WORKING PAPER

The Effect of Price Transparency: Assessment of the German Highway Retail Gasoline Sector

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University of Lüneburg
Working Paper Series in Economics

No. 435

July 2025

www.leuphana.de/institute/ivwl/working-papers.html
ISSN 1860 - 5508

The Effect of Price Transparency:

Assessment of the German Highway Retail Gasoline Sector[1]

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I would like to thank Thomas Wein and Mario Mechtel for their fruitful comments and vivid debate on the paper and Arne Neukirch, Mats Kahl and Jonas Dix for the comprehensive support when dealing with the data and their feedback on numerous drafts of this paper. Additionally, I would like to thank Annika Melles for proofreading several drafts of this paper.

Abstract

Increasing competition and reducing market power are core interests of economists, regulators and the public to maximise aggregate social welfare. Low prices are achieved through intense competition in the retail gasoline market. The absence of fierce competition is referred to as market power. Market power is defined as a firm's ability to influence the market price.

In this paper, I analyse the extent to which highway gasoline stations and the nearest truck stop influence each other's prices. The key question is whether proximity to a truck stop reduces the price of gasoline at highway stations. It is also an assessment of the impact of increased transparency on the German retail gasoline market along the highway system. The analysis is based on 287 German highway gasoline stations and the nearest truck stop. Additionally, two subsamples of 29 highway gasoline stations near truck stops and 29 highway gasoline stations located farther away from truck stops are examined.

The results indicate that higher prices persist in the German highway gasoline retail market. Gasoline retailers expect the majority of customers to not compare prices between highway gasoline stations and the closest truck stop by using mobile devices. Despite offering complete price transparency, low transaction costs, and homogeneous products, highway gasoline stations maintain a dominant market position. This changes significantly if the truck stop is near the highway gasoline station (within 5 kilometres). If a driver has just passed a truck stop or seen a sign indicating a truck stop, the price premium at the highway gasoline station decreases significantly, from 12-14 Cents per litre to 2-3 Cents per litre. Consequently, traditional price transparency has a significant impact on competition, resulting in lower prices.

Keywords: market power, gasoline market, market transparency, perfect competition, Edgeworth cycles

JEL-Classification: D01, D40, L1, L41

Declaration of interest: none

1. Introduction

The functioning of competition is a central area of competition policy. One of the fundamental tenets of economics is that perfect competition is the optimal state, as it maximises aggregate welfare. In the age of digitalisation, it is (theoretically) possible to compare prices at low cost and quickly identify cheaper retailers in the vicinity. Complete price transparency is a feature of perfect competition. Vigorous competition is one way of lowering prices.

That is why I am investigating the degree of competition in the German gasoline retailing market, specifically the German highway gasoline retailing market. I also examine whether the degree of competition changes when the truck stop is located close to a highway gasoline station, and drivers either pass the truck stop shortly before exiting to refuel at a highway gasoline station or see a sign indicating the proximity of a truck stop before driving to a highway gasoline station. I assume that gasoline retailers do not expect a significant share of their customers to use mobile apps to inform them about the price of gasoline when deciding to refuel while driving on a highway. The paper assesses how competition works (or does not) between highway gasoline stations and nearby truck stops. The research examines whether proximity to a truck stop affects prices at a highway gasoline station. Real-time price data allows me to estimate a competitive relationship between the two types of gasoline stations.

The study examines the interdependence between truck stops and highway gasoline stations and whether there is a premium for the lower search costs and time for driving up to 2 km. This includes the return distance from the truck stop to the highway and whether truck stops and highway gasoline stations operate independently, attracting different customers.

In perfectly competitive markets, there is no market power (Zhan et al. (2020)). Market power is defined as the ability to set a price regardless of the cost of (potential) competitors in the vicinity. The reasons for market power can be manifold. This may be due to the company's innovative and efficient character or to market structures that do not allow competitors to flourish (Utton (2003): p. 23 ff.).

A growing body of literature exists on market definition in the gasoline retailing sector. Still, little research has been done on the competitive relationships between individual gasoline stations and the effect of price transparency. When travelling on a highway, a driver can fill up at a highway gasoline station near the highway or at a truck stop. According to German law, truck stops must be located within 1 km of the highway exit and must be open 24 hours a day, 7 days a week. In return, they are privileged in the way that signs indicate their location on the highway. As a result, consumers only face slightly higher time costs when refuelling at a truck stop.

With the introduction of the Market Transparency Unit for gasoline by the German Federal Cartel Office at the end of 2013, all price information became available to consumers in real-time. Using smartphone apps and websites, it is possible to find out the price of any gasoline at any gasoline station in Germany. A driver can either plan their journey and familiarise themself with the price levels at highway gasoline areas and truck stops, or a passenger can check the current prices while travelling on the highway. Critics of comprehensive price transparency in the German gasoline market fear that it could be used to monitor compliance with tacit collusion or other agreements between major gasoline companies to set prices in a certain way and reap oligopoly profits.

Dewenter, Heimeshoff, and Lüth (2017) have already critically assessed the effect of price transparency on the German gasoline market, as companies can also use it to monitor the maintenance of high prices and (potentially) the compliance with tacit collusion. Kahl (2024a) found that the German fuel discount was not passed on entirely to consumers. Montag and Winter (2020) also assess the effects of price transparency. Already in 2013 24% of the German consumers had used an app or website to compare gasoline prices and considered the information when choosing where to refuel (IfD Allensbach (2013)). Rossi and Chintagunta (2016) have demonstrated an effect on the Italian highway gasoline market after the installation of signs alongside the highway that displayed, in real-time, the price for gasoline at the next gasoline station, including the distance to the next stations and highlighted the station with the lowest price.

Another line of research is the pricing behaviour of gasoline retailers. They have been found to raise their prices quickly in response to increases in crude oil prices and lower them slowly when crude oil prices fall (see e.g., Bacon (1991), Bremmer & Kesselring (2016), Galeotti/Lanza/Manera (2003), Tappata (2009), Verlinda (2008). This pricing has been labelled as “rocks and feathers”. Pricing patterns in gasoline markets have often been characterised as Edgeworth cycles. The theoretical roots are based on the work of Maskin/Tirole (1988). Companies compete solely based on market price.

A more recent academic literature in applied economics deals with the geographic market definition of gasoline retailing. Bangle & Muijs (2018) found that the pricing behaviour of highway gasoline stations is highly influenced by the degree to which they are located on a heavy commuter route. Kleineberg (2020) found that highway gasoline stations do not consider the price of street gasoline stations situated at the closest exit when setting their price. A recent branch of the literature assesses how artificial intelligence behaves in competitive situations and to what extent tacit collusion occurs (Assad/Clark/Ershov/Xu (2020)). Hagedorn et al. (2023) find evidence that drivers drive slower on German highways, even at sections with no speed limit, in times of increased gasoline prices. Kahl (2024b) found no evidence of cross-

border competition between Polish and German gasoline stations in the border region, despite a significant price difference resulting from different tax rates.

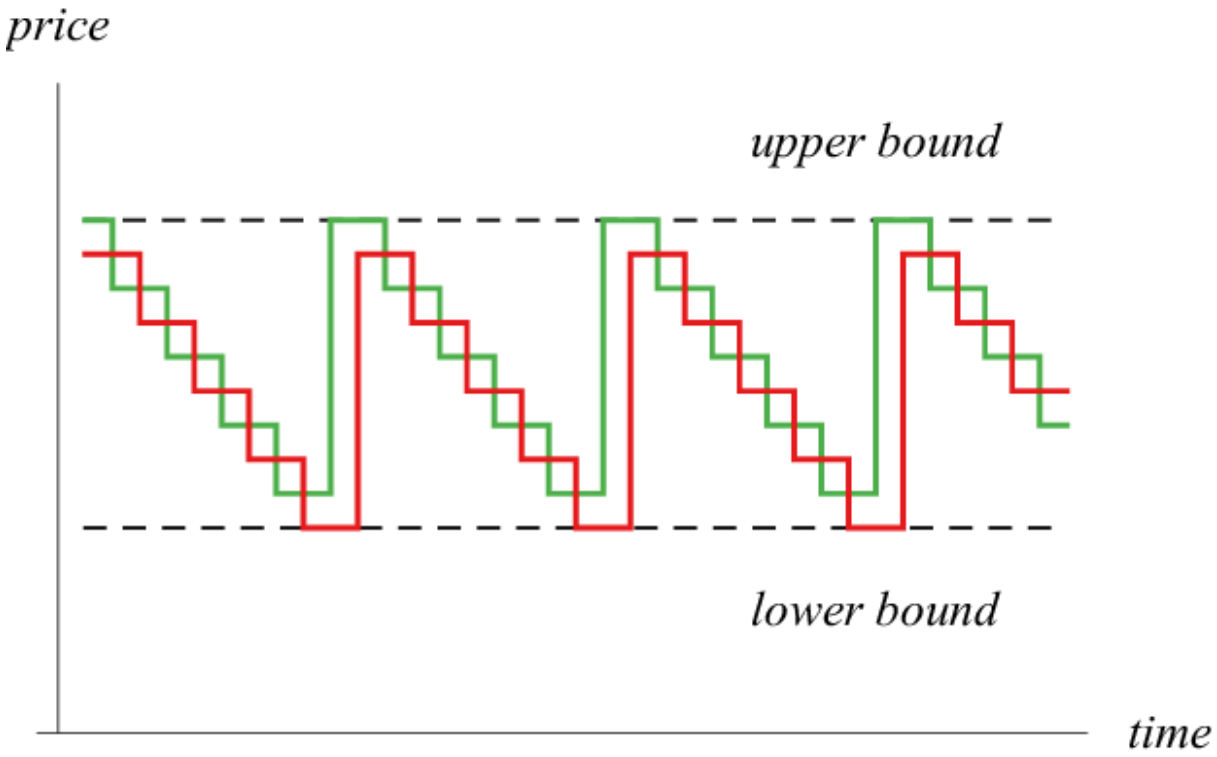

Figure 1: Edgeworth cycles

Source: Schlosser/Boissier (2018): p. 2.

Figure 1 depicts an example of the pricing patterns of two companies engaged in Edgeworth price cycles. The red line in Figure 1 below represents Company A's price, and the green line represents Company B's price. Both companies slightly undercut each other's prices to gain a higher market share. In the economic model of perfect competition, they would win all the demand as the cheapest supplier. Customers only focus on the current period's price when making decisions (Markov strategy). Eventually, one firm will have reached a price equal to its marginal cost. Neither company can lower the price any further, and one will jump to a higher price, which competitors will slightly undercut, and the whole process starts again. The key point about the Edgeworth cycle is that the other company is looking at the competitor's price. It reacts to it and slightly undercuts it to gain market share.

There is evidence for Edgeworth cycles in the gasoline market of the US (Doyle/Muehlegger/Samphantharak (2010) and Lewis (2012)), Western Australia (Wang (2009a, b) and Byrne/de Roos (2019)), Sweden (Nguyen/Steen (2018)), Norway (Foros/Steen (2013)) and Canada (Noel (2007a, b, 2011)).

There is a scholarly debate on whether Edgeworth cycles are a sign of a competitive or an oligopolistic/duopolistic market (Lal/Matutes (1989)). This question is not addressed here as the focus of this paper is different. Through rapid and repeated interaction in their pricing behaviour during the Edgeworth cycles, it can be shown that two market participants are reacting to each other's pricing decisions. Nevertheless, by definition, if the pricing follows Edgeworth cycles, there is no market power as one company does not set its price without considering the competitor's price. In this case, two companies would consequently interact on the same market.

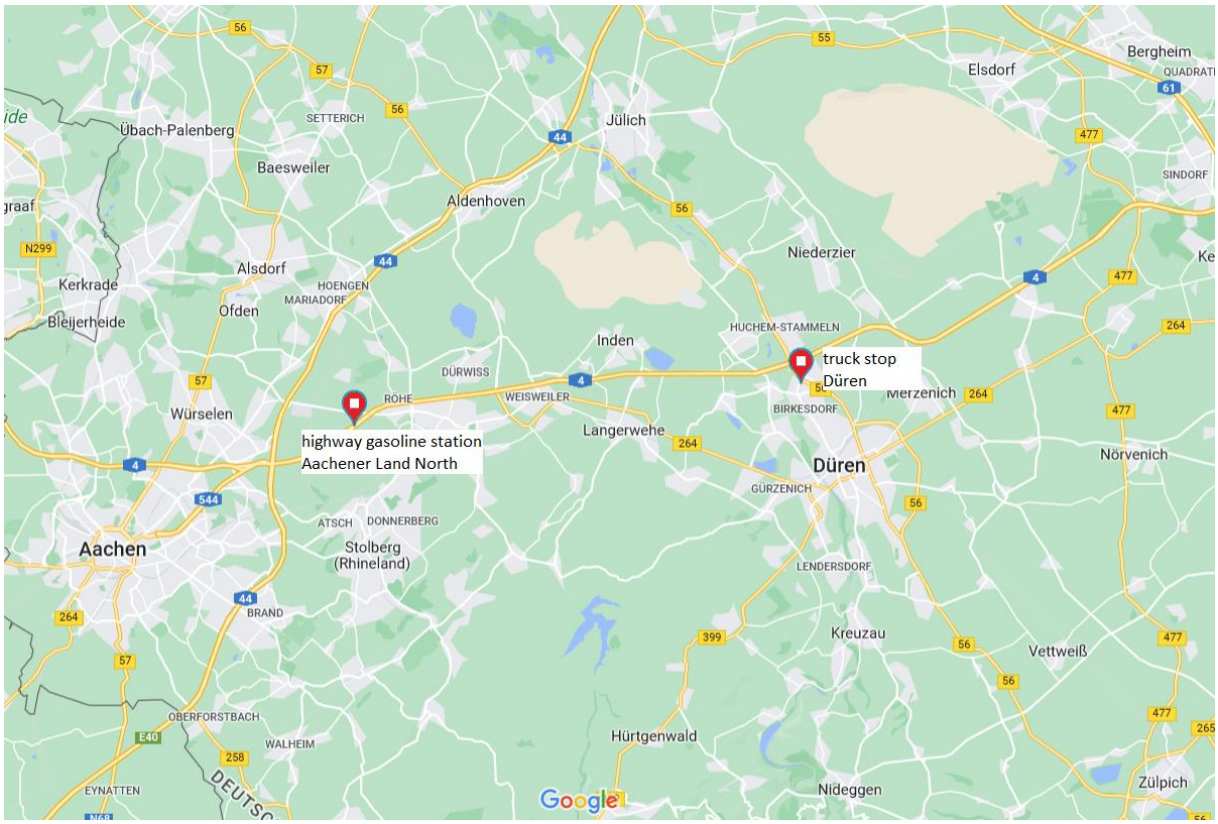

Figure 2: Example connection between a highway gasoline station and the closest truck stop

Source: Google Maps

Figure 2 shows an example of a highway gasoline station, Aachener Land Nord, and the nearest truck stop. Both are on the A4 highway—the distance between them is 26.2 kilometres or an 18-minute drive. The table below (Appendix A) gives more information on distance, driving time, gasoline station make and other location data (east/west, density, traffic level, etc.). The emptier the gasoline tank and the longer the distance left, the greater the significance of finding a refuelling option. Depending on the location, one or the other may be next, and the distance to the different types is only known to the driver if he is driving on a known route.

Gasoline retailers now make assumptions about the driver's refuelling decision and set their prices accordingly.

The paper contributes to the literature by assessing whether or not the proximity of (potential) competitors reduces the premiums of highway gasoline stations from 12-14 to 2-3 Cents per litre. The paper assesses whether there is a weak or strong correlation between the prices of gasoline stations on highways and those at truck stops in the vicinity. This is a valuable contribution to the debate on whether price transparency has a positive impact on competition, enabling consumers to make more informed choices. There are two explanations for this behaviour of charging high premiums at highway gasoline retail stations: Gasoline retailers must make their pricing decisions based on the assumption that customers consider accessible price information for homogeneous products. Considering the available pricing information from all customers, highway gasoline stations would be prevented from charging premiums due to their location. Or highway gasoline retailers would need to assume that their customers are willing to pay a premium for the certainty of a close refuelling opportunity at a highway gasoline station and the slightly shorter driving distance.

The research in this paper is organised as follows. First, the econometric model and the data used in the calculations are explained (2). Then, the descriptive results are presented, followed by the multivariate results (3.). Additionally, a robustness check is conducted to evaluate the viability of the results (4) critically. Finally, a conclusion is drawn (5).

2. Model and Data

Building on the previous section, I assess the pricing decision of gasoline retailers and try to calculate the premium for refuelling at a highway gasoline station compared to a truck stop. Both types of gasoline stations, truck stops and highway gasoline stations, are indicated by signs on the highway. In addition, both types must be open 24 hours a day, 7 days a week. It can, therefore, be assumed that highway gasoline stations and truck stops are direct competitors for commuters on a given route.

2.1 Data

Every gasoline station in Germany is legally obliged to report price changes for all types of gasoline (E5, E10, diesel and other premium gasoline types) to the Market Transparency Unit (MTU) of the Federal Cartel Office within five minutes of opening or changing the price since 2013. This price information is forwarded to independent websites and app services, which make it available to end customers via websites or smartphone applications. It is not possible to obtain information on sales volumes (see Kleineberg (2020)).

The price data used in this study are sourced from Tankerkönig, a service provider. The data includes all price observations for diesel, E5, and E10 gasoline at all gasoline stations in Germany, presented as hourly averages. The assessment is based on available price data from 14,700 gasoline stations in Germany between May 1, 2016, to March 8, 2018 (18 months, 574 days). There are 360 highway gasoline stations in Germany (German Federal Ministry of Transport and Digital Infrastructure (2021)). It was possible to identify 287 highway refuelling stations and connect them with the nearest truck stop refuelling station in the dataset. I managed to set up an unbalanced panel and get 1,435,345 observations[2]. The missing highway gasoline stations had been mislabelled in the data set and could therefore not be identified or were not operating during the investigation period. Hourly average prices are calculated for each gasoline station, categorised by type of gasoline (E5, E10, diesel). If a gasoline station opens at 8:00, the price of diesel increases from €1.05 to €1.15 at 09:37:20 and remains unchanged until at least 11:00. The average price at 9:00 is €1.05, and the average price at 10:00 is €1.10. The price at 11:00 is €1.15. There is no need to exclude certain times, as highway gasoline stations and truck stops are required to remain operational 24 hours a day.

[2] Due to data delivery there are not data for every unit for every hour for every day. This leads to that particular number of observations

Additional control variables were created manually. These are dummy variables for each day of the week and holidays, as well as the frequency of traffic on the highway, and the high or low density of the area. As data is available from all over Germany, only holidays in all German federal states ("Bundesländer") are included.[3] The complete list of gasoline stations in the sample is provided in Appendix A. The following Table 1 gives an overview of the gasoline stations and their brands that are used in my sample:

Table 1: Overview of gasoline stations in the sample

Brand	**Total Number of gasoline stations in the sample**	**Number of Highway Stations**	**Share of all Highway stations**	**Total Market Share**
Aral	174	92	32.06%	17 %
Shell	159	84	29.27%	14 %
Esso	95	37	12.89 %	7 %
Total	75	39	13.59 %	8 %
Jet	2	2	0.70 %	6 %
Independent	6	0	0 %	7 %
Others	63	33	11.50 %	41 %
Total	574	287	100%	100%

Source: Own calculations

The market share of the major gasoline companies in Germany — Aral, Shell, Esso, and Total — is even higher at highway service stations. Until 2013, highway stations were allocated to gasoline companies according to their market share. Since 2013, only 65% of highway stations have been assigned based on general market shares. The rights to operate the remaining stations are auctioned (Federal German Cartel Office (2022)). This suggests that companies with a high market share are better positioned to succeed in the competitive bidding system that allocates the right to operate a gasoline station on a highway.

[3] These holidays are New Year's Day, Good Friday, Easter Sunday, Easter Monday, Ascension Day, Labour Day (1 May), Whit Monday, German Reunification Day (3 October) and the first and second days of Christmas (see Kleineberg (2020)).

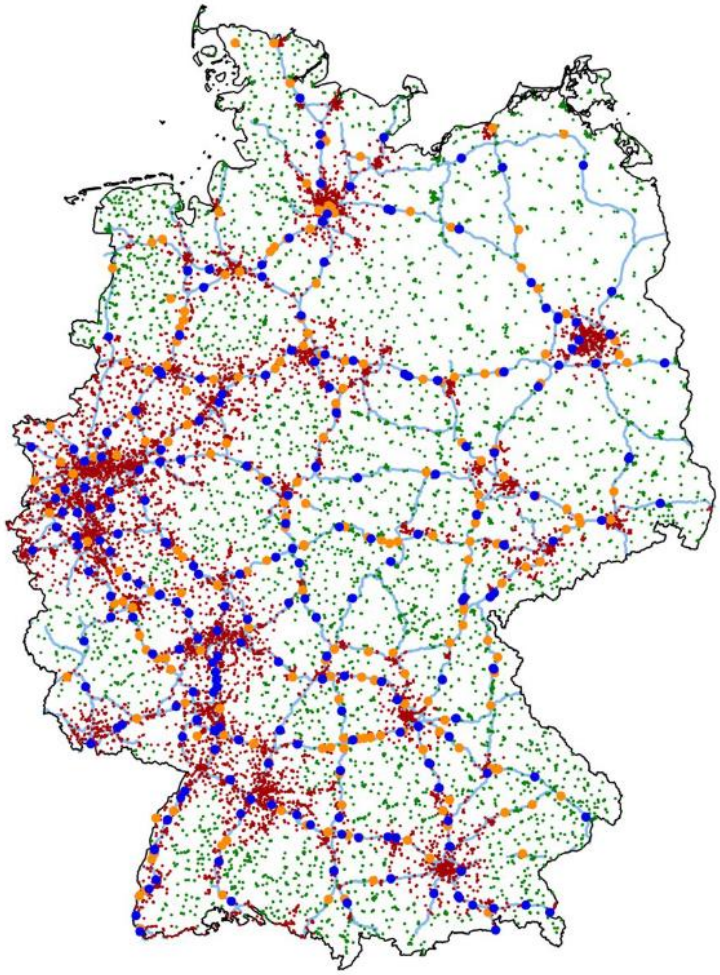

Figure 3: Map with different gasoline station types in Germany

Source: Federal German Cartel Office (2020): p. 12

Figure 3 shows dots of different colours representing different types of gasoline stations. The blue dots represent highway gasoline stations. The orange dots represent truck service stations. The green and red dots represent urban (red) and rural (green) service stations and are irrelevant to the assessment. The Market Transparency Unit assessed price levels at various types of gasoline stations in 2020.

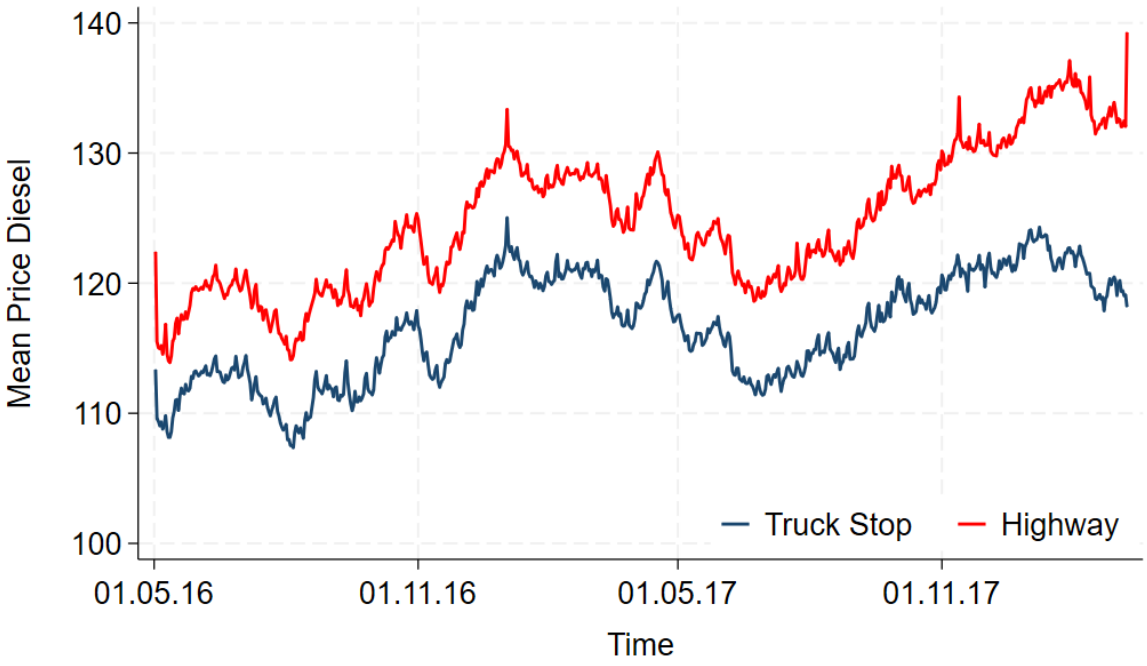

Figure 4: Gasoline prices at different station types for Diesel

Source: Own calculations using Stata 18.1

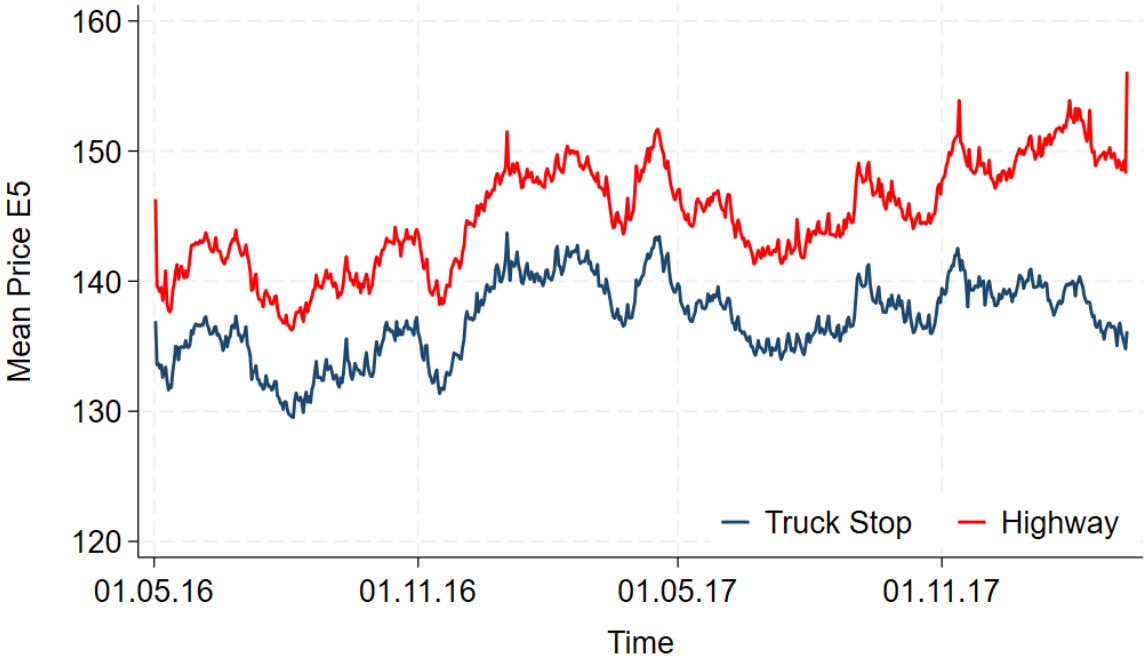

Figure 5: Gasoline prices at different station types for E5

Source: Own calculations using Stata 18.1

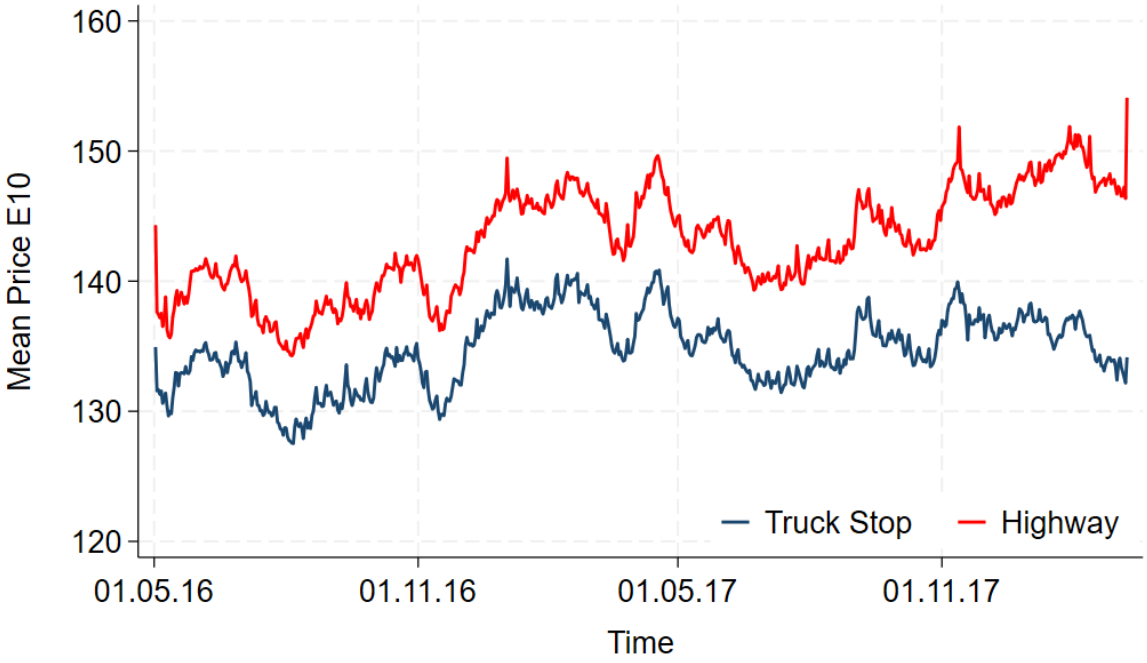

Figure 6: Gasoline prices at different station types for E10

Source: Own calculations using Stata 18.1

The red lines in Figures 4-6 represent the average hourly prices for all highway gasoline stations. The blue lines represent the hourly prices at truck stops. The figures provide a first overview of the correlations between the prices of different groups of gasoline stations.

At first sight, the meta-level impression suggests a close relationship between them, as there is a general tendency for movements (due to fluctuations in crude oil prices), but no exact synchronous movements. Additionally, gasoline prices at truck stops are significantly higher than those at highway gasoline stations. This visual impression will be tested in the following paper through the price assessment of the closest highway gasoline stations and truck stops.

Previous research has shown that include the location of the gasoline station in East or West Germany, whether it is located on a busy highway or in a densely populated area, and the influence of different days of the week influence pricing behaviour in the German retail gasoline market (see e.g., Kleineberg (2020); Neukirch/Wein (2019)). Therefore, these aspects are also included in the analysis to ensure that all relevant factors are considered.

To test whether highway gasoline stations near truck stops are under more significant competitive pressure and, therefore, have lower prices, a subsample of highway gasoline stations located at least 10 kilometres and at most 20 kilometres from the nearest truck stop was selected. They are compared to gasoline stations with the closest truck stop within 5 kilometres. This distance is chosen because truck stops are signposted for all commuters starting 5 kilometres before their location. Therefore, every commuter who drove to a truck stop knew there was a nearby truck stop.

2.2 Econometric approach

The dependent p_{it} variable measures the price at station i at time t. It is the average price per hour and per gasoline station for E5, E10, and Diesel. Equation (1) outlines the econometric approach to estimating the premium that commuters pay for refuelling at a highway gasoline station compared to a truck stop. To account for potential price-insensitive customers, such as individuals with company cars, we control for other factors that may influence price development. Specifically, we include controls for the day of the week, the daily frequency of vehicles on the highway, and the distance to the next service station (Appendix B and C). We also account for the brand of the gasoline station (Aral, Shell, Total, Esso, Jet, independent, or other). These controls help to mitigate the potential for biased estimates and ensure that our results accurately reflect the premium paid by commuters at highway gasoline stations.

The model is specified as follows:

(1) $$p_{it} = \alpha_i + \beta_0 HW_i + \beta_1 Brand + \beta_2 Weekday + \beta_3 Distance + \beta_4 East + \beta_5 Density + \beta_6 Frequency + \beta_7 timetrend + \varepsilon_{it}$$

The explanatory variable of primary interest is the dummy variable HW_i. Furthermore, p_{it} is the price at station I at time t. αi is the constant term, and several independent variables, namely dummy variables for highway (HW_i), brand (Brand), weekday, the nearest truck stop in kilometres (Distance), whether the gasoline station is located in East or West Germany (East) or a densely populated area (Density) and whether the gasoline station is located on a busy highway section (Frequency). A gasoline station is located on a busy highway, if the number of vehicles passing by daily exceeds 47,000, the average traffic volume on German highways (Federal Germany Statistics Office (2014)). The area of a gasoline station is defined as densely populated if more than 1,000 people live per square kilometre. East and West Germany are determined by the former Federal Republic of Germany (until 3 October 1990) and the former German Democratic Republic. No distinction is made for Berlin, as no highway gasoline stations exist. ε_{it} is the error term.

The estimations face a significant problem, which ultimately causes a dilemma. Gasoline prices are not independent of the previous day's prices. Crude oil prices fluctuate, but do not start at 0 € or 0 $, and liquid reservoirs are filled for multiple days, with sales spanning over several days. Consequently, a fixed effects or first-difference model would be well-suited from an econometric perspective. This autocorrelation is considered in both the fixed effects and the first-difference models.

However, the characteristics of a gasoline station, such as being a highway gasoline station or a truck stop, do not change over time and are therefore eliminated in the estimation. While this is an econometrically sound approach, it would also eliminate the core variable of interest, which is the effect of these characteristics on gasoline prices. This presents a trade-off between model specification and the ability to estimate the variable of interest. That is why I do not use fixed effects or first-difference models.

3. Descriptive Statistics and Multivariate Results

In this section, I outline the estimation strategy, describe the data and conduct the first estimations. The goal is first to quantify the premium for refuelling at a highway gasoline station compared to refuelling at a truck stop. Secondly, assess whether the premium changes if the highway gasoline station and a truck stop are close (within 5 kilometres) or further apart (between 10 and 20 kilometres). Some general information about the dataset is provided in Tables 2 and 3.

Table 2: Descriptive I – Data Set

	mean	Standard deviation	Min	Max
Price E5	141.16	11.92	109.99	179.65
Price E10	137.55	18.34	107.78	177.65
Price Diesel	121.54	7.84	105.36	158.65

Table 2 shows that the sample's mean price for a litre of gasoline or Diesel is 134.29 Cents per litre. The highest price is 181.90 Cents per litre, and the lowest is 109.99 Cents per litre. There is a standard deviation of 12.90 Cents per litre.

Table 3: Descriptive II – Data Set

	Mean	Min	Max
Highway	0.558	0	1
East	0.188	0	1
Frequency	0.714	0	1
Population density	0.258	0	1

Table 3 shows that 55.8% of the gasoline stations in the sample are located on highways. That means some highway gasoline stations are closest to the same truck stop. 71.4% of the highway gasoline stations and truck stops are located near highly frequented highways. 18.8% are in East Germany, and 25.8% are in densely populated areas.

The first estimation compares the price of gasoline at highway gasoline stations and the cost of gas at truck stops using hourly average prices. The calculation is an OLS estimation with robust standard errors, considering correlated error terms in the dataset. Model (1) represents E5, Model (2) depicts E10, and Model (3) shows the effects of the regressand of Diesel. The results confirm the existence of an overall price premium between highway gasoline stations and truck stops. The general premium is 8.1 Cents per litre for E5, 8.5 Cents per litre for E10 and 8.3 Cents per litre for Diesel. The average E5 price is 137.0 Cents per litre. The average E10 price is 134.6 Cents per litre, and the average Diesel price is 116.5 Cents per litre at truck stops. There are a total of more than 2 million observations. Due to individual errors, the number of observations varies slightly. There is high statistical significance for all types of gasoline, above the 0.1% level and high economic importance. Furthermore, the effects are meaningful.

Table 4: Basic estimation according to different types

	(1)	(2)	(3)
	E5	E10	Diesel
Highway	8.0721***	8.4516***	8.3106***
	(114.68)	(108.24)	(116.05)
Basis	136.9645***	134.5975***	116.4985***
	(1,172.52)	(1,202.20)	(740.24)
N	2,153,631	2,131,436	2,163,796

Z-statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The second estimation compares the price of gasoline at highway gasoline stations with the price of gasoline at truck stops, including a few control variables. The calculation is an OLS random effects estimation for unbalanced panel data with robust standard errors to account for correlated error terms.

Table 5: Estimation with the control variables – E5

Highway	8.8215***
	(60.89)
Tuesday	-0.0454
	(-0.09)
Wednesday	-0.0776
	(-0.15)
Thursday	-0.2134
	(-0.43)

Friday	-0.0939 (-0.19)
Saturday	0.5013 (0.91)
Sunday	0.8213 (1.66)
Holiday	2.135 (2.73)
Distance	-0.0194*** (-21.37)
East	4.1478*** (-78.14)
Frequency	0.2103*** (12.41)
Density	-0.8155*** (-37.04)
Aral	1.6639*** (24.27)
Shell	2.3344*** (39.14)
Esso	1.9633*** (32.82)
Total	-2.9189*** (-66.92)
Jet	-4.4488*** (-44.30)
Basis	136.7721*** (391.78)
N	2,153,631

Z-statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

There are estimations for highway gasoline stations and truck stops that are less than 5 kilometres apart (1), and for those with longer distances, between 10 and 20 kilometres (2), for E5 gasoline. All estimations are also performed for E10 and diesel and are robust.

The sub-samples were created to identify the degree of competitive pressure between highway and truck stop service stations. One group (Appendix B) consists of the highway gasoline stations within 5 kilometres of a truck stop. When a driver decides to leave the highway at this

service station, they have either recently passed a truck stop or have passed a sign indicating the location of a truck stop ahead. In this case, the driver could have been aware of a refuelling alternative close to the highway. The control group consists of highway gasoline stations with a truck stop within 10 to 20 kilometres (Appendix C). In this case, the driver is not aware of a refuelling alternative close to the highway. Both groups are controlled for make, density, frequency of the highway section, and east-west location. Due to the high covariance between the control variables distance and frequency, they are excluded from the estimation. For both variables, the covariance was above 50% (see Appendix D).

The OLS estimation for the two subgroups shows a significant increase in the premium when the distance between the highway gasoline station and the nearest truck stop is greater. Commuters who just passed a truck stop indicated by a sign on the highway or passed a sign indicating the proximity of a truck stop before exiting to fill up at a highway gasoline station pay a premium of 6 Cents per litre compared to truck stops. The result is statistically significant at the 0.1% level of significance. At highway gasoline stations with subsequent truck stops within 10 to 20 kilometres, this premium increases by six to seven times to 12-14 Cents per litre. There is statistical significance at the 0.1% level. However, the sign on the highway increases the certainty that there is a (likely) cheaper refuelling alternative nearby. The price differences between the two groups also have high economic relevance.

There are further statistically and economically significant effects of increased gasoline prices on Sundays (1 Cent per litre) and Federal holidays (ca. 2 Cents per litre) on the 1% level. There is a total of 701,454 observations of highway gasoline stations and truck stops that are within 5 kilometres, and 733,941 observations of highway gasoline stations and truck stops that are between 10 and 20 kilometres apart. The difference in the number of observations is caused by the fact that highway gasoline stations are often located on both sides of the highway. For them, one truck stop is the closest truck stop. Consequently, the number of truck stops is lower in the groups than the number of highway gasoline stations.

Table 6: Estimation with the control variables for subgroups – E5

	(1)	(2)
	Short distance	Long distance
Highway	2.9655***	13.0029***
	(32.13)	(93.22)
Tuesday	0.0251	-0.0095
	(0.05)	(-0.02)
Wednesday	0.0250	-0.2194
	(0.05)	(-0.05)

Thursday	-0.1295 (-0.27)	-0.2203 (-0.46)
Friday	0.0337 (0.07)	-0.0513 (-0.11)
Saturday	0.6429 (1.34)	0.3743 (0.78)
Sunday	0.9163* (1.95)	0.3701 (1.88)
Holiday	2.2037** (3.01)	2.989** (2.97)
East	-2.4607*** (-23.80)	-4.7981*** (-96.23)
Density	-0.5188*** (-4.80)	-0.3078*** (-3.55)
Aral	7.0230*** (71.39)	-3.6369*** (-38.58)
Shell	5.9908*** (56.47)	-1.6545*** (-14.99)
Esso	7.1534*** (86.26)	-2.6561*** (-25.36)
Total	-0.2356 (-2.50)	-11.3609*** (-116.33)
Jet	-0.8687**** (-7.51)	(omitted) (0)
Basis	137.3754*** (411.85)	137.5828*** (413.11)
N	701,454	733,941

Z-statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4. Robustness Check

To assess robustness, the evaluation is conducted for Diesel and E10 (4.1). Furthermore, an additional model is assessed, which includes interaction terms for the effects of highway and holiday (see Section 4.2).

4.1 Robustness for Diesel and E10

When refuelling Diesel vehicles, the results are robust. The premium for refuelling decreases from more than 14 Cents per litre to 3.5 Cents per litre in the case of a short geographical connection.

Table 7: Estimation with the control variables – Diesel

	(1)	(2)
	Short distance	Long distance
Highway	3.5873***	14.2619***
	(45.43)	(98.76)
Tuesday	0.1213	0.0613
	(0.18)	(0.10)
Wednesday	0.0808	-0.0164
	(0.12)	(-0.03)
Thursday	-0.0129	-0.0947
	(-0.02)	(-0.15)
Friday	0.1041	0.0334
	(0.16)	(0.05)
Saturday	0.7309	0.6386
	(1.12)	(0.81)
Sunday	0.9168	0.9981
	(1.42)	(1.56)
Holiday	1.6210***	1.7125
	(1.37)	(1.44)
East	-3.6190***	-5.0617***
	(-31.45)	(-100.58)
Density	-0.5017***	-0.1235
	(-3.85)	(-1.53)
Aral	5.8227***	-4.9293***
	(64.76)	(-49.49)
Shell	6.7931***	-1.4522***
	(57.73)	(-12.83)

Esso	6.5326*** (75.01)	-4.3797*** (-39.20)
Total	0.1409 (1.48)	-11.3496*** (-124.42)
Jet	-0.6665*** (-4.94)	Omitted (0)
Basis	116.7599*** (253.52)	116.9139*** (260.06)
N	701,454	733,941

Z-statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

When refuelling E10 vehicles, the results are also robust. The premium for refuelling decreases from more than 13 Cents per litre to 3 Cents per litre.

Table 8: Estimation with the control variables – E10

	(1)	(2)
	Short distance	Long distance
Highway	3.3326*** (34.28)	13.3850*** (93.54)
Tuesday	0.0168 (0.04)	-0.0112 (-0.02)
Wednesday	0.0168 (0.04)	-0.0259 (-0.06)
Thursday	-0.1381 (-0.29)	-0.2172 (-0.47)
Friday	0.0228 (0.05)	-0.0544 (-0.12)
Saturday	0.6337 (1.36)	0.3758 (0.81)
Sunday	0.9125* (2.02)	0.8814 (1.92)
Holiday	2.1851** (3.07)	2.2872** (3.02)
East	-2.4448*** (-23.71)	-4.7748*** (-95.37)
Density	-0.5099*** (-4.74)	-0.3420*** (-3.96)
Aral	7.0817***	-3.6699***

	(72.45)	(-38.87)
Shell	6.0247*** (56.37)	-1.7051*** (-15.55)
Esso	7.2071*** (86.99)	-2.6852*** (-25.46)
Total	-0.1976* (-2.08)	-11.4045*** (-116.60)
Jet	-0.8245*** (-7.14)	Omitted (0)
Basis	134.9742*** (417.45)	135.2408*** (414.96)
N	701,454	733,941

Z-statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4.2 Interaction term

One hypothesis was that the premium might be higher or lower during national holidays, as there are fewer commuters to work on the highway and a higher share of travellers. As travellers are often unaware of the gasoline landscape in a particular region, they may be travelling with children, and there may be a higher willingness to pay to refuel at highway gasoline stations. In contrast, travellers are less likely to use company cards and could therefore be more price-sensitive. To assess the potential effect, I calculated the interaction effect. Nevertheless, the results do not differ from the previous results.

Table 9: Estimation with the control variables and the interaction term holiday**X**highway - E5

	(1)	(2)
	Short distance	Long distance
Highway#Holiday		
0 1	2.3714*** (3.67)	2.6430*** (3.50)
1 0	2.9745*** (31.69)	13.0231*** (92.87)
1 1	5.0151*** (6.12)	14.8676*** (18.23)
Tuesday	0.02478 (0.05)	-0.0100 (-0.02)

Wednesday	0.0250 (0.05)	-0.0216 (-0.05)
Thursday	-0.1289 (-0.27)	-0.2159 (-0.46)
Friday	0.0337 (0.07)	-0.0509 (-0.11)
Saturday	0.6430 (1.34)	0.3704 (0.78)
Sunday	0.9160 (1.97)	0.8772 (1.88)
East	-2.4607 (-23.80)	-4.7980*** (-96.28)
Density	-0.5194*** (-4.80)	-0.3074*** (-3.55)
Aral	7.0221*** (71.36)	-3.6378*** (-38.60)
Shell	5.9904*** (56.49)	-1.6545*** (-15.00)
Esso	7.1530*** (86.23)	-2.6550*** (-25.38)
Total	-0.2363* (-2.51)	-11.3613*** (-116.36)
Jet	-0.8692*** (-7.52)	Omitted (0)
Basis	137.3711*** (412.00)	137.5739*** (413.12)
N	701,454	733,941

Z-statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

5. Conclusion

In conclusion, the paper reveals that, despite the high level of price transparency, highway gasoline stations still have more market power than truck stops in the German retail gasoline market. Highway gasoline stations continue to dominate the market, setting their prices independently of the nearest truck stop. This demonstrates that they are not in a competitive relationship with each other.

However, my results also show that the proximity of a truck stop to a highway gasoline station can significantly reduce the premium at highway gasoline stations. Specifically, when a truck stop is located within 5 kilometres of a highway gasoline station, the premium is significantly reduced from 12 to 14 Cents to 2 to 3 Cents per litre (depending on the gasoline type). This indicates a significant reduction in premiums on the German retail gasoline market, mainly due to increased price transparency, achieved through traditional means such as highway signs and an increase in competition. These findings apply to E5, E10 and diesel. The results serve as an essential indicator in applied economics, demonstrating the real-world effects of price transparency. Traditional and easily accessible means of price transparency have a significantly positive impact on competition, whereas this pro-competitive effect is not observed with modern and sophisticated means.

It would be a further area of investigation to see the effect on market power if the current gasoline and diesel prices of the nearest highway gasoline stations and truck stops were displayed on signs along the highway rather than just indicating the location of a truck stop within 5 kilometres. The Italian model of displaying signs alongside the highway showing real-time data of gasoline prices, including the distance to them and highlighting the gasoline station with the lowest price, would be an interesting field for further research. This would further increase price transparency and reduce uncertainty about price levels for commuters. Based on the results, it has the potential to reduce further, if not eliminate, the premiums of highway gasoline stations. It would also be interesting to identify which customer groups typically fill up at highway gasoline stations and how much they purchase. It would be a relevant question for further research to assess which group of drivers has a higher willingness to pay for gasoline and therefore refuels at a highway gasoline station.

Another regulatory option would be to display the distance to the nearest truck stop on the same sign as the exit to the highway gasoline station. This would remove uncertainty about the distance and allow commuters to assess whether they have enough fuel to reach the next service station, provided they are prepared to make the maximum 1-kilometre detour.

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Appendix A

Proximity of highway and truck stop gasoline stations

Highway Gasoline Station	Make	Highway	Frequency	East	Density	Truck stop	Make	Distance	Driving time
Aachener Land North	Shell	A4	1	0	1	Truck Stop Düren	Aral	26,2	18
Aachener Land South	Shell	A4	1	0	1	Truck Stop Düren	Aral	26,2	18
Aalbek West	Shell	A7	1	0	0	Truck Stop Neumünster	SVG	12,6	12
Aggertal North	Aral	A4	0	0	0	Truck Stop Eifeltor/Cologne	SVG	55,7	35
Aggertal South	Aral	A4	0	0	0	Truck Stop Eifeltor/Cologne	SVG	55,7	35
Aichen North	Shell	A8	1	0	0	Truck Stop Merklingen	Aral	4,7	8
Allertal East	Esso	A7	1	0	0	Truck Stop Schwarmstedt	Aral	3,3	5
Allertal West	Aral	A7	1	0	0	Truck Stop Schwarmstedt	Aral	3,3	5
Allgäuer Tor East	Agip	A7	0	0	0	Truck Stop Bad Grönenbach	Aral	5,6	8
Allgäuer Tor West	Agip	A7	0	0	0	Truck Stop Bad Grönenbach	Aral	5,6	8
Alsbach West	Shell	A5	1	0	0	Truck Stop Bensheim	Aral	8,8	7
Alsbach South	Shell	A5	1	0	0	Truck Stop Bensheim	Aral	8,8	7
Altenburger Land North	Avia	A4	0	1	0	Truck Stop Löbichau	Esso	6,3	10
Altenburger Land South	Total	A4	0	1	0	Truck Stop Löbichau	Esso	6,3	10
Am Biggenkopf North	Avia	A44	1	0	0	Truck Stop Diemelstadt	Shell	2,9	6
Am Biggenkopf South	Total	A44	1	0	0	Truck Stop Diemelstadt	Shell	2,9	6
Am Fichtenplan North	Aral	A10	0	1	0	Truck Stop Spreenhagen	Esso	29,8	22

Am Fichtenplan South	Aral	A10	0	1	0	Truck Stop Spreenhagen	Esso	29,8	22
Am Haarstrang North	Aral	A44	1	0	0	Truck Stop Geseke	Aral	46,7	27
Am Haarstrang South	Shell	A44	1	0	0	Truck Stop Geseke	Aral	46,7	27
Am Hockenheimring East	Aral	A6	1	0	1	Truck Stop Sinsheim	Avia	38,3	27
Am Hockenheimring West	Shell	A6	1	0	1	Truck Stop Sinsheim	Avia	38,3	27
Auerswalder Blick North	Shell	A4	1	1	0	Truck Stop Hainichen	Esso	18,2	15
Auerswalder Blick South	Aral	A4	1	1	0	Truck Stop Hainichen	Esso	18,2	15
Auetal North	Esso	A2	1	0	0	Truck Stop Lauenau	Esso	12,4	12
Auetal South	Aral	A2	1	0	0	Truck Stop Lauenau	Esso	12,4	12
Augsburg East	Esso	A8	1	0	1	Truck Stop Gersthofen	Aral	6,8	8
Aurach North	Aral	A3	1	0	0	Truck Stop Erlangen	Total	9,8	10
Aurach South	Shell	A3	1	0	0	Truck Stop Erlangen	Total	9,8	10
Avus	Aral	A115	1	1	1	Truck Stop Berlin-Vogelberg	Aral	21,1	30
Bad Bellingen West	Aral	A5	0	0	0	Truck Stop Binzen	Shell	18,1	7
Bad Camberg East	Aral	A3	1	0	0	Truck Stop Beselich	Aral	15,9	10
Bad Camberg West	Shell	A3	1	0	0	Truck Stop Beselich	Aral	15,9	10
Bad Reichenhall South	Aral	A8	0	0	0	Truck Stop Raubling	Total	72,1	40
Baden-Baden West	Esso	A5	0	0	0	Truck Stop Achern	Shell	23	17
Bayrischer Wald North	Esso	A3	1	0	0	Truck Stop Regensburg	Aral	43,2	24
Bayrischer Wald South	Agip	A3	1	0	0	Truck Stop Regensburg	Aral	43,2	24
Berfa North	Esso	A5	1	0	0	Truck Stop Mücke	Esso	33,1	20
Bergstraße East	Aral	A5	1	0	0	Truck Stop Bensheim	Aral	2,4	6
Biegener Hellen North	Shell	A12	0	1	0	Truck Stop Spreenhagen	Esso	35,2	23
Biegener Hellen South	Shell	A12	0	1	0	Truck Stop Spreenhagen	Esso	35,2	23
Börde North	Total	A2	1	1	0	Euro-Rastpart Irxleben/Hohenwarsleben	Shell	3,8	6
Börde South	Total	A2	1	1	0	Euro-Rastpart Irxleben/Hohenwarsleben	Shell	3,8	6
Bottrop South	Shell	A2	1	0	1	Truck Stop Gladbeck	Shell	13,1	13

Breisgau East	Shell	A5	1	0	0	Truck Stop Bremgarten Hartheim	Aral	13,2	11
Brockbachtal North	Westfalen	A30	0	0	0	Truck Stop Ibbenbüren	Total	17	11
Brockbachtal South	Westfalen	A30	0	0	0	Truck Stop Ibbenbüren	Total	17	11
Brokenlande East	Tamoil	A7	0	0	0	Truck Stop Altenwerder	Shell	60,4	39
Bruchsal East	Shell	A5	1	0	0	Truck Stop Wiesloch	Total	20,9	16
Bruchsal West	Shell	A5	1	0	0	Truck Stop Wiesloch	Total	20,9	16
Brunautal East/Lüneburger Heide East	Aral	A7	1	0	0	Truck Stop Soltau	Shell	15	15
Brunautal West	Shell	A7	1	0	0	Truck Stop Soltau	Shell	15	15
Buckowsee East	Total	A11	0	1	0	Truck Stop Vogelsdorf	Aral	52,8	29
Buckowsee West	Total	A11	0	1	0	Truck Stop Vogelsdorf	Aral	52,8	29
Buddikate East	Esso	A1	1	0	0	Tankpark Moorfleet	Aral	27,5	20
Buddikate West	Aral	A1	1	0	0	Tankpark Moorfleet	Aral	27,5	20
Bühl East	Shell	A5	1	0	0	Truck Stop Achern	Shell	15,7	13
Bühlbeck South	Aral	A44	1	0	0	Truck Stop Elsinger Höhe	Shell	5	7
Bühleck North	Aral	A44	1	0	0	Truck Stop Elsinger Höhe	Shell	5	7
Burgauer See North	Aral	A8	1	0	0	Euro-Rastpark Jettingen-Scheppach	Shell	1,8	7
Cloerbruch North	Shell	A52	1	0	1	Truck Stop Mönchengladbach	Shell	22,6	16
Cloerbruch South	Eni	A52	1	0	1	Truck Stop Mönchengladbach	Shell	22,6	16
Dammer Berge East	Shell	A1	1	0	0	Truck Stop Lohne	Shell	14,6	11
Dammer Berge West	Avia	A1	1	0	0	Truck Stop Lohne	Shell	14,6	11
Demminer Land	Esso	A20	0	1	0	Truck Stop Pommerndreieck	Star	37,9	23
Denkendorf North	Shell	A8	1	0	1	Truck Stop Kirchheim unter Teck	Agip	12,1	11
Dollenberg East	Esso	A45	1	0	0	Truck Stop Haiger	Roth	16,1	12
Donautal East	Aral	A3	0	0	0	Eurorastpark Hengersberg	Esso	44,2	32
Donautal West	OMV	A3	0	0	0	Eurorastpark Hengersberg	Esso	44,2	32

Dresdner Tor North	Aral	A4	1	1	1	Truck Stop Dresden-Neustadt	Shell	11,4	14
Dresdner Tor South	Aral	A4	1	1	1	Truck Stop Dresden-Neustadt	Shell	11,4	14
Edenbergen South	Aral	A8	1	0	0	Truck Stop Dasing	Aral	20,1	13
Eichelborn North	Total	A4	1	1	0	Truck Stop Erfurter Kreuz	Esso	21,4	15
Eichelborn South	Total	A4	1	1	0	Truck Stop Erfurter Kreuz	Esso	21,4	15
Eifel East	Total	A1	0	0	0	Truck Stop Trier	Total	46,2	33
Eifel West	Shell	A1	0	0	0	Truck Stop Trier	Total	46,2	33
Ellwanger Berge East	Esso	A7	0	0	0	Truck Stop Ellwangen	Esso	4,1	7
Ellwanger Berge West	Total	A7	0	0	0	Truck Stop Ellwangen	Esso	4,1	7
Fernthal West	Aral	A3	1	0	0	Truck Stop Bad Honnef	Aral	11,2	10
Fläming East	Shell	A9	1	1	0	Truck Stop Linthe	Esso	3,5	4
Fläming West	Shell	A9	1	1	0	Truck Stop Linthe	Esso	3,5	4
Frankenhöhe North	Agip	A6	1	0	0	Truck Stop Aurach	Shell	7,5	7
Frankenhöhe South	Total	A6	1	0	0	Truck Stop Aurach	Shell	7,5	7
Frankenwald West	Aral	A9	1	0	0	Truck Stop Berg	Shell	7	8
Frechen North	Aral	A4	1	0	1	Truck Stop Eifeltor/Cologne	SVG	12,5	10
Frechen South	Total	A4	1	0	1	Truck Stop Eifeltor/Cologne	SVG	12,5	10
Freienhufener-Eck East	Total	A13	0	1	0	Truck Stop Schönfeld	Aral	35,5	20
Freienhufener-Eck West	Total	A13	0	1	0	Truck Stop Schönfeld	Aral	35,5	20
Fürholzen East	Agip	A9	1	0	0	Euro-Rastpark Schweitenkirchen	Shell	21,2	15
Garbsen North	Shell	A2	1	0	1	Truck Stop Langenhagen	M1	15	11
Garbsen South	Shell	A2	1	0	1	Truck Stop Langenhagen	M1	15	11
Geismühle East	Aral	A57	1	0	1	Truck Stop Duisburg	Total	33,6	30
Geismühle West	Shell	A57	1	0	1	Truck Stop Duisburg	Total	33,6	30
Goldbach North	Aral	A27	1	0	0	Truck Stop Bremen	Aral	34,1	25
Goldbach South	Shell	A27	1	0	0	Truck Stop Bremen	Aral	34,1	25
Goldene Bremm North	Total	A6	0	0	0	Truck Stop Waldmohr	Aral	38,3	26
Goldene Bremm South	Esso	A6	0	0	0	Truck Stop Waldmohr	Aral	38,3	26

Göttingen East	Shell	A7	1	0	1	Truck Stop Northeim	Aral	30,8	20
Göttingen West	Esso	A7	1	0	1	Truck Stop Northeim	Aral	30,8	20
Gräfenhausen East	Shell	A5	1	0	1	Truck Stop Bensheim	Aral	32,8	20
Gräfenhausen West	Total	A5	1	0	1	Truck Stop Bensheim	Aral	32,8	20
Greding East	Shell	A9	1	0	0	Truck Stop Hipoltstein	Total	16,5	12
Greding West	Shell	A9	1	0	0	Truck Stop Hipoltstein	Total	16,5	12
Grönegau North	Aral	A30	0	0	0	Truck Stop Bünde	Shell	18,6	15
Grönegau South	Aral	A30	0	0	0	Truck Stop Bünde	Shell	18,6	15
Großenmoor East	Aral	A7	0	0	0	SVG Truck Stop Hessenland Kirchheim	SVG	20,3	15
Großenmoor West	Aral	A7	0	0	0	SVG Truck Stop Hessenland Kirchheim	SVG	20,3	15
Gruibingen South	Shell	A8	1	0	1	Truck Stop Merklingen	Aral	20,3	15
Grundbergsee North	Total	A1	1	0	0	Truck Stop Bockel	Aral	14,4	13
Grundbergsee South	Aral	A1	1	0	0	Truck Stop Bockel	Aral	14,4	13
Grunewald West	Aral	A115	1	1	1	Truck Stop Oberkrämer	Total	43,4	36
Gudow North	Shell	A24	0	0	0	Truck Stop Altenwerder	Shell	75,7	52
Gütersloh North	Aral	A2	1	0	0	Truck Stop Rheda-Wiedenbrück	Aral	15,8	13
Gütersloh South	Aral	A2	1	0	0	Truck Stop Rheda-Wiedenbrück	Aral	15,8	13
Haidt North	Total	A3	1	0	0	Truck Stop Dettelbach	Aral	16	14
Haidt South	Agip	A3	1	0	0	Truck Stop Dettelbach	Aral	16	14
Hamburg-Stillhorn East	Aral	A1	1	0	1	Truck Stop Moorfleet	Aral	9,3	12
Hamburg-Stillhorn West	Esso	A1	1	0	1	Truck Stop Moorfleet	Aral	9,3	12
Hanover Wülferode East	Total	A7	1	0	1	Truck Stop Mellendorf	Shell	28	20
Hanover Wülferode West	Agip	A7	1	0	1	Truck Stop Mellendorf	Shell	28	20
Harburger Berge East	Total	A7	1	0	1	Truck Stop Altenwerder	Shell	15	15
Harburger Berge West	Shell	A7	1	0	1	Truck Stop Altenwerder	Shell	15	15
Hardtwald East	Esso	A5	1	0	1	Truck Stop Hirschberg	Total	18,9	14
Hardtwald West	Aral	A5	1	0	1	Truck Stop Hirschberg	Total	18,9	14

Harz East	Aral	A7	1	0	0	Maxi Truck Stop Rhüden	Hem	2,9	5
Harz West	Aral	A7	1	0	0	Maxi Truck Stop Rhüden	Hem	2,9	5
Hasselberg East	Shell	A7	1	0	0	Maxi Truck Stop Malsfeld	Esso	7,2	8
Hasselberg West	Aral	A7	1	0	0	Maxi Truck Stop Malsfeld	Esso	7,2	8
Heiligenroth West	Aral	A3	1	0	0	Maxi Truck Stop Mogendorf	Total	30,4	21
Helmstedt South	Agip	A2	1	0	0	Truck Stop Uhrsleben	Aral	18,2	12
Hermsdorfer Kreuz East	JET	A9	1	1	0	Truck Stop Hermsdorf	Aral	4,7	7
Hermsdorfer Kreuz West	JET	A9	1	1	0	Truck Stop Hermsdorf	Aral	4,7	7
Hildesheimer Börde East	Shell	A7	1	0	1	Truck Stop Bockenem	Aral	23,8	17
Hildesheimer Börde West	Shell	A7	1	0	1	Truck Stop Bockenem	Aral	23,8	17
Hirschberg East	Agip	A9	0	1	0	Truck Stop Triptis	Aral	41,7	24
Hochfelln South	Agip	A8	1	0	0	Truck Stop Raubling	Total	48,4	29
Hochwald East	Aral	A1	0	0	0	Truck Stop Trier	Total	30,2	23
Hochwald West	Aral	A1	0	0	0	Truck Stop Trier	Total	30,2	23
Hohe Mark East	Total	A43	1	0	1	Truck Stop Senden	Total	30,1	19
Hohe Mark West	Total	A43	1	0	1	Truck Stop Senden	Total	30,1	19
Hohenlohe North	Esso	A6	1	0	0	Truck Stop Bad Rappenau	Aral	46,6	32
Hohenlohe South	Shell	A6	1	0	0	Truck Stop Bad Rappenau	Total	46,6	32
Höhenrain East	Shell	A95	0	0	0	Truck Stop Bergkirchen	OMV	58,5	42
Höhenrain West	Agip	A95	0	0	0	Truck Stop Bergkirchen	OMV	58,5	42
Holmmoor East	Esso	A7	1	0	1	Truck Stop Neumünster	Other	46,4	32
Holmmoor West	Total	A7	1	0	1	Truck Stop Neumünster	Other	46,4	32
Holzkirchen North	Shell	A8	1	0	0	Truck Stop Dasing	Aral	67,3	41
Holzkirchen South	Aral	A8	1	0	0	Truck Stop Dasing	Aral	67,3	41
Homburg/Saar South	Esso	A6	0	0	0	Truck Stop Ramstein	Shell	21	16
Hörselgau North	Shell	A4	1	1	0	Truck Stop Schwabhausen	Shell	11,7	11
Hösel East	Shell	A3	1	0	1	Truckstop Duisburg	Total	23,9	17
Hunsrück East	Shell	A61	1	0	0	Truck Stop Waldlaubersheim	Total	7,2	10
Hünxe East	Shell	A3	1	0	0	Truck Stop Isselburg	Aral	31	21

Hünxe West	Aral	A3	1	0	0	Truck Stop Isselburg	Aral	31	21
Hüttener Berge East	Shell	A7	0	0	0	Truck Stop Busdorf	Shell	17,1	12
Hüttener Berge West	Aral	A7	0	0	0	Truck Stop Busdorf	Shell	17,1	12
Illertal East	Shell	A7	0	0	0	Truck Stop Bad Grönenbach	Aral	31,1	18
Illertal West	Avia	A7	0	0	0	Truck Stop Bad Grönenbach	Aral	31,1	18
In der Holledau West	Aral	A9	1	0	0	Truck Stop Schweitenkirchen	Shell	7,2	7
Irschenberg South	Shell	A8	1	0	0	Truck Stop Bergkirchen	OMV	85,6	44
Jagsttal East	Eni	A81	0	0	0	Truck Stop Empfingen	Shell	35	24
Jagsttal West	Esso	A81	0	0	0	Truck Stop Empfingen	Shell	35	24
Jura East	Shell	A3	0	0	0	Truck Stop Berg/Neumarkt	Shell	13,9	14
Jura West	Total	A3	0	0	0	Truck Stop Berg/Neumarkt	Shell	13,9	14
Kammersteiner Land North	Shell	A6	1	0	0	Truck Stop Schwabach	Aral	3,4	7
Kammersteiner Land South	Aral	A6	1	0	0	Truck Stop Schwabach	Aral	3,4	7
Kassel East	Aral	A7	1	0	1	Truck Stop Lohfelden	Shell	3,7	7
Köckern East	Total	A9	1	1	0	Truck Stop Könnern	Aral	55,4	34
Köckern West	Total	A9	1	1	0	Truck Stop Könnern	Aral	55,4	34
Köschinger Forst East	Aral	A9	1	0	0	Truck Stop Rockolding	Shell	25,6	18
Köschinger Forst West	OMV	A9	1	0	0	Truck Stop Rockolding	Shell	25,6	18
Kraichgau North	Shell	A6	1	0	0	Truck Stop Sinsheim	Avia	1,5	4
Kraichgau South	Esso	A6	1	0	0	Truck Stop Sinsheim	Avia	1,5	4
Langen-Bergheim- West	Esso	A45	0	0	0	Truck Stop Neuberg/Erlensee	Total	8,6	9
Langen-Bergheim-East	Agip	A45	0	0	0	Truck Stop Neuberg/Erlensee	Total	8,6	9
Lappwald North	Aral	A2	1	0	0	Truck Stop Hohenwardsleben	Shell	32,9	20
Lehrter See North	Aral	A2	1	0	1	Truck Stop Lehrte	Total	3,5	6
Leipheim South	Esso	A8	1	0	0	Truck Stop Günzburg	Total	7,6	7
Lichtendorf North	Westfalen	A1	1	0	1	Truck Stop Werne	Total	33,2	22

Lichtendorf South	Aral	A1	1	0	1	Truck Stop Werne	Total	33,2	22
Limes West	Shell	A5	0	0	0	Truck Stop Mücke	Esso	24,3	15
Linumer Bruch North	Aral	A24	1	1	0	Truck Stop Oberkrämer	Total	18,8	13
Linumer Bruch South	Aral	A24	1	1	0	Truck Stop Oberkrämer	Total	18,8	13
Lipperland North	Westfalen	A2	1	0	0	Truck Stop Rheda-Wiedenbrück	Aral	38,8	23
Lipperland South	Aral	A2	1	0	0	Truck Stop Rheda-Wiedenbrück	Aral	38,8	23
Lonetal East	Agip	A7	0	0	0	Truck Stop Seligweiler	Esso	25,6	16
Lonetal West	Aral	A7	0	0	0	Truck Stop Seligweiler	Esso	25,6	16
Mahlberg East	Total	A5	1	0	0	Truck Stop Mahlberg	Total	6,3	12
Mahlberg West	Aral	A5	1	0	0	Truck Stop Mahlberg	Total	6,3	12
Marienborn South	Esso	A2	1	1	0	Truck Stop Uhrsleben	Aral	13,8	10
Medenbach East	Shell	A3	1	0	1	Truck Stop Rüsselsheim	bft	22,1	16
Medenbach West	Esso	A3	1	0	1	Truck Stop Rüsselsheim	bft	22,1	16
Michendorf North	Total	A10	0	1	1	Truck Stop Linthe	Esso	30,1	19
Michendorf South	Total	A10	0	1	1	Truck Stop Linthe	Esso	30,1	19
Montabaur East	Esso	A3	1	0	0	Truck Stop Mogendorf	Total	10,6	10
Mosel East	Aral	A61	0	0	0	Truck Stop Koblenz-Metternich	Shell	5	6
Muldental North	Shell	A14	1	1	0	Truck Stop Grimma	Aral	2,3	4
Muldental South	Shell	A14	1	1	0	Truck Stop Grimma	Aral	2,3	4
Münsterland East	Westfalen	A1	1	0	0	Truck Stop Osnabrück	Shell	51,4	28
Münsterland West	Esso	A1	1	0	0	Truck Stop Osnabrück	Shell	51,4	28
Neckarburg East	Total	A81	0	0	0	Truck Stop Geisingen	Shell	39,3	23
Neustädter Bucht East	Shell	A1	0	0	0	Truck Stop Moorfleet	Aral	83,4	48
Neustädter Bucht West	AVIA	A1	0	0	0	Truck Stop Moorfleet	Aral	83,4	48
Nievenheim West	Total	A57	1	0	1	Truck Stop Eifeltor/Cologne	SVG	33,4	22
Nurremberg-Feucht East	Esso	A9	1	0	1	Truck Stop Hipoltstein	Total	23,2	14
Nurremberg-Feucht West	OMV	A9	1	0	1	Truck Stop Hipoltstein	Total	23,2	14

Ob der Tauber East	Shell	A81	1	0	0	Truck Stop Wertheim	Esso	34,9	19
Ob der Tauber West	Shell	A81	1	0	0	Truck Stop Wertheim	Esso	34,9	19
Oberlausitz North	Aral	A4	0	1	0	Truck Stop Dresden-Neustadt	Shell	59,2	34
Oberlausitz South	Shell	A4	0	1	0	Truck Stop Dresden-Neustadt	Shell	59,2	34
Oberpfälzer Alb North	Agip	A6	0	0	0	Truck Stop Alfeld	Total	13	13
Oberpfälzer Alb South	OMV	A6	0	0	0	Truck Stop Alfeld	Total	13	13
Ohligser Heide East	Aral	A3	1	0	1	Truck Stop Eifeltor/Cologne	SVG	40,3	27
Ohligser Heide West	Aral	A3	1	0	1	Truck Stop Eifeltor/Cologne	SVG	40,3	27
Ohrenbach East	Total	A7	0	0	0	Truck Stop Wörnitz	Shell	29,8	21
Ohrenbach West	Total	A7	0	0	0	Truck Stop Wörnitz	Shell	29,8	21
Osterfeld East	Shell	A9	1	1	0	Truck Stop Triptis	Aral	47,4	26
Osterfeld West	Shell	A9	1	1	0	Truck Stop Triptis	Aral	47,4	26
Pentling East	Avia	A93	1	0	0	Truck Stop Regensburg	Aral	14,2	13
Pfalz/Wattenheim	Agip	A6	0	0	0	Truck Stop Rammstein		41,5	25
Pforzheim North	Avia	A8	1	0	0	Truck Stop Stuttgart	Aral	51,6	39
Pfungstadt East	Shell	A67	1	0	1	Truck Stop Bensheim	Aral	20,6	15
Pfungstadt West	Aral	A67	1	0	1	Truck Stop Bensheim	Aral	20,6	15
Plötzetal East	Esso	A14	0	1	0	Truck Stop Könnern	Aral	6,1	11
Plötzetal West	Agip	A14	0	1	0	Truck Stop Könnern	Aral	6,1	11
Recknitz-Niederung East	Aral	A19	0	1	0	Truck Stop Rostock	Esso	43,4	28
Recknitz-Niederung West	Aral	A19	0	1	0	Truck Stop Rostock	Esso	43,4	28
Reinhardshain North	Aral	A5	1	0	0	Truck Stop Mücke	Esso	7,8	7
Reinhardshain South	Esso	A5	1	0	0	Truck Stop Mücke	Esso	7,8	7
Remscheid East	Westfalen	A1	1	0	1	Truck Stop Eifeltor/Cologne	SVG	54,5	54
Remscheid West	Shell	A1	1	0	1	Truck Stop Eifeltor/Cologne	SVG	54,5	54
Renchtal East	Aral	A5	1	0	0	Truck Stop Achern	Shell	19,9	13
Renchtal West	Aral	A5	1	0	0	Truck Stop Achern	Shell	19,9	13
Resser Mark North	Westfalen	A2	1	0	1	Truck Stop Gladbeck	Shell	8,1	13

Rhön East	Avia	A7	0	0	0	Truck Stop Eichenzell	Total	33,6	22
Rhön West	Esso	A7	0	0	0	Truck Stop Eichenzell	Total	33,6	22
Rhynern South	Esso	A2	1	0	1	Truck Stop Lippetal	Total	11,4	11
Rhynern North	Aral	A2	1	0	1	Truck Stop Lippetal	Total	11,4	11
Riedener Wald East	Agip	A7	1	0	0	Truck Stop Gramschatzer Wald	Shell	5,3	8
Riedener Wald West	Shell	A7	1	0	0	Truck Stop Gramschatzer Wald	Shell	5,3	8
Rohnetal North	Aral	A38	0	1	0	Truck Stop Sangershausen	Total	9,3	10
Rohnetal South	Esso	A38	0	1	0	Truck Stop Sangershausen	Total	9,3	10
Samerberg North	Aral	A8	1	0	0	Truck Stop Raubling	Total	14	12
Samerberg South	Total	A8	1	0	0	Truck Stop Raubling	Total	14	12
Schaalsee South	Esso	A24	0	1	0	Truck Stop Wittenburg	Aral	17,1	13
Schauinsland West	Esso	A5	1	0	0	s-mailing Freiburg	Extrol	7	8
Siegburg East	Shell	A3	1	0	1	Truck Stop Bad Honnef	Aral	22,2	18
Siegburg West	Shell	A3	1	0	1	Truck Stop Bad Honnef	Aral	22,2	18
Siegerland East	Aral	A45	1	0	0	Truck Stop Wilnsdorf	Total	14,3	14
Siegerland West	Aral	A45	1	0	0	Truck Stop Wilnsdorf	Total	14,3	14
Sindelfinger Wald South	Aral	A8	1	0	1	Truck Stop Stuttgart	Aral	28,1	43
Soester Börde North	Shell	A44	1	0	0	Truck Stop Geseke	Aral	29,2	22
Soester Börde South	Tamoil	A44	1	0	0	Truck Stop Geseke	Aral	29,2	22
Spessart North	Shell	A3	1	0	0	Truck Stop Wertheim	Esso	23,3	16
Spessart South	Aral	A3	1	0	0	Truck Stop Wertheim	Esso	23,3	16
Steigerwald North	Shell	A3	1	0	0	Truck Stop Burghaslach	Esso	8,4	11
Steigerwald South	Esso	A3	1	0	0	Truck Stop Burghaslach	Esso	8,4	11
Sternenberg North	Aral	A46	1	0	1	Truck Stop Castrop-Rauxel	Independent	45,9	36
Sternenberg South	Avia	A46	1	0	1	Truck Stop Castrop-Rauxel	Independent	45,9	36
Stolpe North	Total	A24	0	1	0	Truck Stop Mecklenburg	Hoyer	8,8	9
Stolpe South	Total	A24	0	1	0	Truck Stop Mecklenburg	Hoyer	8,8	9
Stolper Heide East	Eni	A111	1	1	1	Truck Stop Stolper Heide	Total	5,1	9

Tecklenburger Land East	Esso	A1	1	0	0	Truck Stop Osnabrück	Shell	10,2	12
Tecklenburger Land West	Aral	A1	1	0	0	Truck Stop Osnabrück	Shell	10,2	12
Urbacher Wald East	Shell	A3	1	0	0	Truck Stop Mogendorf	Total	15,9	14
Uttrichshausen East	Shell	A7	0	0	0	Truck Stop Hessenland	Shell	55,9	34
Uttrichshausen West	Aral	A7	0	0	0	Truck Stop Hessenland	Shell	55,9	34
Vierwinden South	Shell	A46	1	0	1	Truck Stop Mönchengladbach	Shell	20,8	18
Ville East	Aral	A1	1	0	1	Truck Stop Eifeltor/Cologne	SVG	19,5	15
Ville West	Shell	A1	1	0	1	Truck Stop Eifeltor/Cologne	SVG	19,5	15
Walsleben East	Eni	A24	0	1	0	Truck Stop Herzsprung	Shell	17,6	14
Walsleben West	Eni	A24	0	1	0	Truck Stop Herzsprung	Shell	17,6	14
Weil am Rhein	Aral	A5	0	0	0	Truck Stop Binzen	Shell	4,8	5
Weiskirchen North	Shell	A3	1	0	1	Truck Stop Kleinostheim	Independent	16,6	14
Weiskirchen South	Shell	A3	1	0	1	Truck Stop Kleinostheim	Independent	16,6	14
Wetterau East	Aral	A5	1	0	1	Truck Stop Gießen	Shell	26,3	19
Wetterau West	Aral	A5	1	0	1	Truck Stop Gießen	Shell	26,3	19
Wildeshausen North	Aral	A1	1	0	0	Truck Stop Cloppenburger Land	Total	21,8	17
Wildeshausen South	Aral	A1	1	0	0	Truck Stop Cloppenburger Land	Total	21,8	17
Wolfslake East	Esso	A10	1	1	1	Truck Stop Herzsprung	Shell	58,4	43
Wolfslake West	Esso	A10	1	1	1	Truck Stop Herzsprung	Shell	58,4	43
Wonnegau East	Esso	A61	1	0	0	Truck Stop Schwegenheim	Shell	50,7	32
Wonnegau West	Shell	A61	1	0	0	Truck Stop Schwegenheim	Shell	50,7	32
Würzburg North	Aral	A3	1	0	0	Truck Stop Gramschatzer Wald	Shell	30,4	24
Würzburg South	Aral	A3	1	0	0	Truck Stop Gramschatzer Wald	Shell	30,4	24
Zweidorfer Holz North	Shell	A2	1	0	0	Truck Stop Braunschweig	Total	7,2	12
Zweidorfer Holz South	Shell	A2	1	0	0	Truck Stop Braunschweig	Total	7,2	12

Appendix B – Close relationship between highway gasoline stations and truck stops

Highway Gasoline Station	Make	Highway	Frequency	East	Density	Truck stop	Make	Distance
Kraichgau Nord	Shell	A6	1	0	0	Autohof Sinsheim	Avia	1,5
Kraichgau Süd	Esso	A6	1	0	0	Autohof Sinsheim	Avia	1,5
Burgauer See Nord	Aral	A8	1	0	0	Euro-Rastpark Jettingen-Scheppach	Shell	1,8
Muldental Nord	Shell	A14	1	1	0	Autohof Grimma	Aral	2,3
Muldental Süd	Shell	A14	1	1	0	Autohof Grimma	Aral	2,3
Bergstraße Ost	Aral	A5	1	0	0	Autohof Bensheim	Aral	2,4
Am Biggenkopf Nord	Avia	A44	1	0	0	Autohofe Diemelstadt	Shell	2,9
Am Biggenkopf Süd	Total	A44	1	0	0	Autohofe Diemelstadt	Shell	2,9
Harz Ost	Aral	A7	1	0	0	Maxi Autohof Rhüden	Hem	2,9
Harz West	Aral	A7	1	0	0	Maxi Autohof Rhüden	Hem	2,9
Allertal Ost	Esso	A7	1	0	0	Autohof Schwarmstedt	Aral	3,3
Allertal West	Aral	A7	1	0	0	Autohof Schwarmstedt	Aral	3,3
Kammersteiner Land Nord	Shell	A6	1	0	0	Autohof Schwabach	Aral	3,4
Kammersteiner Land Süd	Aral	A6	1	0	0	Autohof Schwabach	Aral	3,4
Fläming Ost	Shell	A9	1	1	0	Autohof Linthe	Esso	3,5
Fläming West	Shell	A9	1	1	0	Autohof Linthe	Esso	3,5
Lehrter See Nord	Aral	A2	1	0	1	Autohof Lehrte	Total	3,5
Kassel Ost	Aral	A7	1	0	1	Autohof Lohfelden	Shell	3,7

Börde Nord	Total	A2	1	1	0	Euro-Rastpart Irxleben/Hohenwarsleben	Shell	3,8
Börde Süd	Total	A2	1	1	0	Euro-Rastpart Irxleben/Hohenwarsleben	Shell	3,8
Ellwanger Berge Ost	Esso	A7	0	0	0	Autohof Ellwangen	Esso	4,1
Ellwanger Berge West	Total	A7	0	0	0	Autohof Ellwangen	Esso	4,1
Aichen Nord	Shell	A8	1	0	0	Autohof Merklingen	Aral	4,7
Hermsdorfer Kreuz Ost	JET	A9	1	1	0	Autohof Hermsdorf	Aral	4,7
Hermsdorfer Kreuz West	JET	A9	1	1	0	Autohof Hermsdorf	Aral	4,7
Weil am Rhein	Aral	A5	0	0	0	Autohof Binzen	Shell	4,8
Bühlbeck Süd	Aral	A44	1	0	0	Autohof Elsinger Höhe	Shell	5
Bühleck Nord	Aral	A44	1	0	0	Autohof Elsinger Höhe	Shell	5
Mosel Ost	Aral	A61	0	0	0	Autohof Koblenz-Metternich	Shell	5

Appendix C – longer distance between highway gasoline station and truck stop

Highway Gasoline Station	Make	Highway	Frequency	East	Density	Truck stop	Make	Distance
Tecklenburger Land West	Aral	A1	1	0	0	Autohof Osnabrück	Shell	10,2
Montabaur Ost	Esso	A3	1	0	0	Autohof Mogendorf	Total	10,6
Fernthal West	Aral	A3	1	0	0	Autohof Bad Honnef	Aral	11,2
Dresdner Tor Nord	Aral	A4	1	1	1	Autohof Dresden-Neustadt	Shell	11,4
Hörselgau Nord	Shell	A4	1	1	0	Autohof Schwabhausen	Shell	11,7
Denkendorf Nord	Shell	A8	1	0	1	Autohof Kirchheim unter Teck	Agip	12,1
Auetal Nord	Esso	A2	1	0	0	Autohof Lauenau	Esso	12,4
Auetal Süd	Aral	A2	1	0	0	Autohof Lauenau	Esso	12,4
Aalbek West	Shell	A7	1	0	0	Autohof Neumünster	SVG	12,6
Oberpfälzer Alb Nord	Agip	A6	0	0	0	Autohof Alfeld	Total	13
Breisgau Ost	Shell	A5	1	0	0	Autohof Bremgarten Hartheim	Aral	13,2
Marienborn Süd	Esso	A2	1	1	0	Autohof Uhrsleben	Aral	13,8
Jura Ost	Shell	A3	0	0	0	Autohof Berg/Neumarkt	Shell	13,9
Jura West	Total	A3	0	0	0	Autohof Berg/Neumarkt	Shell	13,9
Samerberg Nord	Aral	A8	1	0	0	Autohof Raubling	Total	14
Samerberg Süd	Total	A8	1	0	0	Autohof Raubling	Total	14
Grundbergsee Nord	Total	A1	1	0	0	Autohof Bockel	Aral	14,4
Grundbergsee Süd	Aral	A1	1	0	0	Autohof Bockel	Aral	14,4
Brunautal Ost/Lüneburger Heide Ost	Aral	A7	1	0	0	Autohof Soltau	Shell	15
Gütersloh Süd	Aral	A2	1	0	0	Autohof Rheda-Wiedenbrück	Aral	15,8
Bad Camberg Ost	Aral	A3	1	0	0	Autohof Beselich	Aral	15,9
Haidt Nord	Total	A3	1	0	0	Autohof Dettelbach	Aral	16

Greding West	Shell	A9	1	0	0	Autohof Hipoltstein	Total	16,5
Walsleben Ost	Eni	A24	0	1	0	Autohof Herzsprung	Shell	17,6
Auerswalder Blick Nord	Shell	A4	1	1	0	Autohof Hainichen	Esso	18,2
Auerswalder Blick Süd	Aral	A4	1	1	0	Autohof Hainichen	Esso	18,2
Helmstedt Süd	Agip	A2	1	0	0	Autohof Uhrsleben	Aral	18,2
Linumer Bruch Nord	Aral	A24	1	1	0	Autohof Oberkrämer	Total	18,8
Linumer Bruch Süd	Aral	A24	1	1	0	Autohof Oberkrämer	Total	18,8

Appendix D – Covariance between the control variables

	Diesel	Highway	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Holiday	Distance	Frequency	East	Density	Aral	Shell	Esso	Total	Jet
Diesel	1.0000																	
Highway	0.4994* (0.0000)	1.0000																
Tuesday	-0.0092* (0.0000)	0.0008 (0.2219)	1.000															
Wednesday	-0.0154* (0.0000)	-0.0007 (0.3292)	-0.1711* (0.0000)	1.000														
Thursday	-0.0145* (0.0000)	0.0014 (0.0330)	-0.1719* (0.3292)	-0.1722 (0.0000)	1.000													
Friday	-0.0123* (0.0000)	-0.0006 (0.3864)	-0.1707* (0.0000)	-0.1709* (0.0000)	-0.1718* (0.0000)	1.000												
Saturday	0.0166* (0.0000)	-0.0053* (0.0000)	-0.1640* (0.0000)	-0.1642* (0.0000)	-0.1650* (0.0000)	-0.1638* (0.0000)	1.000											
Sunday	0.0425* (0.0000)	0.0005 (0.4982)	-0.1611* (0.0000)	-0.1613* (0.0000)	-0.1621* (0.0000)	-0.1610* (0.0000)	-0.1546* (0.0000)	1.000										
Holiday	0.0355* (0.0000)	0.0014 (0.0362)	-0.0076* (0.0000)	-0.0665* (0.0000)	0.0304* (0.0000)	-0.0406* (0.0000)	-0.0637* (0.0000)	0.0033* (0.0000)	1.000									
Distance	0.3158* (0.0000)	0.6680* (0.0000)	0.0003 (0.6978)	-0.0001 (0.8738)	0.0013 (0.0574)	0.0000 (0.9992)	-0.0033* (0.0000)	-0.0007 (0.3288)	0.0010 (0.1361)	1.000								
Frequency	0.3956* (0.0000)	0.7164* (0.0000)	0.0003 (0.6689)	-0.0011 (0.1010)	-0.0003 (0.6266)	-0.0009 (0.1797)	-0.0026* (0.0001)	0.0032* (0.0000)	0.0019* (0.0052)	0.3623* (0.0000)	1.000							
East	-0.0338* (0.0000)	0.3590* (0.0000)	-0.0008 (0.2207)	-0.0002 (0.7302)	0.0006 (0.4115)	-0.0003 (0.6317)	-0.0014 (0.0431)	-0.0003 (0.6886)	0.0001 (0.8796)	0.2262* (0.0000)	0.1795* (0.0000)	1.000						
Density	0.1800* (0.0000)	0.3755* (0.0000)	0.0001 (0.8786)	-0.0008 (0.2433)	-0.0008 (0.2430)	-0.0003 (0.6761)	-0.0014 (0.0431)	0.0017 (0.0125)	0.0005 (0.4282)	0.2687* (0.0000)	0.4869* (0.0000)	0.0384* (0.0000)	1.000					
Aral	0.1688* (0.0000)	0.3094* (0.000)	0.0038* (0.0000)	0.0045* (0.0000)	0.0053* (0.0000)	0.0028* (0.0000)	-0.0138* (0.0000)	-0.0093* (0.0000)	-0.0047* (0.0000)	0.1731* (0.0000)	0.1887* (0.0000)	0.1164* (0.0000)	0.0672* (0.0000)	1.000				
Shell	0.3667* (0.0000)	0.4439* (0.0000)	-0.0017 (0.0126)	-0.0031* (0.0000)	-0.0031* (0.0000)	-0.0027* (0.0001)	0.0050* (0.0000)	0.0089* (0.0000)	0.0041* (0.0000)	0.3184* (0.0000)	0.4427* (0.0000)	0.0866* (0.0000)	0.1957* (0.0000)	-0.1900* (0.0000)	1.000			
Esso	0.1457* (0.0000)	0.2293* (0.0000)	-0.0014 (0.0413)	-0.0022* (0.0010)	-0.0025* (0.0003)	-0.0014 (0.0455)	0.0011 (0.1206)	0.0061* (0.0000)	0.0041* (0.0000)	0.1412* (0.0000)	0.1500* (0.0000)	0.0098* (0.0000)	0.0768* (0.0000)	-0.0982* (0.0000)	-0.1408* (0.0000)	1.000		
Total	-0.0661* (0.0000)	0.2718* (0.0000)	0.0000 (0.9526)	0.0003 (0.6585)	0.0007 (0.3368)	0.0006 (0.4006)	-0.0000 (0.9616)	-0.0028* (0.0000)	-0.0012 (0.0676)	0.1633* (0.0000)	0.1185* (0.0000)	0.2663* (0.0000)	0.0801* (0.0000)	0.1163* (0.0000)	-0.1669* (0.0000)	-0.0862* (0.0000)	1.000	
Jet	-0.0550* (0.0000)	0.0771* (0.000)	-0.0007 (0.3260)	-0.0004 (0.5859)	0.0007 (0.2715)	-0.0007 (0.3114)	0.0002 (0.7449)	0.0002 (0.7333)	0.0008 (0.2139)	-0.0480* (0.0000)	0.1077* (0.0000)	0.2149* (0.0000)	-0.0401* (0.0000)	-0.0330* (0.0000)	-0.0474* (0.0000)	-0.0245* (0.0000)	-0.0290* (0.0000)	1.0000

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