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Keywords: natural field experiment; bargaining; focal point; equal split; agent-based model

JEL classification: C78; C93; D74; D83

Israel Waichman
Department of Economics, University of Kiel
Olshausenstrasse 40
24098 Kiel, Germany
E-mail: waichman@economics.uni-kiel.de

Artem Korzhenevych
Kiel Institute for the World Economy
Hindenburgufer 66
24105 Kiel, Germany
E-mail: artem.korzhenevych@ifw-kiel.de

Till Requate
Department of Economics, University of Kiel
Olshausenstrasse 40
24098 Kiel, Germany
E-mail: requate@economics.uni-kiel.de

Equal Split in the Informal Market for Group Train Travel*

Israel Waichman[†] Artem Korzhenevych[‡] Till Requate[§]

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†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, 24105 Kiel, Germany. Email: korzhenevych@economics.uni-kiel.de

§Department of Economics, University of Kiel, Olshausenstrasse 40, 24118 Kiel, Germany. Email: requate@economics.uni-kiel.de

1 Introduction

There is ample literature in experimental economics and psychology showing that people often agree on equal-split solutions when bargaining for a common surplus. Most of experiments reported in these studies focus on 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) 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 the players face uncertainty regarding the gains of the other parties (Janssen, 2006). An alternative explanation is then called for.

A very comprehensive account of alternative rules used in implicit and explicit bargaining games is due to Schelling (1960). In particular, Schelling shows by a variety of experiments that people are often able to coordinate their actions and achieve mutual interests despite the multiplicity of possible strategies, and do so even while being isolated from each other. The successful coordination strategies concentrate on the outcomes 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'.

A prominent focal point, appearing at multiple occasions in Schelling's book, but also in the variety of more recent papers, is the equal split of costs or benefits. In most papers describing economic experiments equal split occurs under the conditions of symmetry. For example, 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.[1]

Some authors, however, suggest that equal split may preserve its prominence also under less favorable conditions. For example, Green *et al.* (1967) describe a two-person bargaining game, where the joint return from cooperation is higher than the sum of individual returns without cooperation. One player suggests a way to divide the joint payoff, and the other player can accept this cooperation or reject it. An interesting finding in this situation is that departures from a 50-50 split of joint payoff are modest even in the trials where the individual payoffs are substantially asymmetric. The authors interpret this finding as a proof of the strength of the focal point principle.

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 in the informal market for group train travel. The scene is the central train station of Kiel, Germany. One of the features of the market is the obvious asymmetry between the participants, which makes the results even more interesting.

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 five 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 by contributing a certain part of the ticket price. Thus, a bargaining situation

[1]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.

is created, where a traveler in possession of a group ticket 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 fact that potential co-travelers do not bargain, but usually accept or reject the offer right away, resembles, to some extent, the Ultimatum bargaining 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 maximum possible number of co-travelers. This result is remarkable because the proposers obviously have more use of the ticket, and full group formation is not always possible. We are able to show, by means of a simple agent-based model, that the observed distribution of prices can be replicated under two important conditions: if a large share of travelers base their expectations upon the maximum (and most frequently observed) size of the group, and if only few travelers have preferences against equal split in this case of asymmetry between proposers and co-travelers. In addition, 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.[2] 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[3] 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 he/she will find in the time left until the departure. In fact, 92% of our obser-

[2]For informed readers, it costs the same €14.40 with a 'Bahncard 25' and with a 'Bahncard 50'.

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

vations are of this kind. We are not interested in the cases where the price is determined ex post 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[4]. A person that agreed on the offered price stays with the proposer, which means that any consequent potential co-travelers (we will sometimes call them 'responders' for short) are offered the same price.[5] 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[6]. The distance between the two is short enough (80 minutes travel), such that many people regularly travel from Kiel to Hamburg for work[7] 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[8] and the

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

[5] 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.

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

[7] 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)

[8] This is particularly amazing, because most people acting in the market perceive this activity as illegal.

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 travelers who make a round trip create a sustainable and flourishing market for group travel by train. 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.

2.2 The 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 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.[9] 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

[9]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.

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 The active participation phase

The observation phase gave us interesting information about the proposers' behavior, 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 the shared ride to Hamburg for a fixed 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).

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. when no traveler would be willing to come with us).

3 Results

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 unusually high 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 3.2 responders agree to the offer. In addition, 64% of the proposers are males, and only 5% are (looking) older than 40 years. A fact important for our further analysis is that the most frequent (56% of all cases) number of co-travelers coincides with the maximum possible number (4 people). Two remarkable 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 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-travelers were observed at all prices, except €5. Furthermore, a proposer could not always ensure to get 4 co-travelers even with the lowest observed price 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-travelers 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

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

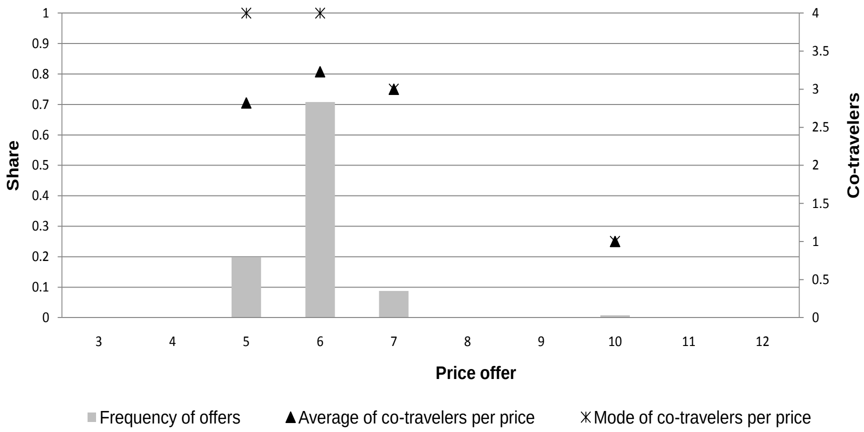


Figure 1: Observed prices and average number of co-travelers.

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[10] Euro).[11] The reason is that the average number of co-travelers a proposer could get at prices €5, €6, and €7 is almost identical.[12] 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 higher price of €7 was rarely chosen by the proposers, we did not observe it to be offered only under special competition conditions. 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 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.

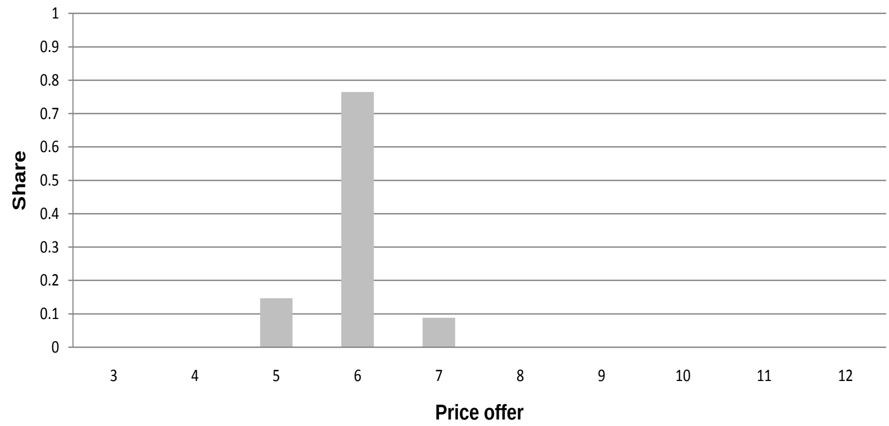
We can formulate our main observations as follows:

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

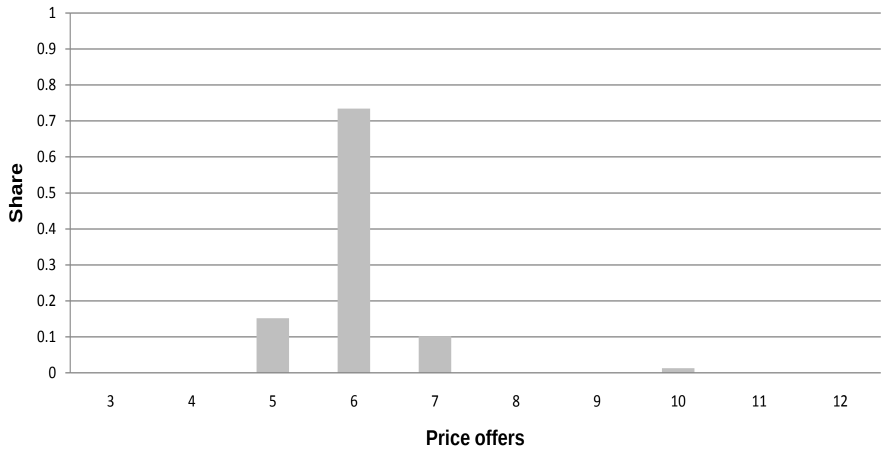
[10] For the prices of 8 and 10 we used the data collected by us in the active participation phase.

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

[12] 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.



(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

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

Observation 3: Rejections of proposers' offers are observed at all prices except for the lowest observed price of €5.

Observation 4: *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.*

In general, the distibution of the price offers is the most puzzling result of our observations. As displayed in Fugure 1, three price offers (5, 6, and 7 Euros) are chosen by a non-negligible share of proposers (however, due to moderate sample size, we cannot exclude the possibility that also other price offers exist). As the three offers produce (significantly) different average revenue levels, it seems that either the observed distribution of demand for shared ride (the number of co-travelers at these prices) 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[13], proposers are not willing to discuss the peculiarities of price-setting with a curious researcher.

We claim that the key to understand the observed distribution of price offers is to consider the alternatives that the one-way travelers assume to have. In fact, sharing the SH-ticket with five other people is the cheapest option a traveler by train from Kiel to Hamburg has. If the number of one-way travelers were unlimited, they would always try to organize themselves in groups of five and pay an average of €5.80 per trip. However, as clearly follows from our observations, it is not always possible to form a group of the maximum size. In such a case, a rational one-way traveler can no longer expect to have the option of paying €5.80. Moreover, a rational proposer offering a shared ride for a fixed price would also recognize that sometimes the one-way travelers do not have the outside option of paying €5.80. In fact, in more than 50% of the observed train departures, the mean number of co-travelers per proposer was less than 4, and in 20% it was only 2 or lower, while the price offers remained at the level of €5 or €6. There were simply not enough one-way travelers to Hamburg around at those occasions. Why didn't the price offers go up then?

Our understanding is that additional, unobserved factors influence the perception of the market situation by the proposers, which makes them reluctant

[13]A ticket should be used by one and the same group of co-travelers. However, because only one person has to write his/her name on the ticket, the possibility for misconduct is left open. In the afternoon, proposers in Kiel typically offer to share an SH-ticket that was bought in Hamburg in the morning, which is illegal.

to choose higher price offers. The exact reason for such behavior is not possible to reveal using the data we have. Possible explanations could include the fear of competition with other proposers, some type of unwillingness to be considered greedy, uncertainty (having little experience with this market), time pressure, etc. We think that any of these factors or their combinations may be true for any individual. However, as we explain later, a lot of such assumptions result in the same market strategy.

One more puzzling finding is that some responders reject the price of €6. We think that it is not only the pure sharing outcome of €5.80 that is seen as an outside option by the responders in these cases. More important is that some proposers offer a shared ride for €5 in the first place. Obviously, although the difference between €5.80 and €6 is rather small, it could be a reason enough for some reponders to reject the offer. However, we think that it is not likely that the proposer would charge €5 just to prevent the rejection based on the €0.20 difference.[14] It is however more plausible to assume that the proposer might consider it fair to divide the ticket price by the *number of uses* of the ticket, and might thus accept double charge on the own account. If many proposers behave like this, the potential co-travelers would see a clear possibility to pay even less than €5.80 on average and thus would have a reason to reject the price of €6.

In Section 4, we suggest a simple model of the market situation under study, which allows for different expectations by the participants, as well as for different attitudes towards fairness. We show that this simple model is capable of reproducing the observed price distribution.

[14]In the situation with many travelers in the market, a proposer can reasonably assume that at least some people will not be such extreme optimizers, and a complete group can be formed despite some rejections.

3.2 The active participation phase

Recall that our aim in this phase was to reveal the price where the demand is equal to zero (i.e. no potential co-traveler 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 share the ride 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 the proposer.[15]

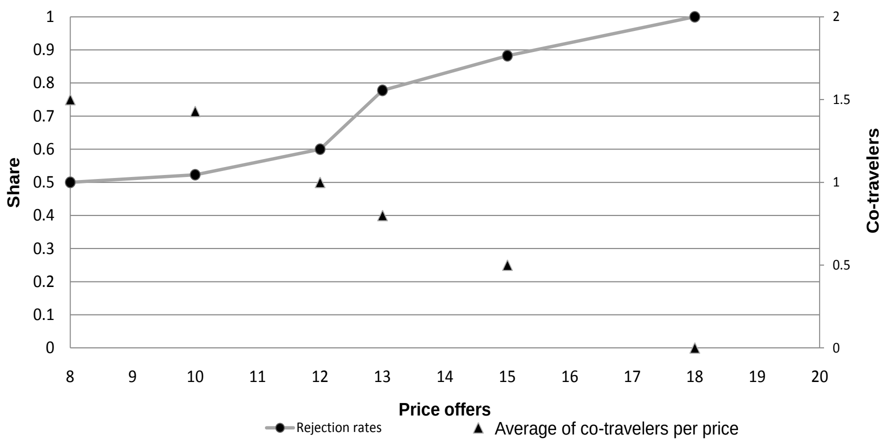


Figure 3: Rejection rates and the average number of co-travelers per price offer.

Finally, we estimated a Logit model, to see if the price, time pressure, and

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

the difference in gender between a proposer and a potential co-traveler 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 before 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 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 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 experiments" (ibid., p.4). These two points describe quite precisely the motivation for the following analysis.

This section presents a simulation study based on a simple model (without learning) that allows for different types of behavior. The agents in the market are distinguished according to the level of expertise in the market, and according to their attitude towards asymmetry. Using this simulation study, we are able to show that if many travelers try to coordinate their expectations using the equal split between the maximum number of group members as a focal point, and if only few people have strong preference against the asymmetric use of the ticket, 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, imagine a situation with many (identical) one-way travelers from Kiel to Hamburg coming to a small spot near the ticket-selling machines. The ticket prices are as described in Section 2. Given the high prices for single tickets, sharing a group ticket is a better choice for any traveler, if the ticket cost is divided in a mutually acceptable way. In a symmetric setup, the most natural way to split the cost would be the equal division. If the passenger flow is large, a group of maximum size can always be formed. Thus, in this situation a one-way traveler can expect to pay €5.80 per trip.

In reality, however, the intensity of passenger flow is not constantly large; it varies depending on the time of the day and the day of the week. We assume that any one-way traveler, r, would try to guess the number $N^r \leq 4$ of other one-way travelers who would show up and want to share the ride with him/her. The way this number is determined will be explained later. Thus, in this situation a one-way traveler expects to pay

$$P^r = 29/(N^r + 1).$$

Let there be some share of two-way travelers in the market. A two-way traveler has two basic options: to join a group of one-way travelers with an expected contribution of P^r (and to buy a single ticket for the way back), or to buy an SH-ticket and become a proposer. The latter option is better if

$$29/(N^p + 1) + T > 29 - N^p \cdot P^p, \text{ or}$$

$$T > N^p \cdot (29/(N^p + 1) - P^p),$$

where T is the single ticket price, $N^p \leq 4$ is the number of co-travelers expected by the proposer, and P^p is the fixed price offer of the proposer. T can take only two values: €14.40 or €19.20. Note that a proposer tries to ensure that other people join his group, and has to compete with the sharing offers[16], $P^p \leq P^r$. However, it is easy to show that if the proposer's price offer is not unreasonably lower than the expected equal split level[17], buying an SH-ticket is always a better choice. The two-way travelers thus always buy an SH-ticket and act as proposers.

The one-way travelers may theoretically also enter the scene as proposers. This would be reasonable if

[16]Possibly, one also keeps in mind the presence of other proposers. In this case, however, it is still most plausible to expect that also other proposers see pure sharing as the best outside option for the potential co-travelers and choose a price correspondingly.

[17]For example, charging €1 when expecting 4 people to join.

$$29/(N^p + 1) > 29 - N^p \cdot P^p, \text{ or}$$

$$29/(N^p + 1) < P^p.$$

The inequality holds if $N^r < N^p$ for every co-traveler r that joins the group of this proposer. It means that the proposer traveling one way must expect all potential co-travelers to have a lower guess of the perspective size of the group. This is a very brave assumption to make. Moreover, from our experience, the proposers are indeed always traveling two ways. That is why we will not consider the case of one-way travelers playing the role of proposers.

We are now ready to define the beliefs and strategies of different agents in the model. As argued above, the equal split of the ticket price between the *expected number of members of the group* is the relevant benchmark against which the fixed price offers of the proposers must be evaluated. However, we can argue that both the idea of the equal split and the base for expectations formation can differ across the population.

In general, our choice of behavioral rules is determined by the focal point theory. We assume that all agents base their strategies on a guess of the most probable size of the group, which is an *integer* number. The outcomes characterized by prominence or having the highest probability are very often used to coordinate strategies in the situations without communication (Schelling, 1960, Chapter 3). It is therefore plausible to assume that similar focal points are used as coordination devices by the bargaining parties in our market situation.

In particular, we assume that there are two types of agents in the market, *optimists* and *realists*. Optimistic agents (both one- and two-way travelers) form their expectations based on the maximum possible size of the group (5 people).[18] The optimistic proposers will thus choose prices close to the €5.80

[18]Implicitely, we assume here that the samples of one- and two-way travelers are not systematically different. It is done to keep the number of model parameters small.

benchmark. Alternatively, one could assume that some proposers are especially afraid of competition, or are unwilling to look gready, and thus choose prices only at the lower end of distribution. One more possble explanation of the same strategy would be the lack of experience, whereby the most frequently observed number of co-travelers or the most frequently chosen price (as communicated by some more experienced locals) is used as a base for expectations formation. The corresponding pricing strategy would however stay the same, and thus we have no way to distinguish between such alternative explanations.

Realists (again, both one- and two-way travelers), in turn, recognize that the average and modal size of the group vary over time, determined by the state of nature (intensity of the passenger flow), and expect this fact to be known to (many) other travelers. We will define 4 states of nature, distinguished by the expected modal number of co-travelers (4, 3, 2, and 1). For that, we will use our data on group formation for 71 train departures (from the observation phase), where only the prices of €5 and €6 where offered (to avoid the price effect). For each departure, we can identify the average group size. Intervals in the values of the mean group size are then defined, such that these intervals have different modes. The results are given in Table 4.

State of nature (intensity)	Above average	Average	Below average	Sporadic
Mean number of co-travelers	4.0-3.5	3.5-2.5	2.5-1.5	1.5-1
Modal number of co-travelers	4	3	2	1
Frequency (%)	48	23	21	8

Table 4: Empirical distribution of the number of co-travelers for prices of €5 and €6.

We will assume that realist agents can correctly recognize the current state of nature. A realist agent would thus make a guess $N^{p,r} = 3$ if the state of nature is 'average', etc, see Table 4. The realist proposers would then charge different prices depending on the state of nature that they observe. Realist responders will correspodingly revise the maximum fixed price offer they will agreee to. All proposers would keep the outside option of the responders in mind.

Given the observed regularity that only integer prices were used in our market, we have to incorporate this feature into the model. The focal point theory can again be used to argue that in order to coordinate mutual expectations, the proposers and responders would likely use the same rule and would round the non-integer outcomes to the next closest integer.

The price offer of the proposer will thus be

$$P^p = \lfloor 29/(N^p + 1) \rceil .$$

The maximum price to which the responder will agree will be

$$P^r = \lfloor 29/(N^r + 1) \rceil .$$

Now we come to the possibility of different interpretations of the notion of equal split. In reality, it is common knowledge that two-way travelers make more use of the SH-ticket. Let us assume a type of fairness-loving (or 'fair', for short) 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/she should pay the double. We will refer to the travelers that do not care about such fair split as 'normal'.

The price offer of the fairness-loving proposer will thus be

$$P^{pf} = \lfloor 29/(N^p + 2) \rceil .$$

The maximum price to which the fairness-loving responder will agree will be

$$P^{rf} = \lfloor 29/(N^r + 2) \rceil .$$

In the next subsection, we will let the share of optimists and the share of fairness-lovers be exogenous parameters, and will vary them. We will then try to find whether some combination of parameters would be able to produce the distribution of prices similar to what we actually observed in Kiel central station.

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. The simulation procedure consists of the following steps:

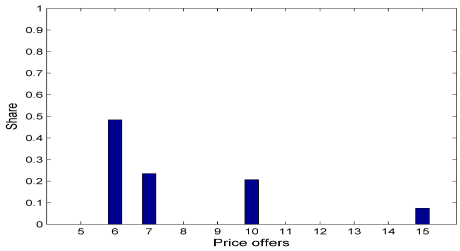
1. The state of nature (expected number of co-travelers perceived by the realists) is drawn from the distribution in Table 4.
2. A proposer is generated, characterized by type (optimist/realist, fair/normal).
3. A potential co-traveler (responder), also characterized by type, is generated.
4. The proposer and the responder meet and the outcome of bargaining is determined according to the described strategies.
5. If the first offer is rejected, the next potential co-traveler is generated and step (3) is repeated. After an offer is accepted, the price offer is saved.
6. Steps (1) until (5) are performed 10000 times.

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 distribution of 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. Note that Figure 5(b) resembles the empirical distribution of offers from the observation phase. In fact, for the share of optimists equal to 60% and the share of fairness-lovers equal to 20%, we get a distribution statistically indistinguishable from the observed one (F-P test produces P-value equal to 0.3).

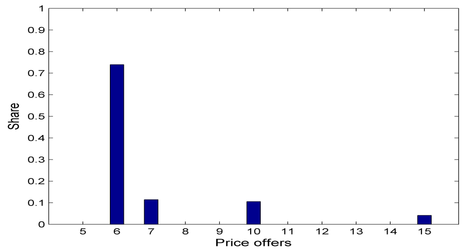
This simulation exercise allows us to identify sufficient conditions that bring the observed distribution of prices. Under quite reasonable assumptions and using the empirical distribution of travelers that was observed in Kiel's train station, we find that market interaction leads to the observed distribution 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 for the case where noone in the population is willing to split equally 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)).

5 Concluding Remarks

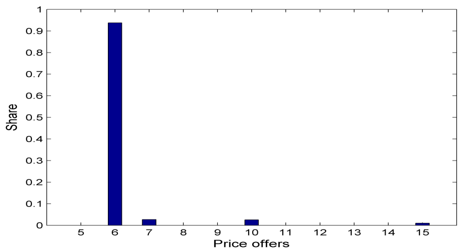
This study describes the informal market for group train travel in the central train station of Kiel, Germany. This market emerged with the introduction of the small-group ticket, which allows a group of maximum five people to travel in regional trains within the area of three neighboring federal states. The market is mainly characterized by individual proposers in possession of the group ticket who search for co-travelers shortly before the train departure. Proposers request a fixed price for a shared ride, without surely knowing how many co-travelers



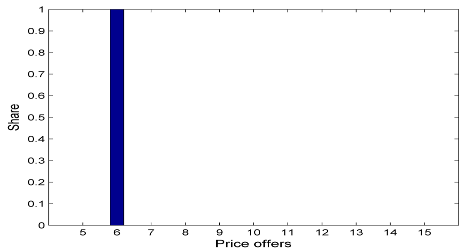
(a) Distribution of prices (0% optimists)



(b) Distribution of prices (33% optimists)

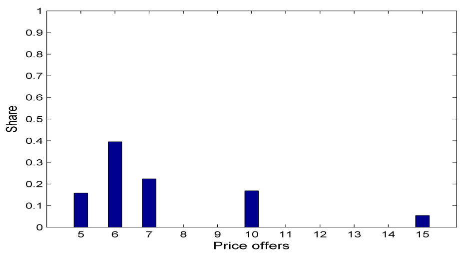


(c) Distribution of prices (67% optimists)

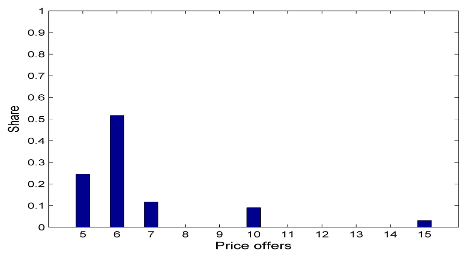


(d) Distribution of prices (100% optimists)

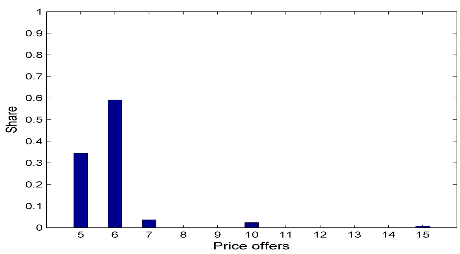
Figure 4: Distribution of prices for different shares of optimists and 0% fairness-lovers



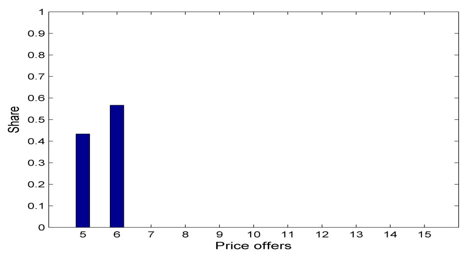
(a) Distribution of prices (0% optimists)



(b) Distribution of prices (33% optimists)



(c) Distribution of prices (67% optimists)

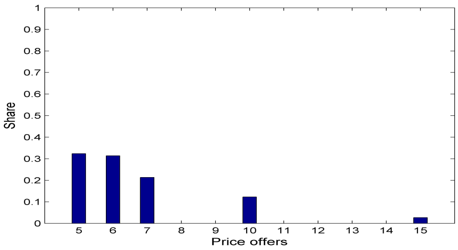


(d) Distribution of prices (100% optimists)

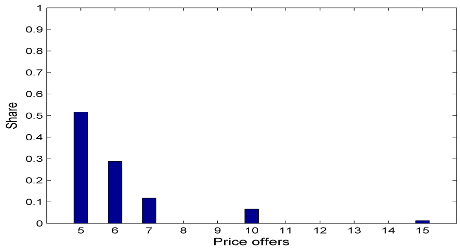
Figure 5: Distribution of prices for different shares of optimists and 33% fairness-lovers

they will eventually find.

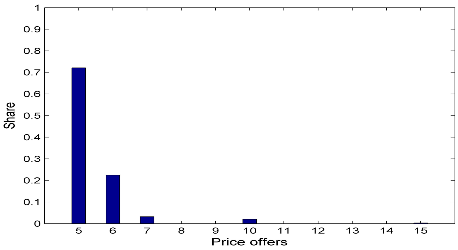
The observation of the market brings up some interesting findings: First, almost half of the proposers, who find less than four co-travelers, do not ex-



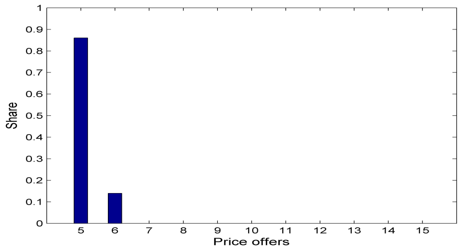
(a) Distribution of prices (0% optimists)



(b) Distribution of prices (33% optimists)

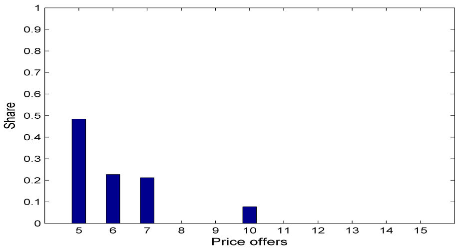


(c) Distribution of prices (67% optimists)

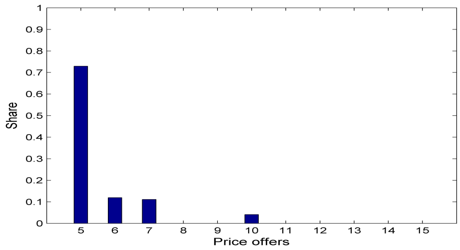


(d) Distribution of prices (100% optimists)

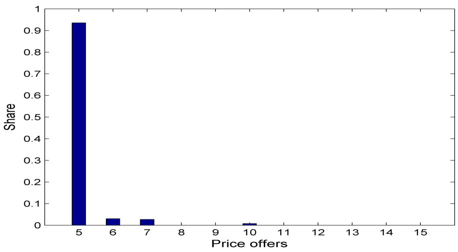
Figure 6: Distribution of prices for different shares of optimists and 67% fairness-lovers



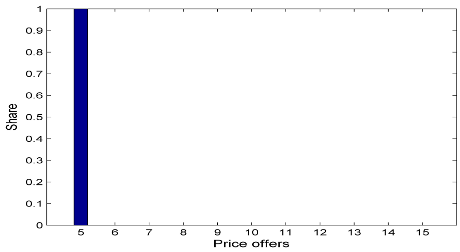
(a) Distribution of prices (0% optimists)



(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 100% fairness-lovers

haust the time until the departure to find additional co-travelers. Second, the prevailing price in the market is not the price of €7, which brings the highest average revenue, but the price of €6, which brings the highest modal revenue.

Third, despite the high prices of single tickets, rejections of such fixed offers occur at all prices except €5. 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. Fifth, by means of a natural field experiment, we show that the probability to accept an unusually high offer is decreasing with the price and is increasing when the offer is made right before the train departure.

Our findings about the distribution of price offers can be best explained by focal point theory, where the equal split of the ticket cost between the expected number of the members of the group is used as a coordination device. Although the focality of equal split was already observed in the lab (see, for example, Green *et al.*, 1967, and Gächter and Riedl, 2005), we are able to demonstrate the strength of this behavioural rule in a completely natural environment. Our findings are particularly interesting since there is a clear asymmetry between the proposer and the co-travelers in terms of the use of the ticket.

Using a simple agent-based simulation model, we are able to reproduce the key features of the observed price distribution. We show that two sufficient conditions for such pattern to arise are, first, a large share of travelers basing their expectations upon the maximum (and most frequently observed) size of the group, and second, a small share of travelers having explicit preference against equal split in this case of asymetric use of the ticket.

By the time this paper has been finalized, a quite remarkable development occured in the market under study. We mentioned in Section 2 that some share of the proposers in the market seem to do this on a professional basis, traveling the whole day between Kiel and Hamburg. After two years, the market seems to be dominated by such professional proposers, most of them being unemployed immigrants. They also managed to establish an active market for sharing the return trip in the central station of Hamburg, although the meeting point is not so ideally located there. Several features of the market that we described in this paper can provide an explanation for this development. First, the rules of the ticket use are not very strict and open clear arbitrage possibilities. Second, the demand for sharing offers is very large most of the time. Finally, we have shown that many travelers are eager to pay prices much higher than the usually observed ones. All this creates favorable conditions for the described transformation of this informal market, which is worth an additonal study. However, we will be surprised if Deutsche Bahn does not react to this development in the nearest future.

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A Appendix

Train	Proposers	Co-travelers	Average price	Average price (offers of €5 and €6)
16:21	2.44	3.05	5.88	5.78
17:21	2.59	3.04	5.86	5.78
18:21	2.00	2.89	6.11	5.70
19:21	2.54	2.79	5.85	5.85

Table A.1: Average values according to the train's departure times.

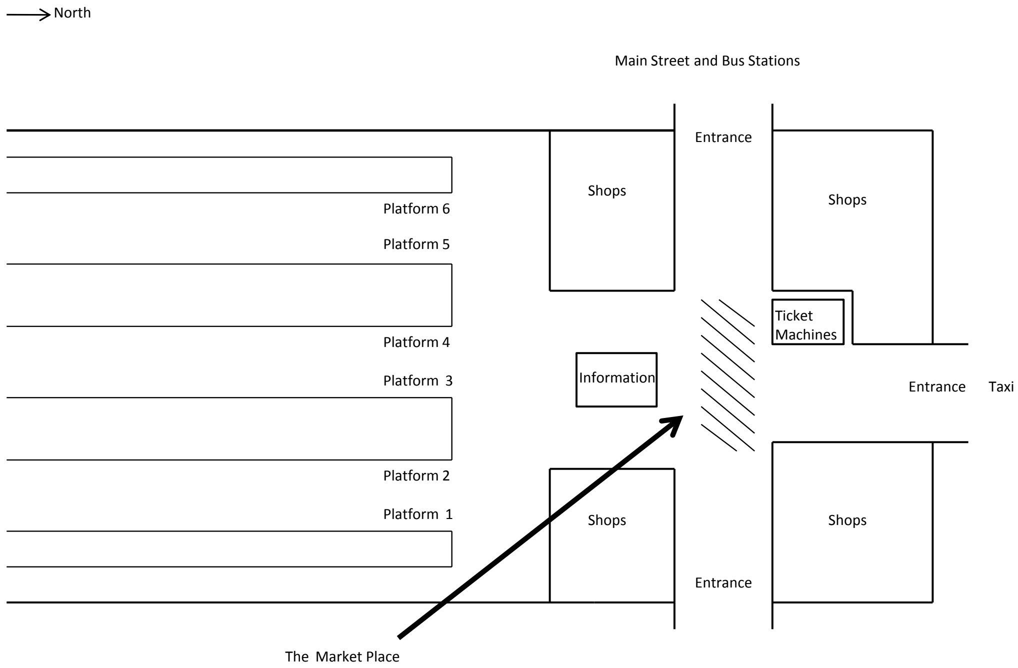

Figure A.1: plan of Kiel's central train station