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## Competing risks for train tickets – An empirical investigation of customer behavior and performance in the railway industry

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### ABSTRACT

Based on a comprehensive data set of German railway customers we analyze consumers' choices and particularly subsequent changes of two-part pricing contracts (loyalty cards). In a competing risks framework, we simultaneously estimate effects on three types of contractual events: cancellations, upgrades, and downgrades. Focusing on customer relationship management (CRM) practices, we find several factors affecting these events, some of which railway companies can influence to their advantage. Intuitively, installing auto-renewal procedures for loyalty cards decreases cancellation hazards. However, automated electronic mailings (e.g., reminders and account statements) and advertising (e.g., ticket offers) can be counterproductive and increase the risk of cancellation.

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### 1. Introduction

Rail transportation has been the subject of increasing research in recent years because of its far-reaching economic, social, and environmental impacts at multiple societal levels. Numerous methodological and empirical studies have profoundly elaborated ways of handling railway timetabling, modeling and optimization of operations, as well as capacity and pricing issues (e.g., Abril et al., 2008; Batley et al., 2011; Corman et al., 2010, 2012; Hansen, 2007; Lin et al., 2012). Another stream of research has focused on consumers' selection criteria and usage preferences for railway travel or other means of transport (e.g., Bhat and Sardesai, 2006; Hess et al., 2007; Keumi and Murakami, 2012).

However, in environments like the transportation and logistics sectors marked by increasing competition, researchers and practitioners alike have emphasized a growing need for customer orientation and relationship management (Ganesan et al., 2009). Reinartz et al. (2004) define CRM at the customer-facing level as a systematic process to manage customer relationship initiation, maintenance, and termination across all customer contact points to maximize the value of the relationship portfolio. Boulding et al. (2005) explain that CRM relates to firm strategy and centers on the development of appropriate (long-term) relationships with specific customers or customer groups, the acquisition of customer knowledge, and the intelligent use of data and technology, to enhance customer loyalty and organizational performance.

Accordingly, interest in CRM practices in the transportation sector has grown considerably in recent years (see Daugherty et al., 2009; Ellinger et al., 1999; Grawe et al., 2012; Ramanathan, 2010; Steven et al., 2012). However, research in the context of two-part pricing schemes is scarce. In addition, previous studies often neglect settings where travel decisions are not only based on consumers' current preferences, but are also influenced by previous contractual choices. As a consequence, a

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comprehensive approach towards understanding customers' travel behavior, and particularly, the determinants of their contractual choices and changes therein and how such decisions can be influenced effectively, is lacking in the literature on (rail) transportation settings.

In various international markets for rail transport, and particularly in the German market, severe oil price increases and growing environmental consciousness have helped public transit and rail transport to achieve substantial and profitable growth over the last decade. In 2011, the light rail traffic and the heavy rail sector served more than 2.5 billion railway travelers, most of them traveling by the major German railway company "Deutsche Bahn AG" (DB) (Statista, 2011, p. 16). DB offers passengers the option of purchasing in advance various loyalty cards that act to discount ticket prices for 12 months from the date of issue. These contractual devices are commonly-known as *BahnCards* and are widely-used in German railway transportation.

Schmale et al. (2013) have studied the travel behavior of German BahnCard customers and found that a disproportionately high proportion of customers fall victim to the "flat rate bias" and underuse their BahnCards. Accordingly, based on the premise that customers strive to choose more suitable BahnCard contracts as time passes, in this study, we focus on analyzing the determinants (e.g., customer demographics, usage behavior, pricing, loyalty programs) of consumers' choices of BahnCard contracts as well as changes to these contractual choices over time. We collated comprehensive travel history data spanning a timeframe of almost 6 years and applied a non-generic competing risks framework. Using a semi-parametric proportional hazards model stratified by failure type, we simultaneously estimated effects on three types of contractual events: cancellation, upgrade, and downgrade of a BahnCard. In addition to identifying reasons for terminating a BahnCard or substituting a different one (which translates into an upgrade or a downgrade scenario), we were also able to quantify the magnitude of effects. We studied these issues based on a large-scale, longitudinal data set comprised of more than four million individual transactions. Accordingly, we find several factors affecting contract choices, some of which railway companies can influence to their advantage. Our study contributes to the literature by offering both theoretical and practical implications.

This paper proceeds as follows. In the next section, we describe the characteristics of the loyalty cards studied (here: BahnCards), and describe our data. The third section explains the methodology. We briefly introduce the concept of survival analysis, describe approaches towards competing risks and apply a specific method developed for the context at hand. We then report our main results; the last section offers a discussion and conclusions.

## 2. Characteristics of loyalty cards and the study data

Our analysis is based on proprietary customer data provided by DB. The data contain comprehensive information on customers' demographic characteristics, BahnCard contract choices, individual transaction data in the form of ticket purchase behavior over time, and fine-grained information on DB's CRM practices within its loyalty cards program. Based on these data we study the determining factors for consumers' choices of BahnCard contracts. The sample period is December 2002 through July 2008.

### 2.1. Contractual options

DB customers can basically choose between three contracts: the BahnCard25 (BC25), the BahnCard50 (BC50) and the BahnCard100 (BC100). Each contract is available for first and second class travel. The number of the BahnCard contract type signifies the discount it affords on the regular ticket price for a 12 month period from the date of issue. Thus a BC25 gives a 25% discount, a BC50 means a 50% discount and a BC100 means a 100% reduction on standard domestic fares for a year. Currently, standard second class BahnCard contracts cost EUR 57 for the BC25, EUR 230 for the BC50 and EUR 3800 for the BC100. First class variants cost EUR 114 for the BC25, EUR 460 for the BC50 and EUR 6400 for the BC100. In addition to standard contracts, there are some exceptional price offers made in promotions and concessions for family members, students and senior citizens.

If they are not cancelled 6 weeks before the end date, BC25 and BC50 contracts are automatically renewed. The contract period for a BC100 is not renewed automatically. For BC25 and BC50 customers, it is always possible to upgrade within the contract period. Then, the residual value of the previous card is refunded. Customers may not downgrade contracts during their operative period.

### 2.2. Sample construction and key variables

The data were drawn from the members of DB's customer loyalty programs "bahn.bonus" and "bahn.comfort" and include more than four million transactions conducted with any of the 800,000 BahnCards in the sample. Our data encompass the entire travel history of over 300,000 customers. Some adjustments were made to enhance reliability of the database. First, we excluded all loyalty program members whose overall lifetime sales did not exceed zero. Then, we dropped customers with inconsistent or not clearly assignable contracts (resulting from e.g., goodwill cancellations or registration errors). In addition, we concentrated on second class BahnCards to ensure contracts were comparable. Our final dataset features 200,851 BahnCards bought by 72,909 customers, with corresponding in-depth information on every single transaction

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