Equal Split in an Almost Ultimatum Game: Field Evidence from the Informal Market for Group Train Travel*

Draft - Please do not cite without permission

Israel Waichman[†] and Artem Korzhenevych[‡]

This version: April 28, 2010

Abstract

In this paper we make use of a unique dataset collected in the train station of Kiel, Germany. A group ticket is used by individual proposers who search to take co-travelers for a fixed price shortly before the train departure. The behavior resembles an ultimatum bargaining game to the extent that proposers offer a specific price and travelers usually accept or reject. We observe that the average price is an equal split of the ticket price by the most frequently observed number of co-travelers. This finding support the conjuncture that the equal split is a focal point even in situations with clear asymmetry between the parties. Moreover, using computer simulations we are able to identify some sufficient conditions for the observed distribution of prices. Finally, we observed that the probability to accept an offer is decreasing with the price and increasing when the offer is made right before the train departure time.

JEL Classification: C78; C93; D74; D83

Keywords: natural field experiment; bargaining; focal point; equal split; simulation

---

*We are grateful to Reinhard Selten, Armin Falk, Werner Güth and participants in the experimental economics seminar of the University of Bonn and in the Max-Planck institute of Economics in Jena for useful comments and discussion. Finally, we are grateful to Mareike Gröwe, Maren Marquardt, Claus Müller, Maximilian Müller, Julia Schirrmacher, and Silke Werner for collecting the data.

[†]Department of Economics, University of Kiel, Olshausenstrasse 40, 24118 Kiel, Germany. Email: waichman@economics.uni-kiel.de

[‡]Kiel Institute for the World Economy, Hindenburgufer 66, D-24105 Kiel, Germany. Email: korzhenevych@economics.uni-kiel.de

1 Introduction

There is ample literature in experimental economics and psychology that shows that people often agree on equal-split solutions in bargaining games. Most of experiments reported in these studies focus at the Ultimatum game and its different modifications (Güth *et al.*, 2001; Falk *et al.*, 2003), but the equal-split phenomenon is also observed in many other bargaining games (Green *et al.*, 1967; Gächter and Riedl, 2005; Janssen, 2006). Although the 'fairness' argument was applied in some well-known studies (e.g. Güth *et al.*, 1982; Hoffman *et al.*, 1994, etc.) to explain the common occurrence of the equal split outcome, this argument may be quite weak when the positions of the bargaining parties are not symmetric, or when they face uncertainty regarding the gains of the other parties. In such situations, an explanation in terms of Schelling's (1960) concept of a focal point may be more plausible (Janssen, 2006).

In this study, we analyze the occurrence of the equal-split outcomes using a unique dataset that we obtained by the observation of a real-world market. In particular, we analyze the bargaining process taking place in the informal market for group train travel between the German cities of Kiel and Hamburg. This bargaining is characterized by several features resembling the Ultimatum game.

The market we are looking at was born in 2001 with the introduction of small-group tickets for regional trains in all federal states of Germany. Such a ticket allows up to 5 people to ride together during one day within the area of one or several neighboring states (the service area). The price of this ticket is fixed irrespective of the actual number of people in the group. It is higher than the price of a one-way ticket for the longest trip within the service area, but is lower than the price of a round trip between some origin-destination pairs, which makes it attractive also for individual use. These two features create an incentive for a person planning a round trip (e.g. a daily commuter) to buy a group ticket and invite other people (potential co-travelers) to share the ride in one direction with him/her by contributing a certain part of the ticket price. Thus, a bargaining situation is created, where a two-way traveler would approach other travelers and request a fixed price for a shared ride, without surely knowing how many co-travelers he/she will eventually find. As a consequence, presently, the group ticket is widely used not only by the organized groups traveling together and sharing the ticket price, but mainly by individual proposers who search for co-travelers shortly before the train departure. The facts that potential co-travelers do not bargain, but usually accept or reject the offer right away, resemble, to some extent, the Ultimatum bargaining game and therefore we name it, quasi ultimatum game.

that all co-travelers pay the same price and that potential co-travelers do not bargain, but usually accept or reject the offer right away, resemble, to some extent, the Ultimatum bargaining game (UG) and therefore we name it, quasi ultimatum game.

We investigated the price-setting process in this market for six months, first as detached observers and later as proposers. We find that the prevailing price of a shared ride is lower than what seems to be the revenue maximizing price. Furthermore, we observe that the prevailing price offer is based on the equal division of the ticket cost by the most frequently observed number of co-travelers. This result is remarkable because the payoffs of the bargaining parties are unknown and hardly symmetric. Moreover, we are able to show, by means of a computer simulation, that the observed distribution of prices can be replicated under two important conditions: First, a large share of travelers base their expectations upon the most frequently observed size of the group. Second, only few travelers have preferences against equal split in this case of asymmetry between proposers and co-travelers. Finally, we show that the probability to accept an unusually high offer is decreasing with the price and is increasing when such offer is made right before the train departure.

This paper is organized as follows: The next section describes the informal market for group train travel and the data collection. Section 3 presents the results and also links the findings to the focal point theory. Section 4 presents a simulation study of the market. Finally, section 5 concludes.

2 The Informal Market for Group Train Travel

In this section we briefly describe the informal market for group train travel operating in Kiel central train station and also identify the conditions for such a market to emerge. Then, we describe the data collection process, which consists of two phases: the *observation phase*, where we have just documented the transactions in the market, and the *active participation phase*, where we have operated in the market, taking the role of proposers.

2.1 Characterization of the market

The so-called 'Schleswig-Holstein ticket' (SH-ticket) allows up to 5 people to ride together in regional trains during one day within the area of the federal German states of Schleswig-Holstein, Mecklenburg-Vorpommern and Hamburg. Its price at 2008 (the year of observation) was €29. A single ticket from Kiel to Hamburg (and the opposite way) costs €19.20, or €14.40 with a popular rail discount card.[1] These prices obviously create an incentive for a person doing a round trip to rather buy a group ticket, than two single trip tickets (the SH-ticket also allows to use the public transport in Hamburg without further charge). It is then possible to recover some part of the ticket cost by sharing the one-way[2] ride with one or several (up to 4) other people. Some people indeed use this opportunity by positioning themselves in the busy spot next to the ticket-selling machines in Kiel central station and taking a role of a 'proposer' (a scheme of the station is given in Figure A.1 in the Appendix).

In this study, we are interested in the situation where the proposer offers a fixed price for a shared ride, without surely knowing, how many co-travelers

[1]It costs the same €14.40 with a 'Bahncard 25' and with a 'Bahncard 50'.

[2]There was no established market for group travel from Hamburg in the direction of Kiel at the time of the experiment.

he/she will find in the time left until the departure. In fact, 92% of our observations are of this kind. We are not interested in the cases where the price is determined by the ultimate number of co-travelers.

Typically, a proposer would approach other travelers with a question like "Are you going to Hamburg?". A traveler going that way may show interest and ask for the price, after which he/she would have a possibility to agree, reject, or try to bargain[3]. A person that agreed on the offered price stays with the proposer, which means that any consequent potential co-travelers are offered the same price.[4] The search continues for some time (on average 14 minutes), after which the group proceeds to the train.

We can identify two general conditions needed for such sustainable market to emerge. There must be a sufficiently large volume of travelers from the origin station to a common destination, and there must be a preferably unique, easy to find meeting point for bargaining at the origin station. These conditions are met in Kiel, a city of 240.000 inhabitants, which is located 100 km north of Hamburg, the second largest city in Germany. Kiel and Hamburg are the economic centers of the two neighboring federal states[5]. The distance between the two is short enough (80 minutes travel), such that many people regularly travel from Kiel to Hamburg for work[6] and leisure. Moreover, a feature of the local rail network is that almost all connections from Kiel to any other major German city go through Hamburg. Thus, the regional trains departing every hour are normally well filled. The central station in Kiel is quite small and a natural meeting place for any occasion exists between the Deutsche Bahn information desk[7] and the ticket-selling machines (see Figure A.1). The high number of travelers in one direction (to Hamburg), together with the fact that there are many passengers who make a round trip create a sustainable and flourishing market for group travel by train.

2.2 Observation phase

During May-June 2008 we observed the market in the central train station of Kiel on weekdays from Monday through Thursday (a total of 19 different days) each day looking at four train departures to Hamburg at 16:21, 17:21, 18:21, and 19:21. We chose to observe the market in the afternoon of normal weekdays

[3]Explicit requests to reduce the price are very rare, and all our observations of potential co-traveler behaviour are of yes-or-no type.

[4]An additional reason why price discrimination between co-travelers is not observed is that members of the group sit close to each other (for the case of ticket control) and can see others' contributions.

[5]In fact, Hamburg is a city-state in itself. It has 1.8 mln inhabitants.

[6]About 2.500 people from Hamburg regularly commute to work in Kiel, and about 3.700 commuters go in the opposite direction. (Federal Employment Agency data)

[7]This is particularly amazing, because most people acting in the market perceive this activity as illegal. You are allowed to make up a group and travel together, but the members of the group must stay together and are not allowed to be replaced by new members. However, because only one person has to write his/her name on the ticket, the possibility for misconduct is left open. Indeed, there are individuals who spend the whole day just traveling back and forth and collecting money from the co-travelers they are able to find.

mainly for two reasons. First, in a very busy hour (as on Fridays or weekends) it may be not feasible to thoroughly trace the offers. Moreover, in busy times competition between proposers may be intensive and the situation becomes less a bargaining and more a market situation. Second, we planned to enter the market as proposers at a later stage, offering prices much higher than the usually observed. This would only be possible with few proposers in the market.

At each day, the observer arrived at the meeting point close to the automatic ticket machines at 15:50 (half an hour before the train of 16:21 departs) and stayed there until 19:21, documenting the arrival and departure time of proposers, their gender, and the prices offered.[8] It amounted to a total of 148 clear observations of price offers, from which 11 cases were not strictly offers to take co-travelers for a fixed price, but rather cost-sharing offers, as explained above. The cases of rejected offers were not documented since it was impossible to track every conversation and thus to differentiate between potential co-travelers and people who travel to other destinations than Hamburg. It must be added that we were observing the market quite often before and also after this systematic study, and although the observed sample is of moderate size, its observed properties are in line with our experience.

2.3 Active participation phase

The observation phase gave us interesting information about the proposers' behaviour, but not so much knowledge about the co-travelers. In order to get some insights about co-travelers' reaction to different price offers, we entered the market as proposers. Initially, we aimed at revealing the otherwise essentially unobserved demand for shared ride at prices higher than the highest frequently observed price of €7. For this purpose we employed four research assistants (three females and one male) to behave as proposers in the market.

The experimental procedure was as follows. The research assistants bought the SH-ticket immediately upon arrival at the train station. They offered to take potential co-travelers for a specified price on the same weekdays and hours as in the observation phase (Mo-Thu, 15:50-19:21). They documented the exact time at which they made an offer to potential co-travelers and the gender of the potential co-travelers. To motivate them to approach as many people as possible, the research assistants could keep the money they had earned as proposers in addition to their hourly salary. If the assistants found at least one person to join them, they took a train to Hamburg. They did not provide information about the experiment to the co-travelers at any point of time. The co-traveler could only know that the proposer is traveling to Hamburg and would come back later using the SH-ticket. In total, our research assistants entered the market as proposers during 35 different days, between June'08 and October'08. The length of test period for every price level is given in Table 1. It is worthwhile to test such high prices, because they are still lower than a single-ticket prices (with and without a discount).

[8] Because we could only document the offers by staying very close to other people, and tried to avoid possible trouble, mobile phones were used to document the results.

Price offered	8	10	12	13	14	15	17	18
Number of days	6	7	6	5	2	4	1	4

Table 1: Length of test period for different price levels

While we initially aimed at revealing the demand for travel using the SH-ticket under the high prices, the collected results for price offers higher than €10 are not directly comparable with the results for lower price offers. One reason is that with prices higher than €10, we could only enter the market in the absence of other proposers. Note that some of the potential co-travelers have experience with the market, and they know the usual price offers. For that reason, at high prices potential co-travelers are looking for a better offer. A second reason is that, despite the monetary incentive, our research assistants felt very uncomfortable in offering such high prices for a shared ride, and they only approached people that subjectively did not embody a source of trouble for them. Therefore, for prices higher than €10, we only aimed at finding the price where the demand is equal to zero (i.e. no passenger is willing to come with us).

3 Results and Discussion

In this section we summarize the empirical findings. We start by analyzing the proposer behavior as reflected by the inspection of the market. Then, we describe our findings regarding the willingness of co-travelers to accept different price offers.

3.1 The observation phase

Table 2 presents the major characteristics of the market. It indicates that on average a proposer waits for 14 minutes in the market, offers a shared ride for an average price of €5.90, and an average of 3 potential co-travelers agree to the offer. In addition, 64% of the proposers are males, and only 5% are (looking) older than 40 years. Two features regarding the price offers (shown in Figure 1) are that all offers were of integer prices, and that most price offers (124/137 = 91%) were either €5 or €6. An interesting fact, and very important for our later discussion, is that an average taken only across these two most frequent offers equals €5.80, which corresponds to $\frac{1}{5}$th of the SH-ticket price (€29).

Another remarkable feature following from our observations is that 47% of the proposers who gather less than four co-travelers, leave the market more than 10 minutes before the train departure. This means that almost half of these proposers do not act as pure revenue-maximizers by exhausting the time until the departure. However, we have to take into account that staying longer in the market may at least bring the cost of getting an uncomfortable seat in the train.

Although not systematically documented, rejections of offers by potential co-travellers were observed at all prices, except €5. Furthermore, proposer could not ensure to get 4 co-travelers even with the lower price observed of €5. Table A.1 in the Appendix shows additional details about the market separately for each train departure time.

	Mode	Mean	Std. Dev.	Min	Max
Number of proposers per train	2	2.42	1.07	1	6
Proposers' price (€)	6	5.92	0.63	5	10
Co-travellers per proposer	4	3.15	1.29	0	4
Waiting time per proposer (min)	16	14	6	3	33
Proposers' revenue (€)	24	18.57	7.01	0	28

Table 2: Summary statistics of the Kiel market for group train travel

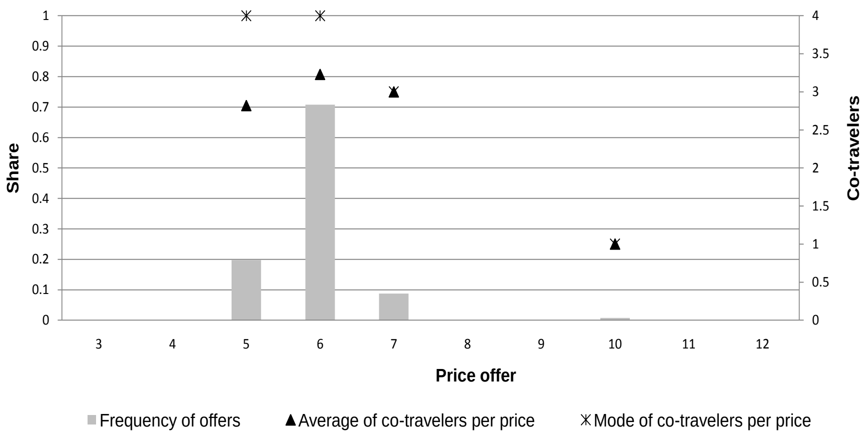


Figure 1: Distribution of prices and average number of passengers per price.

Taking the data from our observations as given, we can identify which price offer brings the highest average revenue to the proposer. Using a Robust Rank Order test (F-P test, according to Fligner and Policello, 1981), we find that the average revenue of proposers who charged €7 is significantly larger than the average revenue of proposers who charged any other observed price (5, 6, 7, 8, or 10[9] Euro).[10] The reason is that the average number of co-travelers a proposer could get at prices €5, €6, and €7 is almost identical.[11] On the other hand, the modal revenue collected with the price of €6 ($4 \cdot 6 = 24$) is higher, than the modal revenue collected with the prices of €7 ($3 \cdot 7 = 21$) or €5 ($4 \cdot 5 = 20$).

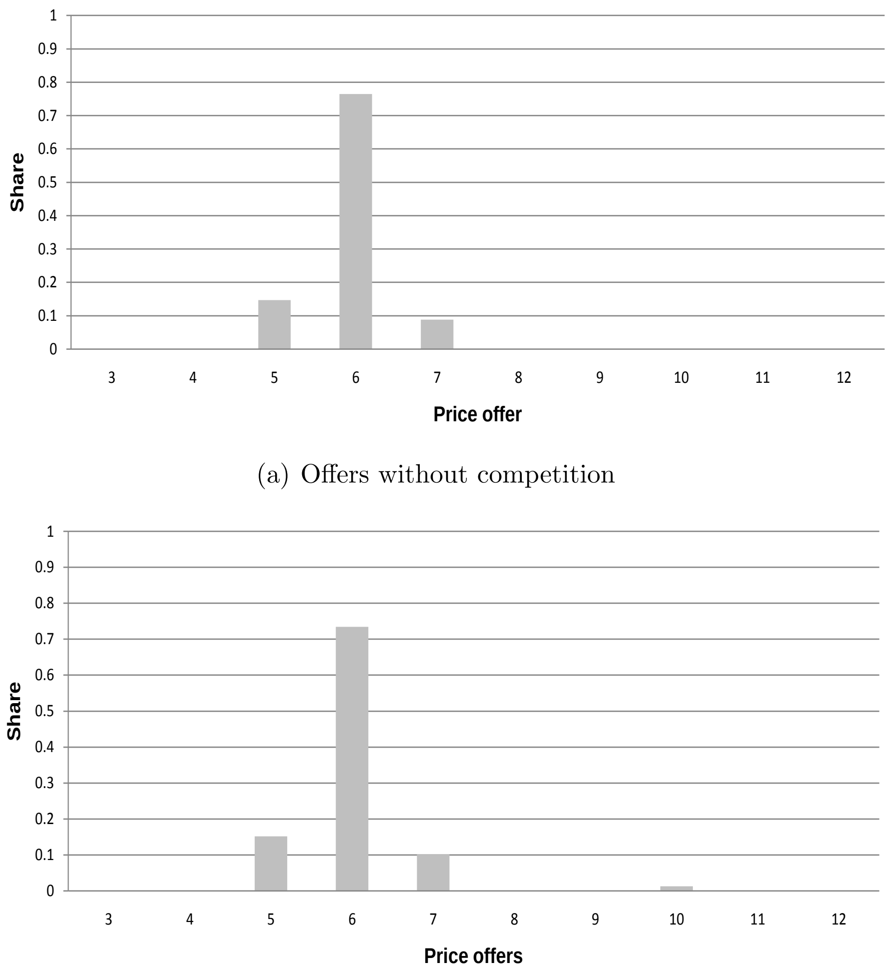
Although the price of €7 was chosen very rarely by the proposers, we did not observe it to be offered under special circumstances only, e.g. with only one proposer in the market. In fact, using the F-P test for comparison between the series of prices when there is one proposer (no competition) in the market and

[9]For the prices of 8 and 10 we used the data collected by us in the active participation phase.

[10]P-value ¡ 0.05 between the series of revenue produced by €7 offer and each of the other observed price offers.

[11]In the active participation phase of the experiment, we find that only for prices of €8 and above it is hard to get more than a single co-traveler.

when there are at least two proposers (some competition), we find no significant difference (P-value = 0.83) between the series. The distributions of prices under these two conditions are given in Figure 2.



(a) Offers without competition

(b) Offers with competition

Figure 2: The distribution of price offers in the market with one (a) and several (b) proposers

We can formulate our main observations as follows:

Observation 1: *Almost 50% of proposers do not exhaust the time until the departure to find additional co-travelers.*

Observation 2: *The prevailing price in the market (€6) brings the highest modal revenue, while €7 brings to the highest average revenue.*

Observation 3: The average of the most frequent offers of €5 and €6 corresponds to the equal split of the ticket price (€29) between 5 people.

Observation 4: *The presence of additional proposers does not change the dis-*

tribution of price offers in the market and does not induce potential co-travelers to bargain for a lower price.

3.2 The equal-split as a focal point equilibrium

We observed that three price offers (5, 6, and 7 Euros) are chosen by a non-negligible share of proposers (however, we cannot exclude the possibility that also other price offers exist, due to the moderate sample size). As the three offers produce significantly different average revenue levels, it seems that either the observed distribution of co-travelers does not convey the expectations of the proposers about this distribution, or that the majority of proposers are not acting as revenue-maximizers, or both. Unfortunately, since the action of gathering co-travelers is perceived as illegal[12], proposers are not willing to discuss the peculiarities of price-setting with a curious researcher. We believe, however, that the described outcomes can well be explained if we abstract from the pure optimization strategies and consider the coordination aspect of this bargaining game.

Probably, the most comprehensive account of alternative rules used in implicit and explicit bargaining games is due to Schelling (1960). In one of the sections of his milestone book, Schelling suggests a view of a bargaining situation as such that "requires, for an ultimate agreement, some coordination of the participants' expectations" (Schelling, 1960, p.70). This view allows him to show the analogy between the search for an agreement in a meeting room and the coordination of behaviour in the situations where communication between the parties is not possible. Schelling shows by a variety of experiments that people often can coordinate their actions and achieve mutual interests despite the multiplicity of possible outcomes, and do so while being isolated from each other. The successful coordination strategies concentrate on the outsomes that "enjoy prominence, uniqueness, simplicity, precedent, or some rationale that makes them qualitatively different from the continuum of possible alternatives" (Schelling, 1960, p.70). Schelling refers to such outcomes at 'focal points'.

Likewise, in almost any bargaining situation there may be a range of outcomes, each of them being preferable to no agreement at all, but each of them viewed with more or less delight by the parties involved. Under these conditions, a player would rationally expect to have to make a concession, a condition however being that a "recognizable limit to retreat" (Schelling, 1960, p.71) can be set. Schelling claims that an ultimate agreement would then often occur at a focal point acting as such an expected limit of retreat, despite that the rationale behind it may be as weak as "if not here, where?". A reliable method to identify such a point a priori is as easy as to imagine what agreement could be achieved if the parties could not communicate.

A prominent focal point, appearing at multiple occasions in Schelling's book,

[12] Proposers are only allowed to use the ticket with the same group of co-travelers. Typically, proposers in the afternoon in Kiel usually use the SH-ticket that was bought in Hamburg in the morning, which is illegal.

but also in the variety of more recent papers, is the equal split of costs or benefits. Janssen (2006) uses the examples of the Nash bargaining game and of the Ultimatum game to show how the focal equal split of the surplus emerges if the positions of the two players are symmetric or subjectively perceived to be symmetric by the players.[13]

Green *et al.* (1967) and Gächter and Riedl (2005) find, in bilateral bargaining experiments, that even in the asymmetric situation (Green *et al.*, 1967) or in situations which is perceived as asymmetric (Gächter and Riedl, 2005) subjects agree upon the symmetric equal share. In particular, Green *et al.*, 1967 conducted a variant of a two-person ultimatum game. Player A decides upon a division of money and player B could agree or reject. If player B rejects, each player earns his/her outside option (each player's outside option is lower than the equal split in case of agreement). Green *et al.*, 1967 investigated the case where the outside option is symmetric and also the case where the outside option is asymmetric (i.e. the outside option of the player A is larger than of player B by a ratio of 2:1). They find that even in the asymmetric case the outcome fell almost always close to the symmetric equal split. Gächter and Riedl (2005) conducted an unstructured bargaining experiment where, first, subjects face a hypothetical bargaining situation. After the subjects state the division of payoffs in this hypothetical situation, they participate in a unstructured bargaining experiment (they could only communicate through a computer terminal) which resemble the hypothetical bargaining situation they faced in the beginning of the experiment. Although, in general, in the hypothetical situation bargainers divided the payoff according to the relative performance of the parties, in the actual experiment bargainers divided the payoff between the parties equally. Thus, the discrepancy between the normative judgments and actual negotiation behavior, demonstrate the strength of the equal split as a negotiation resolution even in a cases perceived by the bargainers as asymmetric.

Furthermore, Janssen (2006) suggests a way to distinguish empirically between 'fairness' considerations and focal point considerations in the bargaining situations leading to the equal split outcome. He argues that while several outcomes may be perceived by the players as being still fair enough, the focal outcome does not endure even smallest deviations. 'Players either follow the rule or not' (Janssen, 2006, p.632). It implies that if many players base their strategies on the focality of the equal split, this solution must clearly stand out as the mode of the distribution of the observed outcomes.

Taking this argument to account, we interpret our results (Observations 2-4) as a proof of high relevance of the focality of the equal split also for asymmetric bargaining situations (where the asymmetry is known to the parties) in a completely natural environment. The existence of other outcomes does not contradict this interpretation, first, because not all players have to follow the same strategy, and second, because by using computer simulations (see Section 4), we are actually able to show that all observed outcomes may result from the equal split considerations. To get to this conclusion, we will have to make some

[13] Janssen (2006) refers to Pull (2003) and Selten (2000) for the support of the claim that the players may perceive the Ultimatum game as symmetric.

assumptions about the agents' behaviour.

3.3 The active participation phase

Recall that our aim at this phase was to reveal the price where the demand is equal to zero (i.e. no passenger is willing to come with us). Although the prevailing price in the market is €6, it was only at the price of €18 that we did not find a single person to join us. This indicates that at least some potential co-travelers are willing to pay any price as long as it is lower than the full cost of the ticket, as economic theory predicts

Observation 5: *Only at a price of €18 none of the potential co-travelers were willing to join our travel to Hamburg.*

Although the collected observations are not entirely comparable with each other, it is still worthwhile to present some findings. Figure 3 illustrates that when the price increases, the share of rejected offers increases monotonically. Moreover, this figure also indicates that the higher the price offer, the lower the average number of co-travelers willing to join.[14]

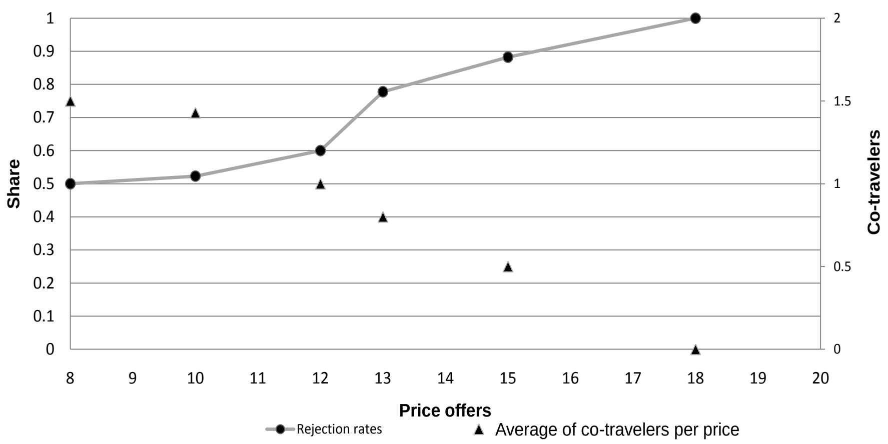


Figure 3: Rejection rates and the average number of co-travelers per price offer.

Finally, we estimated a Logit model, to see if the price, time pressure, and the difference in gender between proposers and potential co-travelers affect the probability that a potential co-traveler will accept an offer. The gender interaction dummy equals 1 when the genders of a proposer and a potential co-traveler are different. The time pressure dummy equals 1 when offer was made less than 10 minutes to the train departure. The results are presented in Table 3. As expected, the probability to accept an offer is lower, the higher the price offer. In addition, the probability to accept an offer is higher when the offer is made right before the train departure time. This result is in line with other bargaining

[14]We do not include the prices of 14 and 17 in Figure 3since we had only 2 and 1 observations of each price, respectively.

experiments imposing a deadline (e.g., Gneezy *et al.*, 2003).

Variable name	Acceptance Rate
Price offered	-0.32***
	(0.08)
Gender interaction	-0.13
	(0.46)
Time pressure	0.83*
	(0.46)
Constant	2.77
	(1.02)
LR test (K-1)	23.36***
McFadden's Pseudo R^2	0.16

* =10% s.l, **= 5% s.l,***=1%s.l

Table 3: Logit estimation of the factors determining the acceptance rate

Observation 6: *The probability to accept an offer is decreasing with higher price offers, and increasing when the offer is made right before the train departure time.*

4 A Simulation Study

In this section we use computer simulations to identify sufficient conditions for the observed behavior. In the recent years, we witness a growing tendency to use agent-based computer simulations in order to explain results obtained from laboratory studies with human subjects (see Duffy, 2006 for a review). Contini *et al.* (2006) identify the contributions of agent-based computer simulations to our understanding of human behavior. Two points are especially appealing for our study. The first is that "agent-based models can be used to investigate sufficient conditions for specific patterns of individual or aggregate behavior to emerge, given the details of the interaction structures" (Contini *et al.*, 2006, p.4). Second, they "provide a benchmark against which to evaluate the actual results of the human subject" (Contini *et al.*, 2006, p.4). These two points describe quite precisely the motivation for the following analysis.

This section presents a simulation study of a simple model (without learning) that allows for different types of behaviour. The agents in the market are distinguished according to the strategy used to coordinate expectations, and according to their attitude towards asymmetry. Using this simulation study, we are able to show that if many travelers try to coordinate their strategies using the equal split between the maximum possible number of group members as a focal point, and if only few people have strong preference against asymmetric payoffs, the resulting distribution of prices is very similar to what we actually observe in the central station of Kiel.

4.1 The model

To begin, consider a situation with a steady flow of travelers from Kiel to Hamburg coming one-by-one to a single meeting place. Sharing the SH-ticket is the cheapest option to travel one-way, so the one-way travelers try to organize themselves in groups of 5, and decide who will be the lucky one to pay €5 by a random draw. The other four travelers will pay €6 (under the behavioral regularity that only integer offers are observed). Thus, a one-way traveler, i, expects to pay:

$$P_i = \left\{ \begin{array}{ll} €5, & \text{with probability } 0.2 \\ €6, & \text{with probability } 0.8 \end{array} \right\}$$

Let there be some share of two-way travelers in the market. Naturally, a two-way traveler faces a higher incentive to buy the ticket himself and offer to take other travelers with him than a one-way traveler. We will assume that there are enough one-way travelers for each two-way traveler.[15]

Note that it is possible to define a lower bound for the offer a two-way traveler would make. However, he will only do so if he expect that the cost of buying the S-H ticket plus the revenue from taking the co-travelers is smaller than the cost of buying a one-way ticket for the travel from Hamburg[16] plus paying for a share travel from Kiel. Thus, there is a whole range of prices that the proposer can consider. As we do not observe prices at the level of the lower bound, we assume that no sufficient downward pressure on the prices exists, which could be the case if the proposers were too many and competed with each other.

A two-way traveler tries to ensure that other people join his group, and has to compete with the sharing offers. The fixed price of proposer's offer then must be determined by a mixed strategy resulting in the expected value slightly under the expected contribution in the sharing game (otherwise, nobody would want to join the proposer's group). The requested fixed price must not be much lower, however, because then it would be better for the proposer to try to share the ticket with 4 additional travelers, than to approach them with a fixed price offer. Thus, a two-way traveler, j, will offer:

$$P_j = \left\{ \begin{array}{ll} €5\text{-}\epsilon, & \text{with probability } 0.2 \\ €6\text{-}\epsilon, & \text{with probability } 0.8 \end{array} \right\}$$

where ϵ is arbitrary small. We can reasonably assume that ϵ is indeed 0 in pure monetary terms, but instead the motivation for the one-way travelers to join the proposer is the small service provided by the proposer in the form of releasing the co-travelers from the effort of forming the group. So far the co-travelers do not care about the asymmetric use of the ticket.

In reality, however, the intensity of passenger flow is not constant; it varies depending on the time of the day and the day of the week. Travelers perceive this intensity subjectively (since they cannot measure the number of the travelers

[15]Enough in this context means that the number of two-way travelers is not larger than $\frac{1}{5}$th of the one-way travelers in the market.

[16]There was no established market for group travel from Hamburg to Kiel by the time of the experiment

at each time point). We assume that by subjectively evaluating the number of people in the station and comparing this to prior experience, any two-way traveler can get an idea of the most probable number of one-way travelers that would join his group before the train departure. Similarly, any one-way traveler can get an idea about the most probable number of other one-way travelers who would show up and want to share the ride with him. If the number of the people in the station is low, both types of travelers would rationally assume that they might not get the maximum number of people to join their group.

Basing upon the focal point theory, we assume that in this situation, the travelers will try to coordinate their expectations. The *equal split* of the ticket price between the *expected number of members of the group* comes naturally as a mutually recognizable rule of setting the price of a shared ride, if both bargaining parties expect the other player to expect the same size of the group. In this case, for example, the two-way travelers will expect the one-way travelers to be unwilling to pay more than what would be the equal split within the group of the size expected by the one-way traveler. However, we can argue that both the idea of the equal split and the base for expectations formation can differ across the population.

Regarding the expectations, we assume that there are two types of agents, *optimists* and *realists*. Optimistic agents form their expectations based on the most frequent size of the group generally observed in the market (5 people). In this case, the optimist proposer (two-way traveler) will play a mixed strategy of offering P_j. All potential co-travelers will accept these offers because they are equivalent to playing the sharing game with the maximum size of the group, and they cannot do better than this.

Realistic agents (both one- and two-way travelers) recognize that the modal size of the group varies over time, determined by the state of nature (intensity of the passenger flow), and expect this fact to be known to other travelers. We will assume these agents can correctly recognize the current state of nature. The realist proposers would then charge different prices depending on the state of nature that they observe. They would still try to coordinate expectations with the potential co-travelers, and thus would play an equivalent of the sharing game, depending on the expected size of the group. If we consider the behavioral regularity towards integers, a realist two-way traveler, j, will use the strategy $S_j^r(n)$ if n is the expected number of co-travelers (see Table). The one-way realist traveler would correctly perceive the state of nature and would accept all offers of realist proposers and of optimist proposers. Optimistic one-way travelers would, however, reject strategies based on $n < 3$, as they all always expect a group of 5 people to form.

Now we come to the possibility of different interpretation of the notion of equal split. Until now we assumed that one-way travelers do not require two-way travelers to pay more, although it is common knowledge that two-way travelers make more use of the SH-ticket. Let us assume a type of "fair" travelers. These fair travelers assume that everyone should pay according to the usage of the ticket. In other words, as a two-way traveler uses the ticket (at least) twice, then he should pay roughly the double. We will refer to the travelers that do

Strategy	Description
$S_j^r(4)$	Request €5 20% of the time and €6 80% of the time
$S_j^r(3)$	Request €7 75% of the time and €8 25% of the time
$S_j^r(2)$	Request €9 33% of the time and €10 67% of the time
$S_j^r(1)$	Request €14 50% of the time and €15 50% of the time

Table 4: Strategies of the realist proposer

not care about such fair split as 'normal'. The one-way optimist fair traveler will then only accept the offer of €5. In turn, a one-way realist fair traveler will expect the proposer to come with the strategy $S_j^r(n)$ for different values of n:

Strategy	Description
$S_j^f(4)$	Request €5 (expected own contribution: €9)
$S_j^f(3)$	Request €6 (expected own contribution: €11)
$S_j^f(2)$	Request €7 (expected own contribution: €15)
$S_j^f(1)$	Request €10 (expected own contribution: €19)

Table 5: Strategies of the fair proposer

4.2 Simulation results

Let us assume that the empirical distribution of the modal number of co-travelers that was observed in Kiel's train station for low prices (5 and 6 Euros) is the true distribution. Table 6 presents this "true" distribution.

Number of co-travelers	4	3	2	1
Probability (%)	60.8	16.6	12.5	10
Average shared price (€)	5.8	7.25	9.6	14.5

Table 6: Empirical distribution of the modal number of co-travelers for prices of 5 and 6 as observed in Kiel train station.

The simulation procedure consists of the following steps:

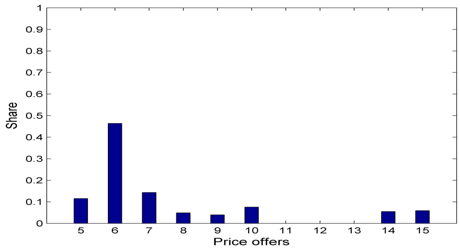
1. The state of nature (expected number of co-travelers perceived by the proposers) is drawn from the distribution in Table 6.
2. A proposer is generated, characterized by type (optimist/realist, fair/normal).
3. Potential co-travelers, also characterized by type, are generated one by one. They interact with the proposer and the outcome of bargaining (accept/reject) is determined according to the described strategies.
4. If the first offer is rejected, the next potential co-traveler is generated and step (3) is repeated.

5. After an offer is accepted, the price offer is saved.

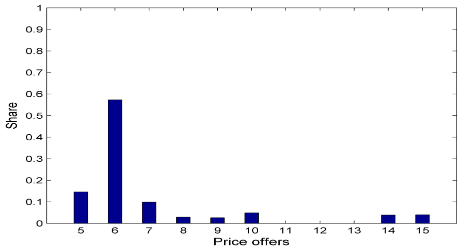
6. Steps (1) until (5) are performed M times with M=10000.

The simulation results for different shares of optimists and fairness-lovers in the population are displayed in Figures 4-7. Figures 4(a), 5(a), 6(a) and 7(a) describe the distribution of prices in the case that all travelers in the market recognize the true state of nature. The rest of the figures illustrate that with higher share of optimists in the population of travelers, the distribution of prices changes towards a bivariate distribution with only two prices, €5 and €6. Note that, as we move from Figure 4 to Figure 7, we observe that higher share of "fairness-lovers", increases the number of offers of €5. Finally, situation with about 67% optimists and a small share of fair (up to 10%) replicates the observed price distribution quite accurately (P-values of the F-P test ranging between 0.3 and 0.6).

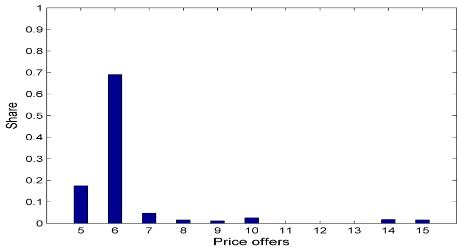
To sum up, using this simulation exercise, we are able to suggest possible conditions that bring the observed distribution of prices. Under quite reasonable assumptions and using the empirical distribution of travelers that was observed in Kiel's train station, we find that market forces lead to the observed distribution of prices if two conditions are met: First, the share of optimists is sufficiently large (but also not too large). Second, the share of fairness-lovers is sufficiently small. The simulation exercise also provides us some benchmark results under extreme conditions, that can be compared to the empirical distribution of prices. For example, it provides a price distribution where half of the population are not willing to equal-split due to asymmetry (Figure 7), or situations where the "true" state of nature is known to all travelers (Figures 4(a), 5(a), 6(a), and 7(a)).



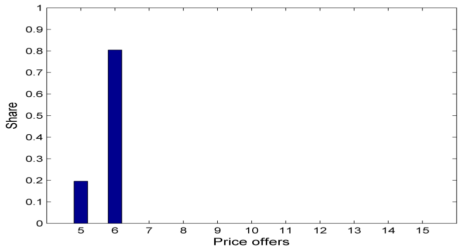
(a) Distribution of prices (0% optimists)



(b) Distribution of prices (33% optimists)

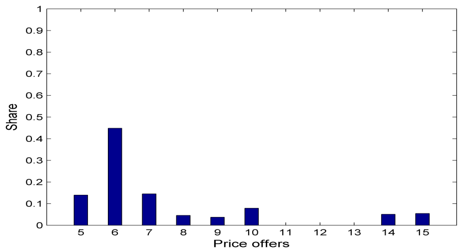


(c) Distribution of prices (67% optimists)

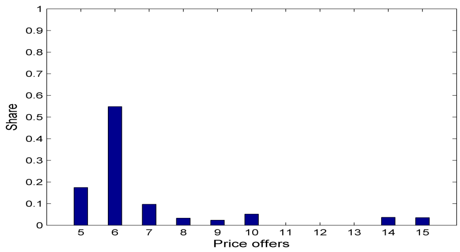


(d) Distribution of prices (100% optimists)

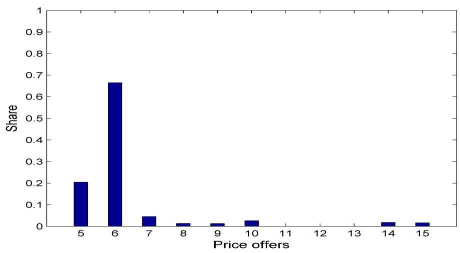
Figure 4: Distribution of prices for different shares of optimists and 0% fairness-lovers



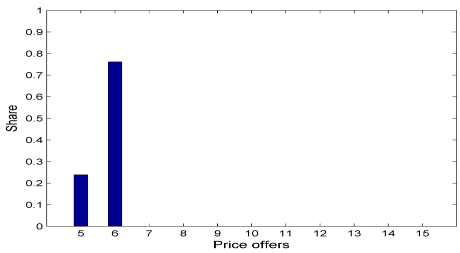
(a) Distribution of prices (0% optimists)



(b) Distribution of prices (33% optimists)

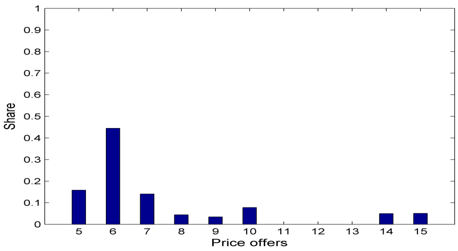


(c) Distribution of prices (67% optimists)

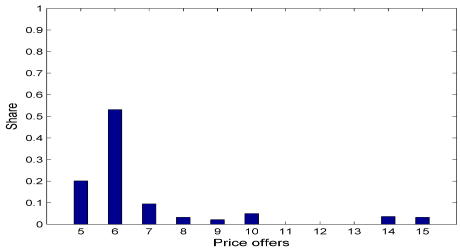


(d) Distribution of prices (100% optimists)

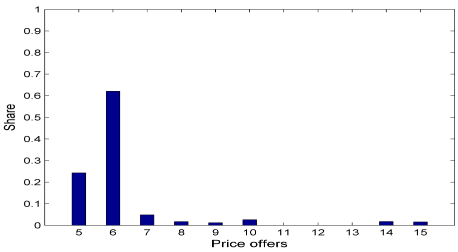
Figure 5: Distribution of prices for different shares of optimists and 5% fairness-lovers



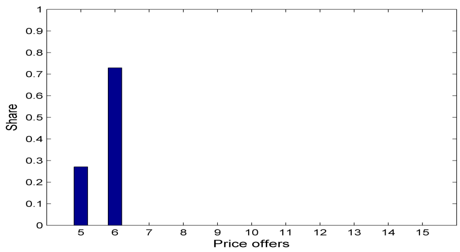
(a) Distribution of prices (0% optimists)



(b) Distribution of prices (33% optimists)

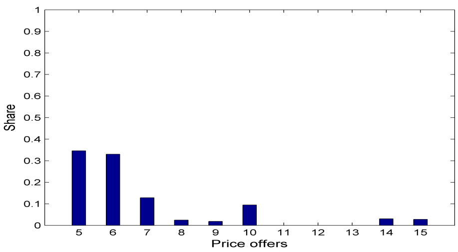


(c) Distribution of prices (67% optimists)

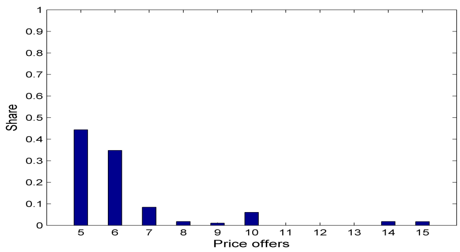


(d) Distribution of prices (100% optimists)

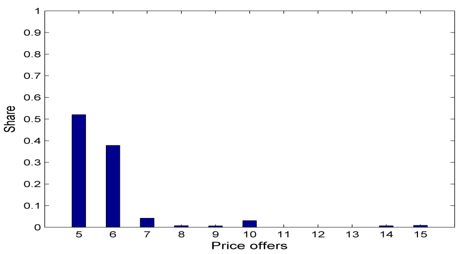
Figure 6: Distribution of prices for different shares of optimists and 10% fairness-lovers



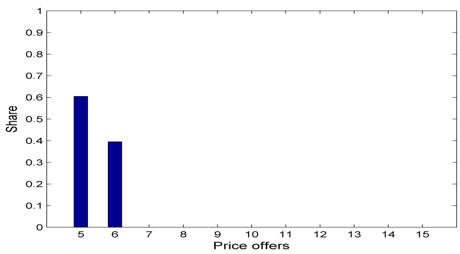
(a) Distribution of prices (0% optimists)



(b) Distribution of prices (33% optimists)



(c) Distribution of prices (67% optimists)



(d) Distribution of prices (100% optimists)

Figure 7: Distribution of prices for different shares of optimists and 50% fairness-lovers

5 Concluding Remarks

This study describes the informal market for group train travel in the German city of Kiel. This market emerges with the introduction of small-group tickets which allows for a group of maximum five people to travel in regional trains in three neighboring federal states. The market is mainly characterized by individual proposers who search for co-travelers shortly before the train departure. All co-travelers pay the same price and potential co-travelers do not bargain, but usually accept or reject the offers.

Observing the market bring up some interesting findings: First, almost half of the proposers who find less than four co-travelers do not exhaust the time until the departure to find additional co-travelers. Second, the prevailing price in the market is not the price of €6 which brings the highest average revenue but the price of €5 which brings the highest modal revenue. Third, the offers of €5 and €6 are remarkably split in such shares, that the average of these two offers equals to what would be an equal split of the ticket price (€29) between 5 people. Fourth, the presence of additional proposers does not change the distribution of price offers in the market and does not induce potential co-travelers to bargain for a lower price. Our findings about the distribution of price offers can be best explained by focal point theory, where the equal-split serves as a focal point. This evidence is particularly interesting since there is a clear asymmetry between the proposer and his/her co-travelers. Although this point was already observed in the lab (see, for example, Green *et al.*, 1967, and Gächter and Riedl, 2005), we are able to demonstrate the importance of equal-split in a completely natural environment.

Moreover, using agent-based computer simulations, we identify two conditions for replication of the observed pattern of prices: First, a large share of travelers is assumed to be optimistic about the chances to form a group of 5 people at any time. Second, only few travelers have preferences against equal split in this case of clear asymmetry between proposers and co-travelers. When these two conditions are met we observe a similar price distribution to the actual observed. The simulation also allows us to compare the observed pattern of prices with different conditions (for instance, the case when all travelers are realistic regarding the probability of a proposer to find four co-travelers, when many of the travelers are against equal share since it is 'unfair', etc.). Finally, by means of a natural field experiment, we show that the probability to accept an offer is decreasing with the price and is increasing when the offer is made right before the train departure.

References

CONTINI, B., LEOMBRUNI, R. and RICHIARDI, M. (2006). Exploring a new expace: The complementarities between experimental economics and agent-based computational economics. *Journal of Social Complexity*, **3** (1).

DUFFY, J. (2006). Agent-based models and human subject experiments. In L. Tesfatsion and K. L. Judd (eds.), *Handbook of Computational Economics*, *Handbook of Computational Economics*, vol. 2, *19*, Elsevier, pp. 949–1011.

FALK, A., FEHR, E. and FISCHBACHER, U. (2003). Reasons for conflict:

Lessons from bargaining experiments. *Journal of Institutional and Theoretical Economics (JITE)*, **159**, 171–198.

Fligner, M. A. and Policello, G. E. (1981). Robust rank procedures for the behrens-fisher problem. *Journal of the American Statistical Association*, **76**, 162–168.

Gächter, S. and Riedl, A. (2005). Moral property rights in bargaining with infeasible claims. *Management Science*, **51**, 249–263.

Gneezy, U., Haruvy, E. and Roth, A. E. (2003). Bargaining under a deadline: Evidence from the reverse ultimatum game. *Games and Economic Behavior*, **45**, 347–368.

Green, P. E., Gross, I. and Robinson, P. J. (1967). Behavioral experiment in two-person bargaining. *Journal of Marketing Research*, **4**, 374–379.

Güth, W., Huck, S. and Müller, W. (2001). The relevance of equal splits in ultimatum games. *Games and Economic Behavior*, **37**, 161–169.

—, Schmittberger, R. and Schwarze, B. (1982). An experimental analysis of ultimatum bargaining. *Journal of Economic Behavior and Organization*, **3**, 367–388.

Hoffman, E., McCabe, K., Shachat, K. and Smith, V. (1994). Preferences, property rights, and anonymity in bargaining games. *Games and Economic Behavior*, **7**, 346 – 380.

Janssen, M. C. (2006). On the strategic use of focal points in bargaining situations. *Journal of Economic Psychology*, **27**, 622–634.

Pull, K. (2003). Ultimatum games and wages: Evidence of an implicit bargain. *Schmalenbach Business Review*, **55**, 161–171.

Schelling, T. (1960). *The Strategy of Conflict*. Cambridge, Massachusetts: arvard University Press.

Selten, R. (2000). Thünenvorlesung: Eingeschrankte rationalitat und ökonomische motivation. *Zeitschrift fur Wirtschafts- und Sozialwissenschaften*, **9**, 129157.

A Appendix

Train	Proposers	Co-travelers	proposer arrival	proposer departure	Price	Price (5-6)
16:21	2.44	3.05	15:56	16:10	5.88	5.78
17:21	2.59	3.04	16:57	17:11	5.86	5.78
18:21	2.00	2.89	17:54	18:08	6.11	5.70
19:21	2.54	2.79	18:57	19:08	5.85	5.85

Table A.1: Average values according to the train's departure times, co-travelers denotes the number of co-travelers per proposer, price denotes the average price, and price (5-6) denotes the average between the most common observed prices of 5 and 6.

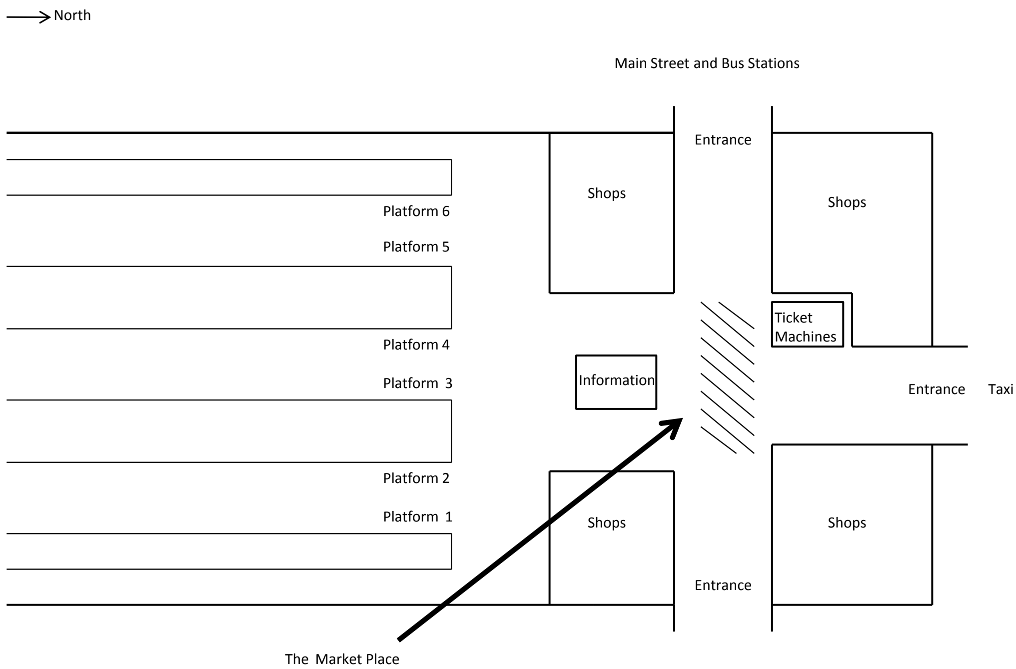


Figure A.1: plan of Kiel's central train station