No. 51-2017

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Shopping hours and entry – An empirical anlysis of Aldi's opening hours

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An empirical analysis of Aldi's opening hours

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November 6, 2017

Abstract

Aldi, the biggest discounter in Germany, started to systematically extend shopping hours of its stores in 2016. We interpret the decision to extend opening hours of a specific Aldi store as entry into a new market. By using a novel data set containing the opening hours of nearly all German grocery retailers, we find that consumer and firm learning influence that decision. The presence of a nearby Aldi already opened longer increases the probability that a given Aldi extends its opening hours. However, if a nearby competitors store is short opened, the probability that Aldi extends opening hours decreases.[1]

JEL codes: L22, L41, L81
Keywords: Shopping hours, Retailing, Coordination, Market Entry

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1 Introduction

In mid 2015, Aldi, Germany's biggest discounter[2], started to extend the opening times of some of its stores from 8 to 9 p.m.. This article empirically examines the drivers of the decision to open stores longer. For this purpose we collected data on the opening hours of all German retail grocery stores as well as the distance between them. By controlling for socio-demographic variables such as income and population density, we study the strategic effects driving the decision of a given Aldi store to extend shopping time until 9 p.m..

The goal of our study is to examine how the choice to open a given Aldi outlet longer than 8 p.m. is affected by the opening hours of nearby stores of competitors as well as by nearby Aldi outlets that already stay open until 9 p.m.. A quasi natural experiment in the industry allows us to isolate these strategic responses of a given Aldi store because until mid 2015 basically all Aldi outlets were closing at or before 8 p.m..[3] This schedule was a world-wide policy. By the time we collected the data for this study, for instance US shops were also closing at 8 p.m..[4]

Although speculative, we assert that this change in policy is due to a turnover in Aldi's leadership structure.[5] Despite being unable to pin down the exact reasons for these developments, it is fact that Aldi refrained from extending shopping hours after 8 p.m. for a long time after legal changes in 2006 and 2007 that allowed for extended shopping hours and led all of Aldi's main competitors to do so (See Section 4.2). We thus assume that around 2015 there was a potentially exogenous event that triggered Aldi's strategical adjustment of opening hours.

In 2015, four grocery retail groups controlled roughly 67 % of the German market: Edeka

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[2]Aldi has 4,195 stores and Lidl, the second largest discounter, 3,187 outlets (See Section 5).

[3]Exceptions are some markets located in shopping centers. Systematic extensions of opening hours started in 2015, See https://goo.gl/aRG5fs

[4]See, https://goo.gl/gWFY0U or Aldi's online store locator (https://goo.gl/50OpWj) for detailed information.

[5]Aldi is and always was a family-led firm and information on its policies and plans are extremely scarce. After the death of the two founders in 2010 and 2014, respectively, changes in the firm's conduct were expected by experts (See https://goo.gl/V2kycS; https://goo.gl/h7Mz0H; https://goo.gl/Y9yJDc).

(25.3 %), Rewe (15 %), Schwarz (Lidl) (14.7 %) and Aldi (11.9 %). There were 6 smaller players with 1-5 % market share whereas there is a fringe of 13.7 % that comprises very small suppliers. [6] Since at least 2007, most federal states of Germany allow retail grocery stores to open longer than 8 p.m. on workdays.[7]

To examine the drivers of Aldi's decision on whether to extend the shopping hours of a given store, we interpret this decision as entry into a new market, namely, the market of retail grocery shopping after 8 p.m.. This interpretation allows us to apply a straightforward Logit regression in order to analyze entry decisions based on, e.g., Berry (1992) and Toivanen and Waterson (2005) (See Section 3). To the best of our knowledge, we are the first to adopt this approach to examine shopping hours. Moreover, empirical studies on the topic are quite scarce (See Section 2).

Our main findings are, first, that firm learning influences Aldi's decision to expand shopping hours. In our sample the probability that a given Aldi is open later than 8 p.m. decreases when there is an outlet of a close competitor nearby that closes at or before 8 p.m.. However, the presence of a given store of a competitor that allows for shopping past 8 p.m. does not significantly influence Aldi's decision about whether to extend shopping hours. This observation suggests that Aldi learns in which areas not to open later than 8 p.m. from its closest competitors. Second, we find that consumer learning occurs. The probability that a given Aldi stays open until 9 p.m. significantly increases if there is another Aldi outlet nearby that stays open later than 8 p.m.. As we control for population density and purchasing power, this result suggests that consumer learning occurs. In areas where consumers learned that late shopping at Aldi outlets is possible, it is more likely that Aldi extends shopping hours of additional stores.

The findings about consumer learning can be interpreted from the viewpoint of evolutionary game theory as proposed by Kosfeld (2002). In those areas where coordination between consumers and discounters was successful, extending shopping hours of an additional Aldi

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[6]See BVE (2016); https://goo.gl/TibsZv.

[7]Exceptions are Bavaria and the Saarland where stores are allowed to open from 6 a.m. until 8 p.m. only.

store is more likely to be profitable. Moreover, one can interpret the aforementioned firm learning in a similar fashion. In areas where the population of consumers focused on discounters have not (yet) coordinated on longer shopping hours, Aldi refrains from opening longer than 8 p.m.. These are those areas where close competitors also close their outlets at or before 8 p.m..

The article is structured as follows. In Section 2 we outline the determinants of shopping hours as well as the related literature. In Section 3 the underlying model for our empirical approach will be explained. Some facts about the German retail grocery industry are outlined in Section 4. In Section 5 we present our empirical findings as well as descriptive statistics. Section 6 concludes.

2   Related Literature

Retail grocery stores compete in different dimensions. First, they compete in prices (See, e.g., Binkley and Connor (1998)). Second, the quality of products and service may differ, e.g., between full-range retailers and discounters (Ellickson, 2006). Third, retailers may strategically locate their stores in order to differentiate from competitors (Ellickson and Grieco, 2013; Konishi, 2005). Moreover, they compete in at least a fourth dimension, namely, in their shopping hours.

Most of existing theoretical literature on shopping hours aims at determining welfare-maximizing opening hours (See, e.g., Thum and Weichenrieder (1999) and Shy and Stenbacka (2006) for an overview). One major factor that impedes social welfare are retail prices above marginal costs. Some authors (Clemenz, 1990; Ferris, 1991; De Meza, 1984) argue that opening hours constitute another instrument of competition retailers can use in order to differentiate from competitors and thus to raise prices.

According to Shy and Stenbacka (2006), there are four factors influencing opening hours of stores. These are:

1. **Spillover effects**: Consumers choose shopping hours other than their preferred when a given set of stores does not offer their services at the consumers' preferred time.

2. **Asymmetric ideal service times**: Consumers' schedules lead to peaks in demand on a regular basis, e.g., on Saturday morning when many consumers' have the time to get their weekly grocery supplies.

3. **Economies of Scale**: The cost structure of the store may exhibit increasing, constant or decreasing returns to scale with respect to sales and/or service hours.[8]

4. **Price competition**: More intense price competition between stores might drive firms to supply their service at different hours. Firms thus use opening hours in order to relax competition and increase prices.

Shy and Stenbacka (2006) analyze optimal opening and closing times based on a Salop model.[9] By allowing for non-uniformly distributed consumer's tastes on shopping hours, they show that spillovers can occur whereby consumers adjust their shopping time. This creates social (transportation) costs and Shy and Stenbacka (2006) show that a monopolist provides a time frame for shopping that is narrower than would be welfare maximizing. By including a competitor in their model, they show that in equilibrium there may be a first-mover advantage that allows one firm to offer non-stop shopping (i.e., providing the good over the whole circle). The second firm reacts by providing its service only partly.

Inderst and Irmen (2005) analyze price competition (see point 4 above) in a duopolistic, two dimensional Hotelling model differentiating between a spatial and a temporal dimension. One result of their model is that deregulating shopping hours allows for differentiation on the time-dimension resulting in relaxed competition between the competitors. Hence, both stores will charge higher prices in equilibrium. Interestingly, in the mid-1990 some German

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[8]Note, that it is possible that the cost function has steps, e.g., because the maximum of working hours per employee is restricted.

[9]Other models analyzing spatial and temporal competition are Hosseinipour and Sandoh (2013) and Sandoh et al. (2015).

consumers anticipated an increase in retail-prices to follow deregulation of shopping hours (Thum and Weichenrieder, 1999).

The result that asymmetric shopping hours can arise in equilibrium is particularly interesting for our data set because we observe a pattern of differentiated shopping hours. However, the structure of the natural experiment does not allow for testing the results of Shy and Stenbacka (2006) and Inderst and Irmen (2005) as it requires data from the time of the liberalization of shopping hours (e.g., from 2004-2008). Moreover, in order to test their theory, data on retail grocery prices or price indices would be required.

Based on evolutionary game theory, Kosfeld (2002) analyzes the empirically observed phenomenon that German retailers reduced their shopping hours again after extending them shortly after the law allowed them to. After the first deregulation of shopping hours in Germany in 1996 about 60 % of the shops expanded their opening hours. However, one year later, some 10 %-points of total retailers *reduced* the opening hours again. Kosfeld (2002) interprets this observation as a result of the consumers' and retailers' failure to coordinate on a potentially efficient equilibrium. It is costly for retailers to expand shopping hours and at the same time consumers face uncertainty: if they decide to shop later they will not know for sure whether the store is indeed open.

Our findings can be interpreted in a similar way as it is proposed by Kosfeld (2002). We find that the probability that a given Aldi outlet expands shopping hours increases, when there is an Aldi store nearby that is active in the market after 8 p.m.. This suggest that the consumers in this area have learned that shopping until 9 p.m. is possible at Aldi stores. Although Toivanen and Waterson (2005) cannot identify such a pattern for the UK fast food market, we find that consumer learning or habit formation influences Aldi's decision whether to allow for shopping later than 8 p.m..

In summary, most previous theoretical approaches predict effects on prices and quantities. As we do not have the relevant data to test such effects we here chose a different approach and used entry theory to structure our estimations (See Section 3).

Firm entry has been the object of multiple studies. For instance, theoretical models deal with entry deterrence (e.g. Dixit (1979)) or product differentiation (e.g. Shaked and Sutton (1982)). An early review of the empirical literature on entry can be found in Geroski (1995).

An additional aspect from a labor market perspective which is relevant for our study is the concept of "threshold labor" Gradus (1996), i.e., staff that should be present independent of the sales volume. Additional staff in the stores constitutes a cost factor of extending shopping hours. Whereas expenses such as additional cooling, heating or light may be negligible, the labor costs of longer opening hours may not be. We qualitatively address the supply of labor in different regions by including unemployment rates.

3   Theory

We interpret the decision of extending shopping hours of a given Aldi as entry into the market of shopping after 8 p.m.. This departure from the traditional Hotelling-based analyses (e.g., Inderst and Irmen (2005); Shy and Stenbacka (2006)) allows for a convenient and very tractable empirical assessment.

Our approach is largely based on the model of Toivanen and Waterson (2005) who analyze entry into the fast-food market in the UK. As it is standard in the Industrial Organization literature, entry occurs if expected profits from entry into a new market exceed those from not entering. Formally, let $e_{ijt} \in \{0, 1\}$ denote the decision of firm $i \in I$ in market j at time t on whether to enter a particular market.[10] Profits π_{ijt} are a function of e_{ijt}, of the number of own outlets Own_{ijt} and the number of rival outlets $Rival_{kjt}$ where k is an index for the respective rival. Let $\boldsymbol{Rival}_{jt}$ denote the vector containing the rivals' entry decisions in market j at time t. Entry costs are denoted by F_{ijt}. Total costs of entry are furthermore influenced by an i.i.d. cost-shock ϵ_{ijt}. Similar to Toivanen and Waterson (2005) total profits can be formalized as follows.

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[10]Note that contrary to Toivanen and Waterson (2005) we do not consider a duopoly. In the baseline model we consider the four major German food retailers as explained in the introduction.

$$\Pi(e_{ijt}|Own_{jt-1}, \boldsymbol{Rival}_{jt-1}) = \pi(Own_{jt-1} + e_{ijt}, \boldsymbol{Rival}_{jt-1}) - (F_{ijt}(Own_{jt-1} + \epsilon_{ijt}))e_{ijt} \ \forall k$$

$$(1)$$

Just as in Toivanen and Waterson (2005), we model a sequential entry decision as proposed by Berry (1992). The rationale for this assumption is that Aldi started to extent shopping hours past 8 p.m. in 2015, years after its rivals did. For our analysis the exact order of movements is not important except for Aldi being the last firm to decide about entry. Thus, Aldi takes the entry decisions of its rivals as given. Those entry decisions are collected in the vector $\boldsymbol{Rival}_{jt-1}$.

Central to the article of Toivanen and Waterson (2005) is the idea of firm learning. If there is an outlet of the competitor in the industry, this not only implies that residual demand for the firm under consideration is smaller in expectation, but it also signals that the competitor runs a profitable business. In case of uncertainty, entry can indeed be fostered by the activity of the competitor. The entrant learns from the competitor's mere presence in the market that entry is profitable. The source of uncertainty we consider relevant is the (unobservable) consumer preference to shop later than 8 p.m.. Consequently, the residual demand for a given Aldi outlet is unknown.

For the decision on whether to extend the opening hours of a given Aldi store, the entry decisions of all the competitors' stores are exogenously given at the beginning of each period t. In particular, the number of the competitors' stores in the relevant distance around an Aldi outlet being opened or closed after 8 p.m. are independent variables. We thus assume that Aldi may draw information from the entry decisions of its competitors in the respective markets. Note that this also applies to Aldi stores which prolonged their opening times *before* period t. This assumption will be further discussed in Section 5.

Although we have no data concerning this, we expect that entry costs are small in our example. Just as Toivanen and Waterson (2005) we are unable to distinguish between fixed

and sunk costs of entry. However, besides some very minor costs such as changing the websites or advertising brochures, the main cost driver of an extension of opening hours is most likely the threshold labor value (Gradus, 1996), i.e., providing the staff necessary to offer an additional hour of shopping. Although labor costs are typically seen as variable cost, in our case they are fixed because each period in the market entails these labor costs, irrespective of the number of units sold in a given outlet.[11]

Another point worth mentioning is the issue of cannibalization. By extending shopping hours, some consumers of a given Aldi outlet might switch from shopping before to after 8 p.m.. These consumers, however, still buy from Aldi. If, on the contrary, Aldi did not allow for longer shopping hours, some consumers might instead switch to a competitor. A positive correlation between the presence of a nearby incumbent in the shopping market after 8 p.m. and the probability to open longer than 8 p.m. could thus also be explained as an attempt to prevent business stealing by competitors or by Aldi itself.

4   The German supermarket industry

4.1   General characterization of the industry

The German supermarket industry is characterized by a high level of concentration. The largest share of the market is divided among the Edeka-Group, the Rewe-Group, the Schwarz-Group, Aldi and the Metro-Group. With the upcoming takeover of Kaiser's Tengelmann by Edeka, it can be assumed that the share of the top 5 will increase further.[12]

Edeka-Group, a cooperation of independent goods retailers, is the largest operator of supermarkets in Germany. Several brands belong to the group's portfolio. "Netto" covers the discount segment and "Edeka" markets are either active in the supermarket or the hypermarket segment. Similar to Edeka-Group, the Rewe-Group was founded as a cooperation

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[11]Typically, more employees are present during the daytime. However, also at the nighttime at least some employees have to be present if the store stays open.

[12]See BVE (2016); https://goo.gl/TibsZv.

of independent retailers. The largest subsidiaries are "Rewe" (super- and hypermarkets) and "Penny" (discount). The Schwarz-Group operates discount markets ("Lidl") as well as hypermarkets ("Kaufland"). Aldi consists of two independent units, Aldi Nord and Aldi Sued and solely operates discount markets. It is said to be one of the price leading companies in the market (Morschett et al. 2006).

Aldi and Lidl as well as other discount chains are typically characterized by a limited selection of products and offer few manufacturer brands. The sales area as well as the surrounding are typically functional, with less services being offered. The discounters Aldi and Lidl claim that their own brands are of equal quality as those of leading brands but are cheaper. Often products are in fact produced by or in cooperation with those brands, however, the actual manufacturer is often veiled. Due to the growing competition traditional supermarkets like Edeka and Rewe have also started to add no name brands to their assortment. The prices are orientated or equal to those of Aldi and Lidl.

Supermarkets offer a large variety of brand products. The sales area is larger and there are more services offered than in discount markets. However, Aldi and Lidl have started to to take up additional branded items and to increase competitive pressure on competitors as well as among each other.[13] Also, the appearance of the sales area is approaching the one of supermarkets and Aldi and Lidl plan to offer a wider range of services like rest rooms.[14] As prices and quality are becoming more and more equal, opening hours constitute one of the only remaining strategic variables among which ALDI is not yet aligned with its competitors.

The size of stores and variety of products clearly vary within the Edeka- and Rewe-Group, whereas the stores of Aldi and Lidl are largely standardized. Even the arrangement of the products is very similar for Aldi stores all over Germany (Brandes and Brandes, 2015). This homogeneity between Aldi stores is of great benefit for our empirical analysis: We can rule out that the decision to extend shopping hours of a specific Aldi store is driven by internal

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[13]See Lebensmittelzeitung, 25, 19.06.2015, https://goo.gl/8FRPST
[14]See Lebensmittelzeitung, 40, 02.10.2015, https://goo.gl/pcToCL and ALDI Press Release, 11.05.2016, https://goo.gl/MIP4yP.

factors like size of the shop our product variety. Instead, the decision seems to be driven by external factors like socio-demographic variables or the competitive environment in the local market, respectively.

4.2   Regulation of shopping hours in Germany

Since 2006 the responsibility for the regulation of the opening hours of stores in Germany is with the federal states. Since 2006 and 2007 closing times are allowed to be extended past 8 p.m. in Baden-Wuerttemberg, Berlin, Brandenburg, Hamburg, Hesse, Lower Saxony and Schleswig-Holstein. In Mecklenburg-Western Pomerania, North Rhine-Westphalia, Saxony-Anhalt, Thuringia, Rhineland-Palatinate and Saxony regulations vary according to the day of the week. Only in Bavaria as well as the Saarland no changes have been made, and opening hours are regulated the same way they were before 2006 (i.e. 8 p.m.). On Sundays the operation of shops is only possible as an exception and strict conditions have to be met in order to stay open, regardless of federal state.[15] As discussed above, Edeka, Rewe and Lidl started to extend shopping hours of their shops after the deregulation. Aldi, however, refrained from opening its stores longer than 8 p.m. until 2015. In 2016 they started to systematically extend shopping hours of various stores - this observation was the starting point for our analysis.

5   Empirical analysis

In this section, we present our empirical analysis. We first describe the construction of our novel data set in 5.1 and go on to provide descriptive statistics including information on number, locations and opening hours of stores in our data set in Section 5.2. In Section 5.3 we provide the results of our regressions, which estimate the impact of different socio-demographic variables and the opening hours of nearby competitors on the decision to extend

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[15]See law on shop opening hours of each Federated State (Ladenoeffnungsgesetz) as well as the Federal law on shop closing hours (Gesetz ueber den Ladenschluss).

shopping hours of a specific Aldi store.

5.1 Construction of the data set

To evaluate drivers of the decision to extend opening hours of a specific Aldi, we use a novel panel data set. The data set was constructed by merging data from different sources. The basic data was obtained by collecting shop data including addresses and opening hours of all Aldi, Lidl, Rewe, Edeka, Penny and Netto stores in Germany listed in the corresponding online store finders.[16] We collected these data for two points in time: July ($t = 0$) and December ($t = 1$) 2016. In a next step, we compute distances (driving time) of every single Aldi store to all its competitors and other Aldi stores, that are located within a maximum range of 20 minutes driving time. Thus, we are able to define local markets and control for the competitive environment within these markets, i.e., the number of nearby competitors for all Aldi stores.[17] The driving times are based on *Open Source Routing Machine* using the *fastest route* option.[18] As control variables we include the following socio-demographic variables: population density, share of households under 40 years, private purchasing power per household, share of 1-person households, share of 2-person households and unemployment rate in the regression.[19] However, there are two potential problems with the socio-demographic covariates. First, the data is available on postcode level only. Consequently, spatial separation on the demand side is not as detailed as the above mentioned radius around the respective Aldi outlets. Second, the data is only available on an annual basis whereas we observe variations during the year. Nevertheless, we expect the impact on the estimation to be negligible as we use these data only to control for socio-demographic

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[16]See https://filialfinder.aldi-sued.de/,
https://www.lidl.de/de/filialsuche/,
https://www.edeka.de/marktsuche.jsp,
https://marktsuche.rewe.de/
and https://www.rewe-dortmund.de/marktsuche/ (last accessed on 30 June, 2017)

[17]The range of 20 minutes driving time in order to define a local market is based on former analyses of the German grocery industry, e.g. by the German Federal Cartel Office (Bundeskartellamt, 2015) However, qualitative results does not change in plausible (15 min or 25 min) variations of the radius.

[18]http://project-osrm.org/ (last accessed on 30 June 2017)

[19]This data is provided by Axciom Deutschland GmbH, Neu-Isenburg, 2016.

effects.

5.2 Descreptive analysis

Our data set contains about 23,000 stores. Table 1 provides an overview of the competitors' market shares as well as the share of stores with opening hours later than 8 p.m. at $t = 0$ (July 2016).

Table 1: Absolute number and share of long opened stores (July 2016)

Competitor	Number of stores (market share)	Opened after 8 p.m. (share)
Aldi	4,195 (18.2%)	948 (22.6%)
Lidl	3,187 (13.8%)	2,306 (72.4%)
Rewe	3,461 (15%)	2,650 (76.6%)
Edeka	5,920 (25.7%)	1,607 (27.2%)
Penny	2,133 (9.3%)	1,312 (61.5%)
Netto	4,116 (17.9%)	1,779 (43.2%)
Sum	23,012 (100%)	10,602 (46.07%)

We find, that Rewe has the highest share (about 77%) of stores that are opened after 8 p.m.. The share is even higher, i.e., 91%, if we exclude those stores in Bavaria and Saarland where shopping later than 8 p.m. is generally not allowed (see Section 4.2). Edeka has a share of about 27% (respectively, 36% without Bavaria and Saarland) of stores that are opened after 8 p.m.. The shares of the discounter are 72% (86%) for Lidl, 61% (70%) for Penny and 43% (53%) for Netto. With about 23% (26%) Aldi has the smallest share of stores with long opening hours. This is not surprising, as Aldi just started to systematically extend opening hours in 2016. However, the number of Aldi stores that stayed open until 9 p.m. in $t = 0$ was already higher than the initially targeted number of 650 stores.[20] Thus, it seems that the announced test phase was successfully concluded before our observation period starts and Aldi started to systematically extend shopping hours of further stores.

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[20]See Handelsblatt online, https://goo.gl/Ke9NTx (last accessed on November 7, 2016)

Focusing on Aldi outlets that were closed after 8 p.m. at $t = 0$ and without stores located in Bavaria and Saarland, we find 2,646 Aldi stores that can potentially enter the 'new market' for shopping after 8 p.m..

Aldi has the largest number of shops extending their shopping hours during our observation period (from $t = 0$ to $t = 1$, i.e., from July to December 2016). They extended opening hours of 85 stores. Lidl extend opening hours of 4, Rewe of 10, Edeka of 13, Penny of 7 and Netto of 32 stores. As these numbers are small we do not expect them to be the result of strategic considerations concerning the changes in Aldi's policy. However, even if these would have been reactions to Aldi's policy, there would be no impact on our estimation results because none of the adjustments in the respective stores' shopping hours happened in the relevant radius (20 min driving time) around an Aldi outlet that extended its opening hours during our observation period. There was also a handful of newly opened and closed stores for all competitors. However, we are not interested in these numbers because we assume that the decision to extend opening hours of a specific Aldi store in $t = 1$ is based on the competitive environment at $t = 0$ ($Rival_{k,j,t-1}$), as described in Section 3.

Figure 1 illustrates the locations of the corresponding stores all over Germany by ownership and opening hours at $t = 0$. It can be seen that Rewe stores stayed open after 8 p.m. almost everywhere, except for Bavaria and Saarland, where opening hours are still restricted to 8 p.m.. There are also some stores with shorter opening hours in North Rhine-Westphalia. These outlets are mostly owned by 'Rewe Dortmund' which is the only independent regional subsidiary of Rewe. Whereas there were only a few Lidl stores in Eastern Germany that stayed open after 8 p.m., most of Lidl stores in Western Germany and Berlin stayed open after 8 p.m.. Penny and Netto employed a similar kind of policy. For Edeka a somewhat different picture emerges. The share of Edeka outlets with closing times at or before 8 p.m. in Western Germany, especially in the northern parts, is much higher than the corresponding shares of Lidl, Penny or Netto. For Aldi, we find that stores with opening hours later than 8 p.m. are mostly located in major cities and regions with high population densities such

as Hamburg, Berlin or the Rhine-Maine and Ruhr area. The share of Aldi stores that stay open after 8 p.m. is particularly high in North Rhine-Westphalia.[21].

We observe that Rewe pursues a country-wide strategy that does not seem to be influenced to a large extent by strategic or even socio-demographic factors. We therefore interpret Rewe as the 'first mover' or the 'incumbent' in the market for late night shopping. Lidl's, Penny's and Netto's strategies can be characterized by differentiating between Eastern and Western Germany. Although there was an area-wide coverage of shops staying opened later than 8 p.m. in Western Germany, outlets in Eastern Germany had shopping hours later than 8 p.m. mostly in regions with a high population density. For Edeka there does not emerge a clear pattern. One explanation for this observation might be that the owners of an Edeka outlet are more independent than those of the competitors and may be able to adjust their shopping hours more freely.[22] The strategy of Aldi is discussed in detail in Section 5.3.

5.3 Empirical results

As described in Section 3, we assume that the decision to extend shopping hours of a specific Aldi store at time t is based on its competitive environment at $t-1$ (July 2016). Thus, we estimate the following Logit model (Toivanen and Waterson, 2005):

$$Pr(e_{j,t}|X_{j,t-1}, Z_{j,t-1}) = \delta_0 + X'_{j,t-1}\beta_1 + Z'_{j,t-1}\beta_2 + \epsilon_{j,t} \tag{2}$$

The left-hand side takes the value 1 if Aldi j extended it shopping hours during our observation period and 0 if not. X is a vector including the weighted[23] number of nearby (max. 20 min driving time to Aldi j) Aldi stores already opened later than 8 p.m. as well as the weighted number of nearby late (past 8 p.m.) and early closing (at or before 8 p.m.)

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[21]We conjecture that this observation can be explained by the close distance to Aldi's headquarters located in Essen and Mühlheim, where they potentially started to extend shopping hours of its stores.

[22]Most Edeka outlets are owned by independent retailers. See also Edeka concept http://goo.gl/rtUaEf (last accessed on December 8, 2016).

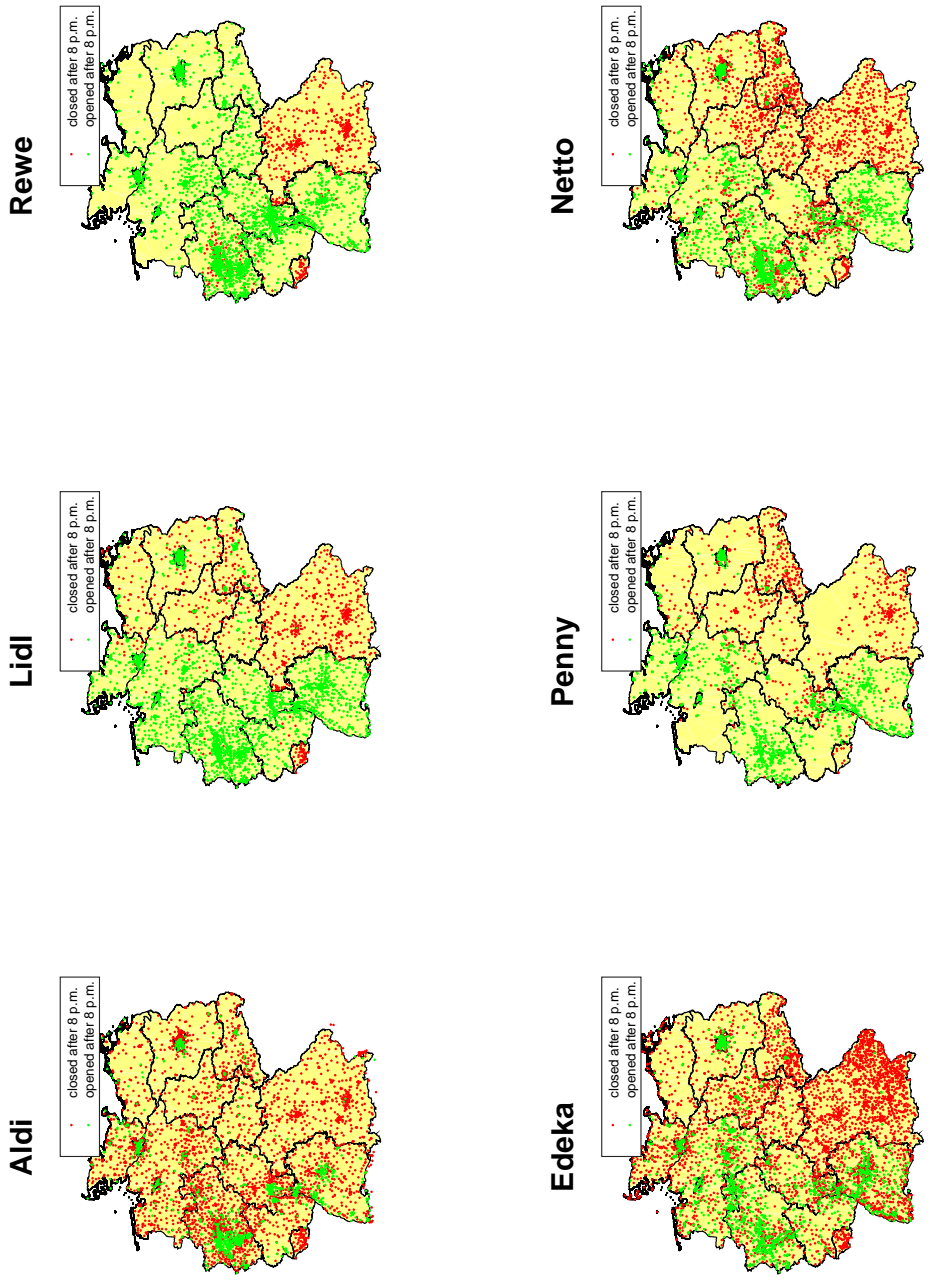[23]A store is inverse weighted by the distances (in seconds).

Figure 1: Location and shopping hours of the stores in July 2016

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Lidl, Rewe, Edeka, Penny and Netto stores at $t-1$. Z is a vector of socio-demographic covariates including population density, the share of households under 40 years based on the head of household, purchasing power per household (in Euro), share of one and two person households and unemployment rate in the same postcode area than Aldi j.

The Results of the Logit regression are shown in Table 2.[24] We observe that *AldiOpeneded* has a significantly positive coefficient whereas the coefficients of *LidlClosed* and *NettoClosed* are (weakly) significant and negative. The other coefficients concerning the competitive environment are insignificant. All else equal it is more likely that a specific Aldi outlet extends shopping hours if the number of nearby Aldi stores with a longer opening time is higher. Furthermore, a given Aldi store's probability to stay open after 8 p.m. decreases if the numbers of nearby Lidl or Netto stores with shorter opening hours are higher. Apart from unobservables that might drive our results, these correlations cannot be explained by traditional entry theory (e.g. Shaked and Sutton (1990)): On the one hand a high number of own stores should have a negative impact on residual demand (cannibalization) and thus on entry. On the other hand, a higher number of Lidl or Netto stores with closing times at or before 8 p.m. should have a positive impact on demand because one would expect a certain share of (marginal) consumers to switch from a given Lidl or Netto outlet to an Aldi store which just started to offer shopping hours longer than 8 p.m..

Our findings can, however, be explained by consumer and/or firm learning. On the one hand, habit formation should have a positive effect: Consumers learned already that shopping *longer* than 8 p.m. is possible in areas with a high number of late closing Aldi stores (*AldiOpened*). As a result of that some consumers start shopping after 8 p.m. and demand in this 'market' increases. However, in an area with a high number of early closing discounter outlets (*LidlClosed* and *NettoClosed*), consumers does not have that 'learning effect'. On the other hand, the presence of an Aldi store already closing later than 8 p.m. allows for firm learning by reducing uncertainty about demand. On the other hand, an area with a

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[24]We do not see large differences when we apply a Probit regression.

Table 2: Logit Estimation Results

	Coefficients	(Standard Errors)	[Marginal effects]
AldiOpened	32.01624**	(15.82148)	[.4188573]
LidlOpened	-.0991352	(1.127131)	[-.001297]
LidlClosed	-115.9935*	(65.68014)	[-1.517503]
ReweOpened	-.0851474	(.5685345)	[-.001114]
ReweClosed	-34.24884	(33.45161)	[-.4480656]
EdekaOpened	.1478814	(.1704865)	[.0019347]
EdekaClosed	-.799308	(1.320445)	[-.0104571]
PennyOpened	-5.24184	(7.753597)	[-.0685772]
PennyClosed	-74.47581	(54.16493)	[-.9743411]
NettoOpened	-1.688713	(3.476472)	[-.0220928]
NettoClosed	-29.47408**	(14.26875)	[-.3855992]
Population	-.0000105	(.0000468)	[-1.37e-07]
Household < 40years	10.45381**	(4.517175)	[.1367635]
PurchasingPower	.0001277***	(.000044)	[1.67e-06]
Unemployment	19.06482**	(8.87898)	[.2494184]
1Person − Household	14.69657***	(4.836539)	[.1922702]
2Person − Household	21.1024***	(7.513504)	[.2760753]
Constant	-26.09854***	(5.400548)	
Observations	2,547		
Pseudo-R^2	0.1438		

The estimation is performed by using a logistic regression. Cluster-robust standard errors (clustered on district level) are presented in normal parentheses. Marginal effects after logit are obtained by using the 'mfx' method in Stata and presented in square brackets. Statistics are significant for * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

high number of discounter stores closing early (*LidlClosed* and *NettoClosed*) signaled a potentially small demand for shopping after 8 p.m.. This argument is important especially as we expect Lidl and Netto to have more experience with the profitability of late closing outlets, because they entered the market for late shopping much earlier than Aldi. Of course, whenever Aldi already have own stores closing late in the relevant area (*AldiOpened*), infor-

mation about demand for extended shopping hours is even higher (Toivanen and Waterson, 2005). Focusing the marginal effects, we find that the strategic effects of Lidl is stronger than the ones of Netto.

We find that the coefficient for $Population$ is not significant whereas the coefficients of $Household < 40years$, $PurchasingPower$, $Unemployment$, $1Person - Household$ and $2Person - Household$ are significantly positive. Hence, the local share of households under 40 years, private purchasing power, unemployment rate and the share of one and two person households raise the probability that a given Aldi outlet extends its opening hours. We expect younger people to prefer late shopping because of their working habits. The same holds for one and two person households. Another explanation would be that younger people are already used to late night shopping, whereas older people are more used to shop early given the long time of regulated opening hours in Germany. The positive influence of purchasing power and unemployment rate at the same time seems surprising. One would expect that these variables are negatively correlated because higher unemployment rates are typically connected to lower income and, consequently, lower purchasing powers.

However, focusing on each variable separately, one could argue that purchasing power is correlated with longer working times and thus with higher demand for late shopping, on the one hand. On the other hand, one could argue, that it is easier to find additional staff in areas with a high unemployment rate ("threshold labor", as discussed in section 3).

We did robustness checks concerning the strategic effects by first varying the "nearby-radius" (15 min and 25 min driving time) and, second, by excluding the socio-demographic variable $Population$ that carried an insignificant coefficient from the basic specification. The results did not change much compared to the ones described in Table 2.

6   Conclusions

This article examines the drivers of Aldi's decision on whether to extend shopping hours of particular outlets past 8 p.m. in Germany. We interpret Aldi's decision to open a given outlet until 9 p.m. as entry into a new market, namely, the market for grocery retail shopping after 8 p.m.. To examine this issue, we investigate a natural experiment: Aldi started to systematically extend shopping hours past 8 p.m. in 2016, roughly 9 years later than its competitors. We collected data on locations and shopping hours of all major players in the German retail grocery sector and merged these with data on socio-demographic variables such as population density and purchasing power.

Using a Logit regression based on entry theory as in, e.g., Toivanen and Waterson (2005), we are able to identify two effects. First, we find that the presence of nearby Lidl or Netto outlets that are closing no later than 8 p.m. significantly decreases the probability that an Aldi outlet extends shopping hours past 8 p.m.. Second, if there are Aldi outlets nearby that already close later than 8 p.m., the probability that a respective Aldi store also allows for shopping hours past 8 p.m. increases significantly.

These findings can be explained by consumer and/or firm learning. Habit formation suggests that consumers have learned that shopping past 8 p.m. is possible in areas with a high number of Aldi stores already closing later than 8 p.m.. Consequently, a fraction of consumers starts shopping after 8 p.m. and demand in this 'market' increases. This interpretation can for example be based on a coordination process as analyzed in Kosfeld (2002). By the same reasoning, in an area with a high number of discounter outlets closing at or before 8 p.m., the process of consumer learning has not (yet) been initiated or it has failed.

The presence of Lidl or Netto stores that are closing no later than 8 p.m. potentially allows for firm learning by reducing uncertainty about demand. An area with a high number of Lidl or Netto outlets closing already at or before 8 p.m. signals that area comprises small demand for shopping after 8 p.m.. Firm learning should have a strong effect which

we especially observe with respect to closest competitors' (Lidl and Netto) conduct. It is reasonable to assume that Lidl and Netto have better information about the profitability of late night shopping (past 8 p.m.) in a respective area because they entered the market much earlier than Aldi. Lidl's and Netto's behavior thus provides valuable information for their main competitor. On the other hand, the presence of Aldi outlets already closing later clearly reduces uncertainty about demand in the corresponding area.

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