed, as well as multimodality for Gasoline and Diesel in served mode. LPG distribution is unimodal, with a right asymmetry, while methane is multimodal and very concentrated around the mode (Kurtosis > 12), invariant over time; worth of note, methane main mode is 1.05€/kg in the Center and 1.09 in the South and the Islands.

The analysis shows the presence of clear multimodality for gasoline and diesel fuel in served mode for most areas of the country. In the next section we discuss the macro-area price distributions distinguishing between branded and independent retailers.

4.1 Branded vs. independent retailers by Macro area ⁹

North-West. Gasoline and Diesel served average distance between branded and independent is approximately 0.25€/lt. A left asymmetry characterizes the independent price distributions, the opposite holds for branded; Kurtosis are 5 and 7 respectively, *i.e.* higher dispersion for independent. Gasoline-self distributions are unimodal, with modes difference ≈ 0.15 €/lt.; the distributions are characterized by left-sided for no-logo and right-sided for branded. Diesel self distributions are distinct (lower prices for independent), unimodal and left-asymmetric, showing two opposite local modes, left for independent, right for branded. Both branded and independent price means are 0.15 €/lt. lower compared to served mode. LPG distributions of both branded and no-logo are very similar: unimodal and left asymmetric; the modes difference is approximately 0.15 €/lt. Kurtosis of 11 and 9 confirm the strong concentration around the mode. Methane distributions are unimodal, asymmetries are left and right for independent and branded respectively, although the two functions' modes reflect different price levels (difference = 0.12 €/kg) and they have one left-sided local mode and two right-sided.

North-East. Gasoline and Diesel served present a modal distribution distance of 0.35€/lt. between branded and independent retailers. A left asymmetry characterizes the independent distributions, the opposite holds for branded; kurtosis confirm a higher dispersion for independent. Gasoline-self distributions are unimodal with a constant right-sided local mode; skewness is negative (left asymmetry). Diesel-self is unimodal, and it is characterized by a left asymmetry and a high concentration confirmed by Kurtosis. LPG distribution is unimodal for independent and bimodal for branded. The two functions show a marked overlap, though the branded appears more concentrated. Methane distributions are both stable and unimodal, with three local modes on the tails for both retailers (two of which are in the high prices' Alpine regions); main Methane modes are 1.0€/kg and 0.975 for branded and independent respectively.

Centre. Gasoline and Diesel served distributions show the usual opposite asymmetries, although, compared to the Northern regions, Central Italy has higher prices and lower concentration: Kurtosis 4 for branded and 3 for no-logo. The distribution shape is multimodal for both branded and independent retailers. Gasoline self distribution is constantly unimodal, with a left asymmetry. LPG distribution is unimodal with a right asymmetry. Methane distribution is stable, as usual, with branded prices showing two right-sided local modes, while independent have only one; modal prices are 0.97 and 1.03€/kg respectively.

⁹ The interactive version for all Macro-areas and fuels can be accessed at the following link: <https://goo.gl/rv3fkt>

South and Islands. The price distributions of branded and independent retailers for gasoline, diesel and LPG are similar to the Central regions but with modes indicating 3€cents per liter higher prices. The distributions of methane in the South and Islands are unimodal both above 1€/kg. Branded mode = 1.08 and independent stations = 1.05€/kg, with two local modes on both sides; right mode values in the Trapani area at 1.1€/kg, while the lower price in Campania create the left-sided mode at 1.05 €/kg. For the distribution characteristics in the Macro areas by company type, including Kurtosis and IQD, see *Table 2*.

Table 2 – Branded and independent retailers price distribution characteristics

Fuel	Self Mode	Area	Brand	Mode number	local	Skewness	Kurtosis	IQD €/t		
Gasoline	Y	Italy	B	1	R	R	M	0,20		
			I	1	L	L	M	0,18		
		N-W	B	1	R	R	M	0,19		
			I	1	R	L	M	0,15		
		N-E	B	1	R	R	H	0,22		
			I	1	R	L	H	0,19		
		C	B	1	R	L	M	0,23		
			I	1	R	L	M	0,20		
		S&I	B	1	R	R	M	0,22		
			I	1	R	L	M	0,19		
		Diesel	Y	Italy	B	1	R	R	M	0,27
					I	1	R	L	H	0,26
				N-W	B	1	R	R	M	0,24
					I	1	L	L	H	0,22
N-E	B			1	R	R	H	0,23		
	I			1	R	L	H	0,20		
C	B			1	R	L	M	0,30		
	I			1	R	L	M	0,28		
S&I	B	1	R	R	M	0,32				
	I	1	R	L	M	0,29				
Gasoline	N	Italy	B	2	no	R	L	0,28		
			I	2 or 3	no	L	L	0,27		
		N-W	B	1	R	R	L	0,25		
			I	2	no	L	M	0,24		
		N-E	B	2	no	R	M	0,23		
			I	2	no	L	H	0,20		
		C	B	1 to 2	no	L	L	0,28		
			I	2	no	L	L	0,25		
		S&I	B	2	no	R	H	0,30		
			I	2	no	L	H	0,27		
		Diesel	N	Italy	B	1	R	R	L	0,30
					I	2	no	L	L	0,25
				N-W	B	1	R	R	L	0,20
					I	2	no	L	L	0,19
N-E	B			2	no	R	M	0,22		
	I			2	no	L	M	0,19		
C	B			2 to 3	no	L	M	0,30		
	I			2 to 4	no	L	M	0,28		
S&I	B	2	no	R	H	0,34				
	I	2 to 3	no	L	H	0,30				
LPG	N	Italy	B	1	L, R	R	H	0,22		
			I	1	L, R	L	H	0,19		
		N-W	B	1	2R	L	M	0,18		
			I	1	no	L	H	0,17		
		N-E	B	2	no	no	M	0,21		
			I	1	no	no	M	0,19		
		C	B	1	no	R	H	0,22		
			I	1	no	R	H	0,20		
S&I	B	1	no	L	H	0,21				
	I	1	no	L	H	0,19				
Methane	N	Italy	B	1	L, R	R	H	0,17		
			I	1	L, R	L	H	0,15		
		N-W	B	1	L, R	R	H	0,12		
			I	1	L, R	L	H	0,10		
		N-E	B	1	L, R	R	H	0,10		
			I	1	L, R	L	H	0,08		
		C	B	1	L, R	R	H	0,19		
			I	1	R	L	H	0,17		
S&I	B	1	L, R	R	H	0,20				
	I	1	no	L	H	0,22				

List of Abbreviations

Area: N-W: north-west; N-E; north east; C: centre; S&I: south & islands

Self mode: Y: yes; N: no

Mode local: L: left= low price regions; R: right = high price regions

Skewness: L: left; R: Right

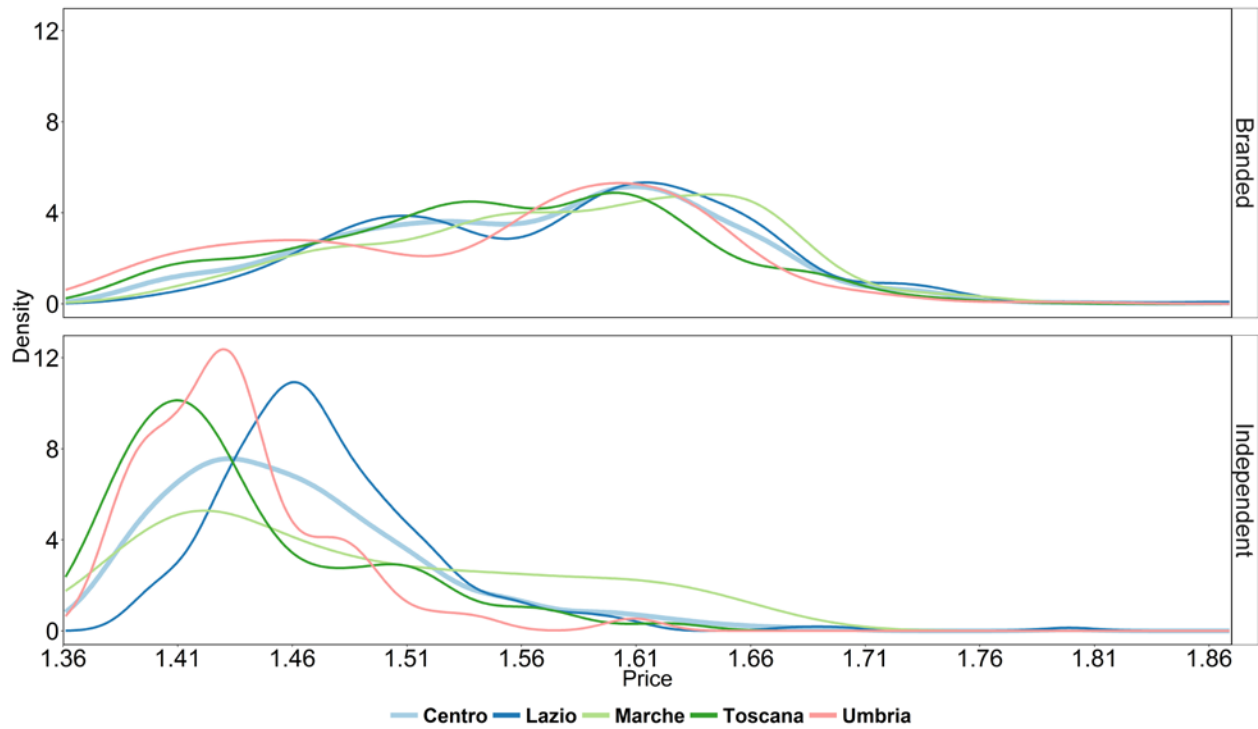
Kurtosis: L: low = 3-6; M: medium = 7-10; H: high = > 10

Brand: B: branded; I: independent

Source: elaboration from the Authors

In *Figure 16* we give an example of branded and independent distributions for the Macro area Centre, which is illustrative of the peculiarities: branded prices are more dispersed and bimodal, independent prices are asymmetric and unimodal.

*Figure 16 – Gasoline served price distribution in the Centre by company type*¹⁰

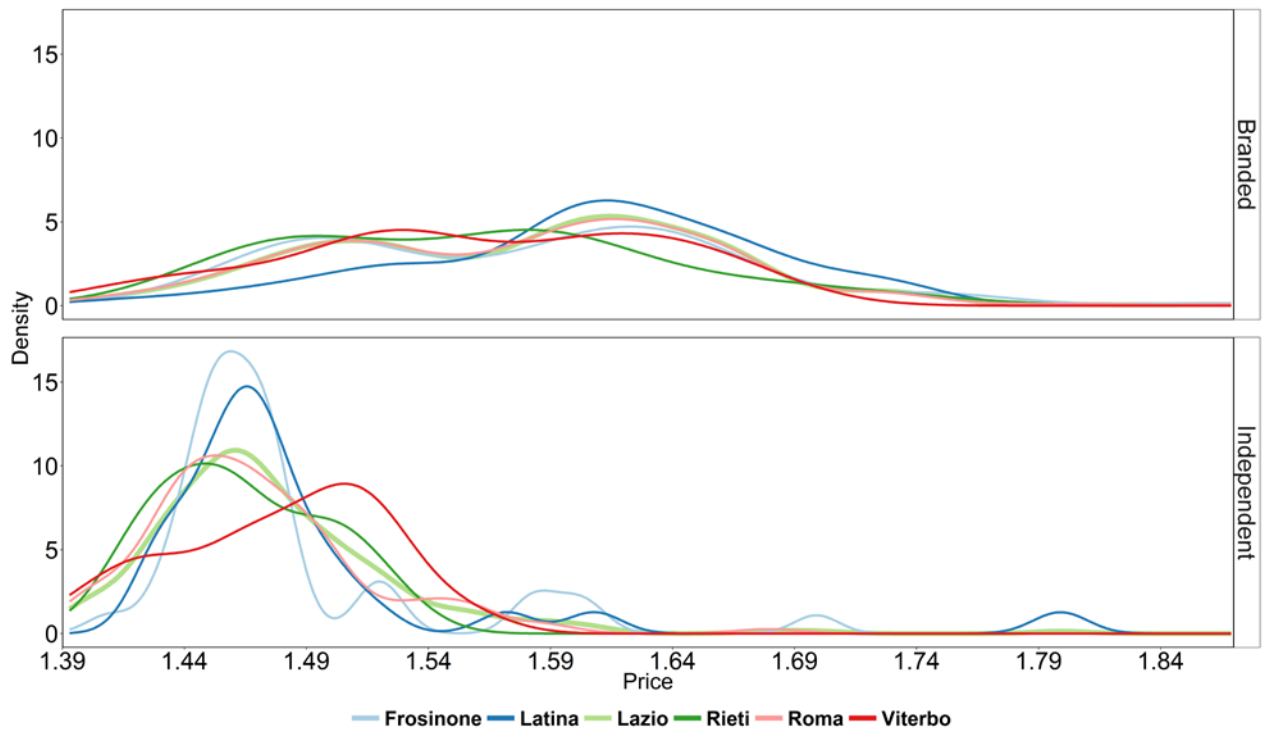


Source: elaboration from the Authors

As bimodality remains for the integrated companies at the regional level we decided to focus on the Lazio region (*Figure 17*). The results show a higher dispersion and two different price regimes for the branded retailers compared to independent in the provinces of Lazio. The distributions confirm the differences between branded and independent retailers highlighted above for the Macro-area Centre: the two aggregates have distinct modal prices and a clear multimodality, as for example the far-reached prices in Latina province, attributable to retailers operating on the Pontine islands or other monopolistic rent, like a single station in a mountain municipality or at the harbor.

¹⁰ The interactive version can be accessed at the following link: <https://goo.gl/MkKUOu>

Figure 17 – Gasoline served price distribution in Lazio by company type¹¹



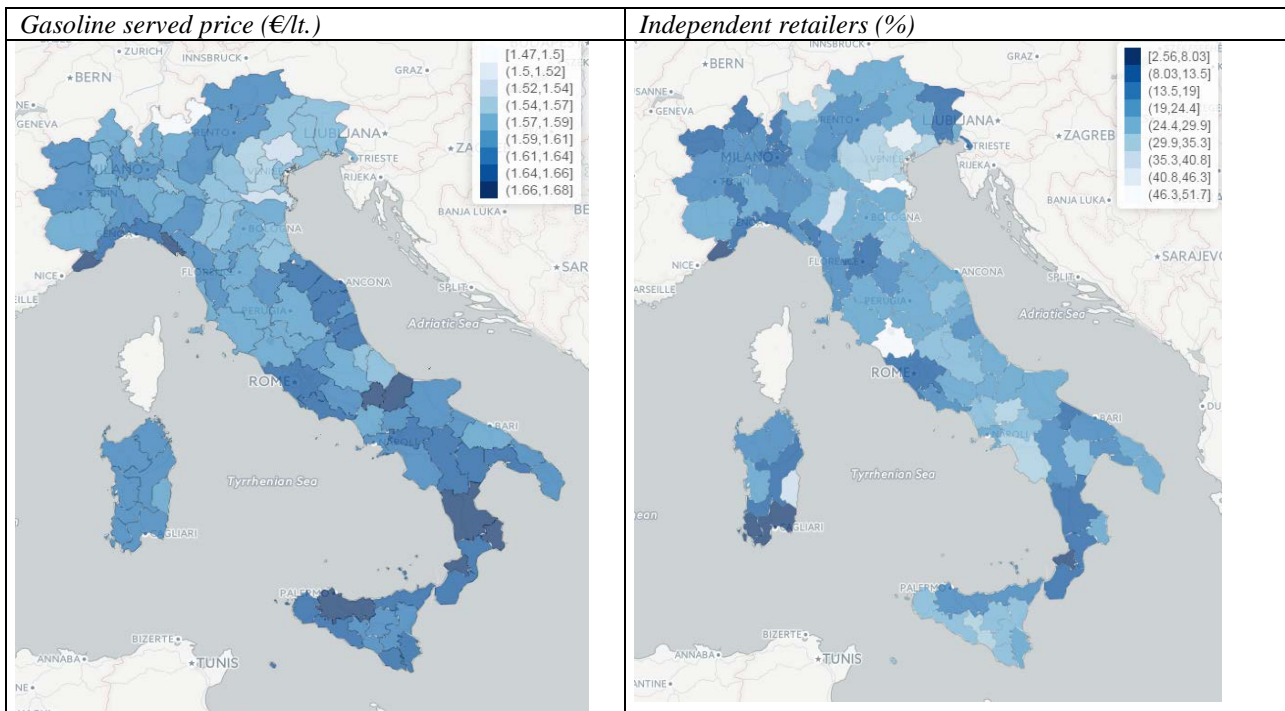
Source: elaboration from the Authors

One important factor we can account for geographical price differences and heterogeneity, as outlined in Lazio, is the percentage of independent retailers in each province. In *Figure 18* we can see how the presence of independent retailers is related to a lower price level. This fact is formalized in *Figure 19* where we represent the empirical correlation between the presence (in percentage) of independent fuel retailers and the price level of the province¹².

¹¹ The interactive version can be accessed at the following link: <https://goo.gl/85Q78w>

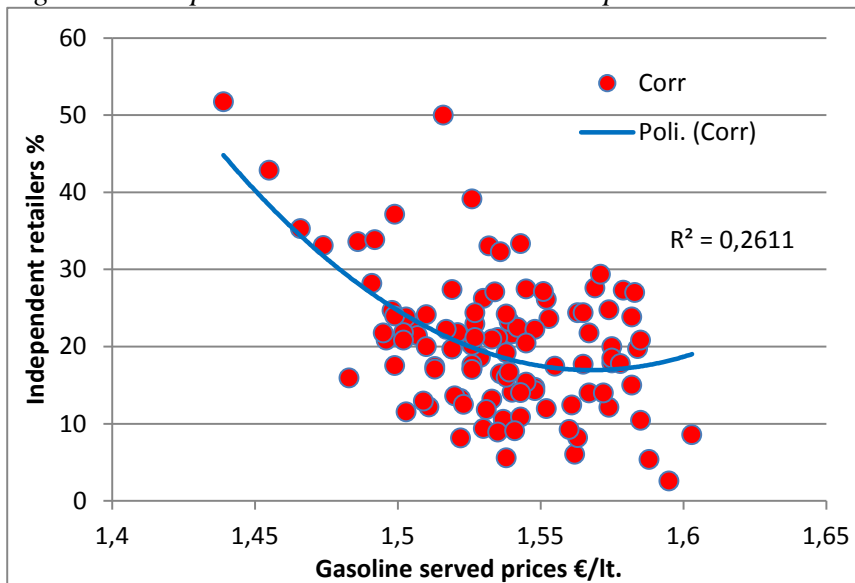
¹² In *Fig. 19* Sondrio province has been excluded since it includes Livigno, a mountain municipality with no excise on fuels.

Figure 18. Price level and independent retailers in the Italian provinces in December 2015



Source: elaboration from the Authors

Figure 19. Empirical correlation between independent retailers and prices in the Italian provinces



Source: elaboration from the Authors

4 – Conclusions

We treated a census-like fuel price database over a 18-months timeframe. The analysis has been led by an innovative tool to visualize the details of both price level - the maps by five administrative areas - and the price distribution over time - the 3D kernel. The resulting 3D graph allows a better understanding of fuel prices and related market structure, as well as competition insight in times of price fluctuations. The price differences are visualized and explained on the

Italian territory by geography and economic structure. The topography of Italy is also an important factor for price difference across the country, since delivering fuel in isolated or mountain regions is more costly. An important result is how the concentration of independent retailers does have an influence on price, as the right and left asymmetries of the distributions, for branded and no-logo retailers respectively, seem to confirm.

The 3D kernel of dynamic fuel price distribution is a new visual analytical tool to analyze fuels price behaviour both at national and local level, enabling a straight visual representation of market behaviour. A “natural” development of the present contribution can be to represent branded and independent price distributions at the regional/province level to explain definitely the distribution pattern (asymmetry and multimodality), appearing especially for the liquid fuels in served mode.

Further research might produce a more sophisticated analysis including area altitude (meters above sea level), seaside areas, car density and the average fuel sold in the province. Such approach to price explanation, by use of dedicated econometric modeling, under continuous development (Asane-Otoo and Schneider 2015, Bagnai and Ospina 2015, Bastianin et al. 2014) is needed at foremost at the European level.

References

- Alderighi, M. and Baudino, M. 2015. *The pricing behavior of Italian gas stations: Some evidence from the Cuneo retail fuel market*, Energy Economics, 50, 33–46 [doi:10.1016/j.eneco.2015.04.017](https://doi.org/10.1016/j.eneco.2015.04.017)
- Asane-Otoo, E., Schneider, J. 2015. *Retail fuel price adjustment in Germany: A threshold cointegration approach*, Energy Policy 78, 1–10 <http://dx.doi.org/10.1016/j.enpol.2014.12.013>
- Bagnai, A., Mongeau Ospina, C. A. 2015. *Long- and short-run price asymmetries and hysteresis in the Italian Gasoline market*, Energy Policy 78, 41–50 <http://dx.doi.org/10.1016/j.enpol.2014.12.017>
- Bastianin, A., Galeotti, M., Manera, M. et al. 2014. *Forecasting the oil–Gasoline price relationship: Do asymmetries help?* Energy Economics 46, 44–56 <http://dx.doi.org/10.1016/j.eneco.2014.08.006>
- IEA 2015, *CO₂ Emissions from Fuel Combustion* www.iea.org/statistics/topic/CO2emissions/
- EEA 2015. *Air quality in Europe — 2015 report* http://www.eea.europa.eu/publications/air-quality-in-europe-2015/at_download/file
- Eurostat (2012): *Motorisation rate*, Database tsdpc340
- Unione Petrolifera 2013. *Annuale Report* <http://www.unione petrolifera.it/?wpdmpo=up-relazione-annuale-2013&wpdmdl=409>
- WHO 2015. *Ten Strategies For Keeping Children Safe On The Road* http://www.who.int/roadsafety/week/2015/Ten_Strategies_For_Keeping_Children_Safe_on_the_Road.pdf

Annex 1 – Fuel price distributions by Macro area¹³

Figure A1. Gasoline self by Macro area

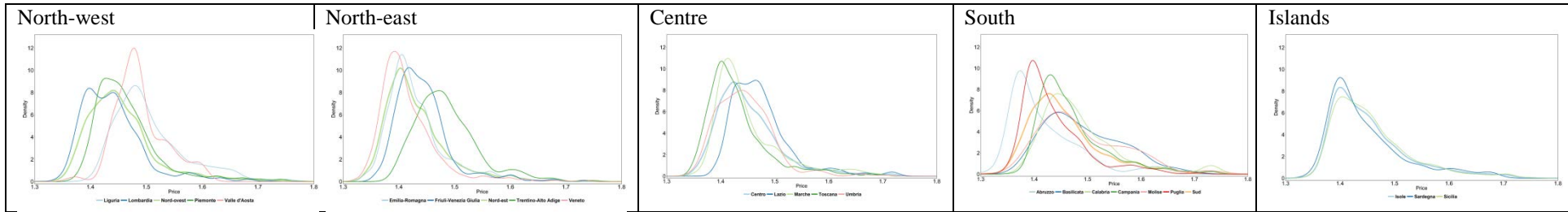


Figure A2. Gasoline served by Macro area

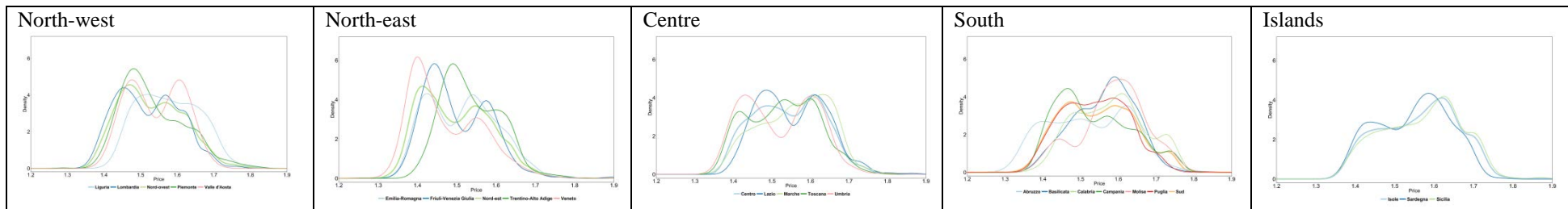
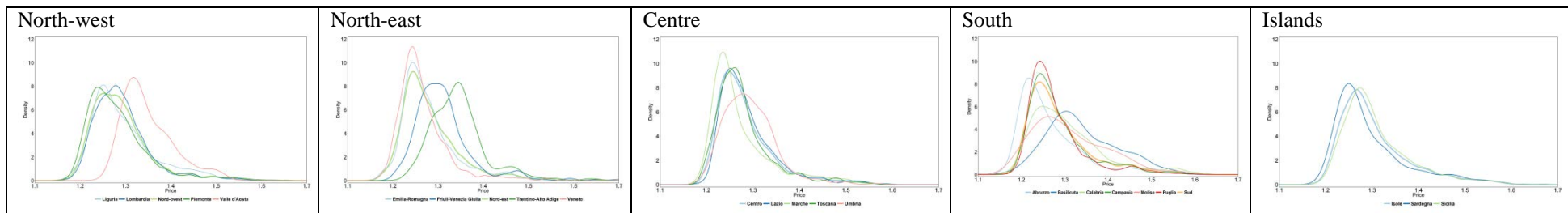


Figure A3. Diesel self by Macro area



¹³ The interactive version can be accessed at the following link: <https://goo.gl/ISYQ9B>

Figure A4 Diesel served by Macro area

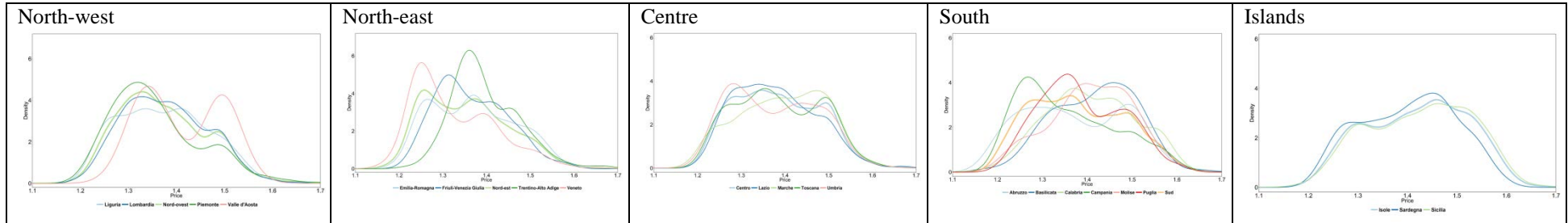


Figure A5. LPG by Macro area

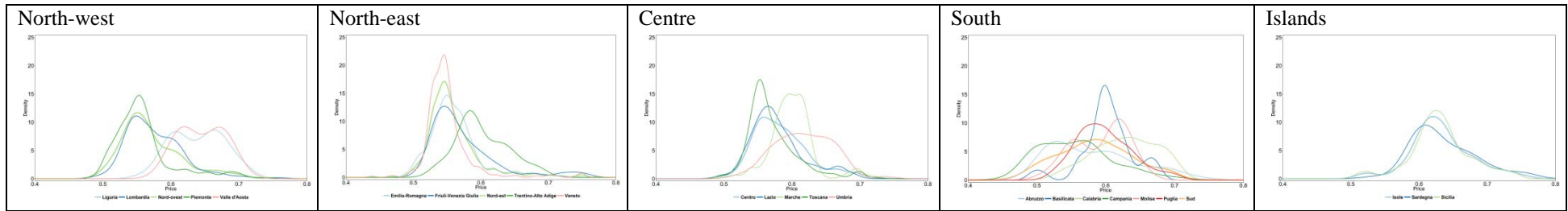
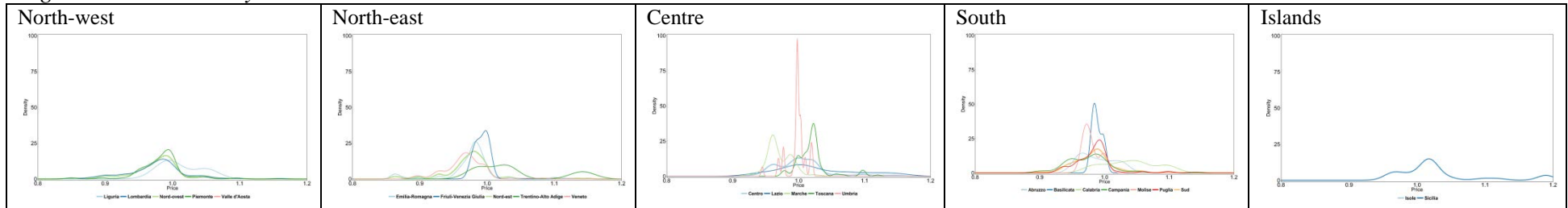


Figure A6. Methane by Macro area



Source: elaborations from the authors