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Determinants of entry in the deregulated German interurban bus industry

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Abstract

Two years after the deregulation of the German interurban bus industry in January 2013, two new entrants emerged as industry leaders: MeinFernbus (MFB) and FlixBus (FB). We use a comprehensive route-level data set to investigate the determinants of route entry for both providers. Applying survival models, we find that both companies show an increased probability to enter populous routes with large shares of young inhabitants; however, they both avoid entries into routes with low-quality rail connection as well as cities located farther away from the next motorway. Furthermore, both industry leaders largely refrain from entering small- and medium-sized routes in which the other provider is already operating. In large markets, however, they both show an increased entry probability independent of the presence of the other provider.

JEL classification: L92, L11, L20, C41, M20, R41

1. Introduction

In a number of industries, the success and sustainability of a new firm's business strategy is closely tied to its sequential decisions to enter multiple markets. Prominent examples include fast food restaurants, supermarkets, banking, and transportation services. In all these industries, firms face the key challenge to optimize the sequence of entries in a number of different markets—taking into account possible internal resource constraints and external barriers to entry—to operate profitably and to build up a sustainable market presence. In designing such sustainable entry patterns, both, incumbents and new entrants typically have to decide on the optimal mixture of two distinct entry strategies: entering existing markets and facing competition by incumbent firms and entering new markets, which can be expected to contribute to the overall profitability and success of the company (Müller *et al.*, 2012).

Although both types of entry are commonly observed in many industries and markets, recently deregulated industries provide a particularly appealing environment for empirical entry studies—first and foremost because the removal of legal barriers to entry is expected to be followed by the development of new business concepts and their application in both existing (incumbent) markets and new markets. Although the study of the effects of such market entries on, e.g., price levels and consumer welfare is particularly appealing—reflected in many *ex post* studies guided by the seminal contributions of Morrison and Winston (1986) and Kahn (1988, 2003)—the complementary question after the determinants of entry is at least equally important in understanding competitive processes in recently deregulated industries.

In this context, we take the opportunity of the recently deregulated German interurban bus industry to investigate the following two separate but related research questions: first, what are key determinants of route entry in the deregulated interurban bus industry? Answers to this question are not only helpful in understanding the evolution of competition in the industry but also of value in developing well-founded scenarios for the future development of competitive interaction in the industry. Second, given their (eventually) clear role as industry leaders, the question whether and how the entry strategies of MeinFernbus (MFB) and FlixBus (FB) differ suggests itself. In this respect, it is especially interesting to investigate whether the two providers actively promoted competition by entering each other's routes or whether they preferred to avoid direct confrontation wherever possible.

Aiming at providing answers to these two main research questions, we use a comprehensive route-level data set to investigate the determinants of route entry in the first 2 years of the deregulated industry. Applying survival models, we find that both companies show an increased probability to enter populous routes with large shares of young inhabitants; however, they both avoid entries into routes with low-quality rail connection as well as cities located farther away from the next motorway. Furthermore, both industry leaders largely refrain from entering small- and medium-sized routes in which the other provider is already operating. In large markets, however, they both show an increased entry probability independent of the presence of the other provider.

The remainder of the article is structured as follows. In the second section, we provide an initial characterization of deregulation and entry in the German interurban bus industry. The third section then initially develops a general framework to study determinants of entry and subsequently applies it to the German interurban bus industry. The fourth section presents our empirical analysis. Subsequent to the development of our empirical strategy and the description of our data set, we present and discuss our main estimation results as well as several robustness checks. The final fifth section concludes the article with a review of its main insights and the derivation of several avenues for future research.

2. Deregulation and entry in the German interurban bus industry

In this section, we provide an initial characterization of deregulation and entry in the German interurban bus industry. Following a description of the deregulation movement in Section 2.1, we present an overview of (firm- and route-level) entry activities in Section 2.2.

2.1 The deregulation process at a glance[1]

Although the majority of deregulation movements in many network industries and countries were initiated and implemented two to three decades ago, a mixture of public policy arguments and lobbying activities delayed the necessary steps toward deregulation in the case of the German interurban bus industry. Since 1931, bus companies were only allowed to offer regular interurban bus services on routes on which the state-owned German railway company Deutsche Bahn AG (or its predecessors) was unable to provide an acceptable service. Due to the rather dense (intercity) railway network in Germany, the respective law—that aimed at protecting a core business of Deutsche Bahn AG—led to only sporadic interurban bus services except for routes to/from former West Berlin (operated by BerlinLinienBus), routes to/from airports with no rail connection,[2] and international routes (by providers such as Eurolines Germany).

In parallel to initiatives by the European Commission to deregulate the international carriage of passengers by coach and bus, in 2009, the German government announced plans to deregulate the national German interurban bus industry. Despite several attempts by different lobbying groups to prevent or at least weaken any policy action, the German interurban bus industry was deregulated in January 2013—after the respective paragraphs of the Passenger Transport Act were changed in the usual legislative (and lobbying) processes (see generally Maertens (2012) and Schiefelbusch (2013) for further information). According to the new paragraph 42a Personenbeförderungsgesetz

1 This section largely follows Dürr *et al.* (2016).

2 In the majority of cases, such routes were connecting inner cities with secondary airports often located in rural areas such as, for example, Mannheim to Frankfurt–Hahn airport (HHN), a road trip of more than 130 km (that cannot be undertaken by rail).

("Passenger Transportation Act"), national scheduled transport with passenger vehicles is allowed for routes above a distance of 50 km or where no regional rail connection with up to 1-h travel time is offered.

2.2 Deregulation and entry

Prior experiences with deregulation processes in transport industries in general[3] and interurban bus industries in particular[4] raise the expectation that—at the early stages of a deregulated industry—substantial market entry by both new and incumbent firms will lead to a quick extension of the respective route networks. As we will show in the following by differentiating between general entry activity (Section 2.2.1) and competition-related entry activity (Section 2.2.2), the post-deregulation developments in the German interurban bus industry are fully in line with these prior experiences.

2.2.1 General entry activity

General entry activity in recently deregulated industries is typically studied on three different levels: (i) the number of operating licenses issued, (ii) the actual entry of new firms into the industry, as well as the (iii) entry of either incumbents or new entrants in particular routes. With respect to the issuing of operating licenses, data from the Office for Goods Transport (2017: 12) clearly confirms the expected growth trend: the number of valid operating licenses increased from 86 in December 2012 to 221 in December 2013 and finally 285 in December 2014 (an overall increase of 331%).

In terms of firm entries, i.e., operating license holders that actually decided to offer scheduled passenger transport services with buses, the German Office for Goods Transport (2017: 10) reports a rather small growth from 76 firms in December 2012 to 97 in December 2013 and finally 94 firms in December 2014 (an overall increase of 24%). However, despite this only moderate increase in the number of providers, the deregulated environment allowed several new entrants to contribute substantially to general industry growth according to measures such as the number of operated lines or routes. Generally, while a line is defined as scheduled service from a particular departure city to a particular arrival city—e.g., from Hamburg to Munich—such a line usually contains several stops at which passengers are able to board or alight the bus. We therefore define each combination between two different stops on a line as route, i.e., if a line has N stops, the number of (nondirectional) routes is $\sum_{i=1}^{N-1} i$.

Focusing on the number of routes as our unit of observation and analysis in both the descriptive and the econometric approaches, Figure 1 below plots the respective data—provided by Simplex Mobility and characterized in more detail in Section 4.2 below—for the German interurban bus industry on the monthly level from January 2013 to December 2014.

As revealed by Figure 1, the industry experienced an impressive general growth in the number of served routes. Beginning from 151 routes in January 2013, the aggregated entry activity of all providers led to an overall network consisting of 3603 routes in December 2014 (an increase of a magnitude of 24). Furthermore, Figure 1 suggests a certain seasonality in entry (and exit) activity with a higher number of route entries in the spring and the summer and a lower (or even negative) increase in the number of served routes in the late fall and winter months.

Turning from an analysis of aggregated entry activity of all providers to a more detailed analysis of single providers, the industry can generally be separated into one incumbent [BerlinLinienBus (BLB)], three (eventually larger) new entrants (MFB, FB, and ADAC Postbus (ADAC)) that constructed nation-wide networks in the first 2 years after deregulation, regionals (providing specific regional services such as, e.g., transfers to secondary airports), and others that are mostly operating a small selection of lines connecting urban areas (such as, e.g., DeinBus).

As shown in Figure 1, the first year after deregulation experienced a substantial growth in the entry activities of particularly BerlinLinienBus and MFB. While the former company had substantial prior experiences in operating bus services from the regulatory era, also MFB started operating (on a small scale though) still in the regulatory era in April 2012. FB and ADAC Postbus, however, commenced their operations in February 2013 and October 2013, respectively, providing a straightforward explanation for their smaller numbers of served routes in the first year of our observation period.

For 2014—the second year after deregulation—Figure 1 above reveals a further substantial increase in the number of served routes, particularly driven by elevated entry activities of FB and ADAC Postbus but also fortified by further

3 See Williams (1993), Morrison and Winston (1986, 1995), or Borenstein and Rose (2007) for the US airline industry.
4 See Robbins and White (1986, 2012) for Great Britain or Aarhaug *et al.* (2012) for Norway.

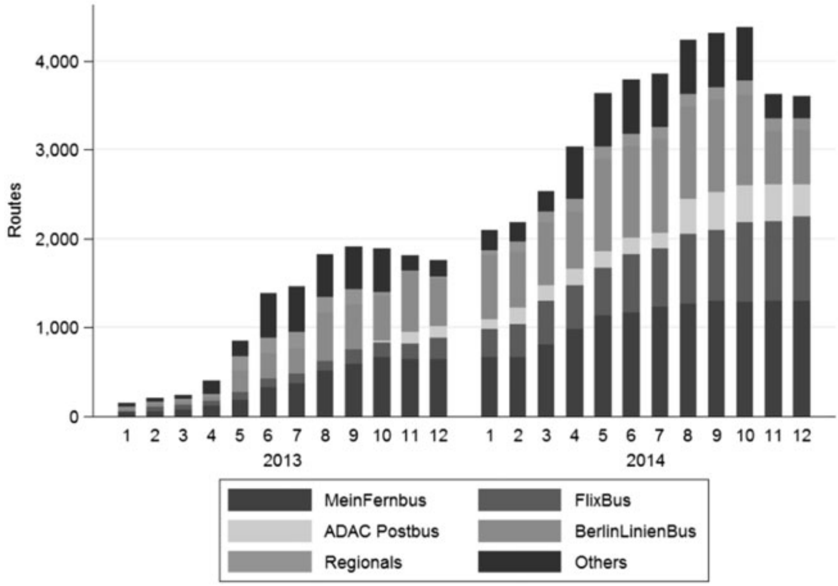

Figure 1. Number of served routes in the German interurban bus industry.

Source: Own figure based on Simplex Mobility schedule data.

expansions of BerlinLinienBus and MFB. Eventually, in December 2014, MFB was the industry leader providing services on 1296 routes (i.e., a share of 36%), followed by FB which was present on 947 routes (i.e., a share of 26%), and BerlinLinienBus and ADAC Postbus with 603 and 369 routes (i.e., 17% and 10%), respectively.

2.2.2 Competition-related entry activity

Complementary to our initial overview of general entry activity into the German interurban bus industry, our aim to study the determinants of entry requires a more detailed assessment of the development of monopoly and competitive markets in general and the entry behavior of major providers with respect to new and existing routes in particular. Building on our initial analysis of the number of routes per provider in the previous section—and under the strong assumption that the German interurban bus industry constitutes an own relevant market—Figure 2 below plots the number of monopoly and competitive routes between January 2013 and December 2014.

As shown in Figure 2, the number of monopoly routes follows a clear growth trend—with only one small temporary downward trend in winter 2013—leading to in sum 1259 served monopoly routes in December 2014. Interestingly, although the number of competitive routes is substantially larger than the number of monopoly routes in the large majority of months in our observation period, its development over time is more volatile leading to in sum 1457 served competitive routes in December 2014.

Although not shown in Figure 2, the competitive routes category can be subdivided further by the number of providers per route. For example, in December 2014, the majority of 1080 competitive routes (about 40%) were operated by two providers, compared to 164 routes (about 6%) by three providers, 140 routes (about 5%) by four providers, and 73 routes (about 2%) that were served by five or six providers.

Complementary to this summary information on the development of monopoly and competitive routes in the first 2 years after deregulation, our main research questions investigated in Section 4 below demand a more detailed perspective on route entries into new and existing routes on the (major) provider level. Table 1 below presents such a matrix referring to all entries in the first 2 years of the deregulated industry.

As revealed by the respective shaded cells in Table 1, BerlinLinienBus had most entries into new routes (1231 route entries), however, closely followed by MFB showing 1178 entries. All other providers show substantially smaller entry activities into such routes (which are not too surprising, given the earlier entry dates of BerlinLinienBus and MFB into the industry). With respect to entry into existing routes, FB entries into routes in which MFB was

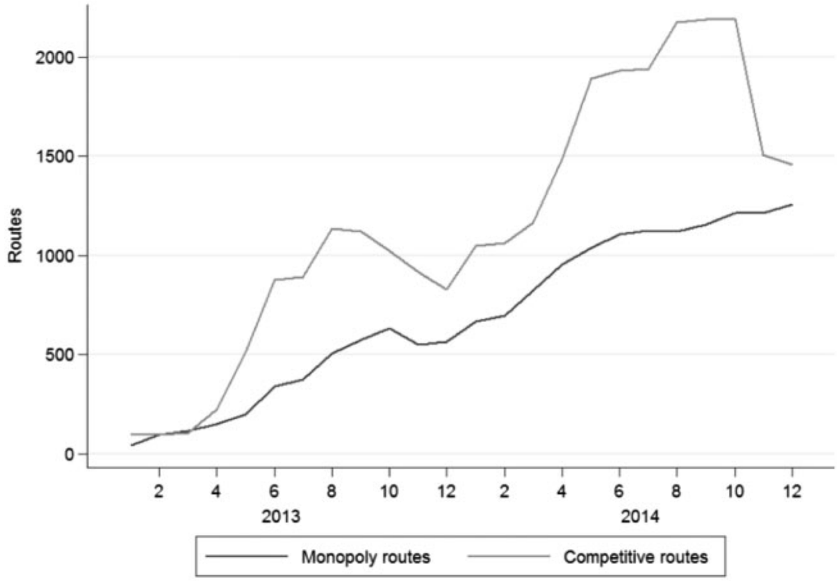

Figure 2. Number of served monopoly and competitive routes.

Source: Own figure based on Simplex Mobility schedule data.

Table 1. Matrix of entries into new and existing routes (in 2013 and 2014)

Operator	Mein Fernbus	FB	ADAC Postbus	BerlinLinienBus	Others	Regionals	*Total entries*
MFB	1178	189	59	147	105	17	*1526*
FB	277	641	74	149	130	22	*1110*
ADAC Postbus	143	136	287	78	97	3	*532*
BerlinLinienBus	48	56	9	1231	68	27	*1384*
Others	90	112	30	74	629	5	*825*
Regionals	1	2	2	7	4	262	*273*

Note: Number of entries into new routes in shaded cells; number of entries in existing routes in remaining cells.

already present appeared most often (277 entries), followed by 189 entries of MFB into FB routes and 149 entries by FB into BerlinLinienBus routes.[5]

3. General determinants of entry and application to the German interurban bus industry

In this section, we begin in Section 3.1 with a discussion of general determinants of entry—subdivided further into the profitability and the possibility of entry. Section 3.2 adopts this general framework and applies it to the German interurban bus industry.

3.1 General determinants of entry

Any meaningful empirical analysis of the determinants of entry in transport markets in general and interurban bus markets in particular must be guided by both theory- and facts-based knowledge on possible key factors that may

5 Referring to the "total entries" column in Table 1, please note that the number of total entries per provider is not the sum of the preceding columns, as a provider may enter markets that were populated by two or more competitors already.

affect entry decisions. Generally, a transport network is constructed by multiple market entry decisions. In determining these decisions, a company's management generally has to assess both the external attractiveness of the candidate markets—determined by potential customers, suppliers, competitors, and partners—and the internal capabilities and resources of the company that determine its ability to compete in the respective candidate markets (Spulber, 2009: 433ff). Limiting our further assessment to the external attractiveness of candidate markets, prior research particularly on the determinants of entry in airline markets (Müller *et al.* (2012) for an overview) suggests to condense down market entry decisions to answers of the following two questions: "Is entry profitable?" and "Is entry possible?"

3.1.1 Profitability of entry

With respect to the profitability question, it can be expected that current and expected profitability of a particular market typically is a key determinant in the decision to enter a market. In general, it is reasonable to assume that a profit-maximizing, risk-neutral firm will enter a market if the net present value of expected postentry profits is greater than the sunk costs of entry. As postentry profits depend on postentry competition, the entry decision is therefore connected to the entrant's expectations about the conduct and performance of the firms after entry. Furthermore, the level of sunk costs incurred is a critical determinant of the entry decision (Besanko *et al.*, 1996: 396ff). The higher the necessary sunk costs to enter an industry, the higher is the risk of entry and the lower the expected profits. Additionally, the entry condition above clarifies that profits immediately after entry are not necessary for a rational entry decision. It is sufficient that, for instance, market growth expectations promise ample profits in the future. Furthermore, with respect to entry sequence, routes which are expected to be most profitable should be entered first.

3.1.2 Possibility of entry

Although the expected profitability certainly is a key determinant of entry, empirical studies have regularly found evidence that abnormal profits are not competed away by entry but remain persistent for longer time periods (see Geroski (1995) for a general analysis). This finding suggests that an entrant also has to address the issue of the possible extent of entry into a particular market and implies that a positive net present value (which at least outweighs sunk costs) is a necessary but not sufficient condition for entry—as barriers to entry can reduce or even eliminate entry incentives. In transport markets, prominent (structural and/or strategic) barriers to entry are access to necessary (point and line) infrastructures, brand loyalty programs, or network size in combination with service frequency.

3.2 Application to the German interurban bus industry

In this section, we apply the general framework of entry profitability and entry possibility to the German interurban bus industry. In essence, this allows us to derive a detailed set of hypotheses that can subsequently be investigated as part of our empirical analysis. A particular challenge in the derivation of these hypotheses is taking account of the fact that route entry decisions by interurban bus providers are likely to be interdependent. In particular, it is reasonable to assume that providers first identify major "backbone" routes between larger cities and subsequently decide whether and where to stop in between and/or whether to serve smaller cities beyond the two larger cities. Although to the best of our knowledge, this interdependence issue has not been addressed (or even solved) in the transport literature, we aim at controlling for this important aspect as part of our spatial structure characteristics (explained further in Section 3.2.2 below).

3.2.1 Possibility of entry

Starting with a brief assessment of the possibility of entry to the German interurban bus industry, there are no reasons to believe that specific barriers substantially constrain the entry of providers in their entirety or with respect to certain routes. With respect to entry into the industry as such, first, the existing obligations of any new interurban bus company to apply for an operating license is unlikely to be a significant entry barrier—basically because these licenses are issued as soon as a general qualification test is passed.

Second, although smaller bus companies as subcontracting partners—exclusively used by virtually all new entrants to the industry to allow a quicker and more efficient extension of their route networks—are a strategic resource for a sustainable market entry into the industry in general and significant route extension in particular, there are no signs that a large fraction of existing smaller bus companies (together with the compulsory driving personnel) are already contracted by an existing provider and are thus constraining the entry possibilities of new competitors. Finally but importantly, buses as such are—by construction—a highly mobile factor of production thus allowing a very flexible operation over the entire country.

With respect to entry into particular route markets, first, there have been instances reported in particular cities that the respective main bus stations reached capacity limits during certain times of the day (and several providers were thus partly forced to use secondary bus stations in the suburbs of the respective cities). However, these instances appear to be exceptions rather than the rule.

Second, although brand recognition is likely to become an entry barrier in the future—as particularly the industry leaders substantially invest in marketing campaigns—it currently is unlikely to impose a substantial entry barrier (particularly as the respective search platforms on the internet list all providers for a specific route on the specific day). This reasoning is fortified by the large absence of frequent travellers programs in the industry (that typically aim at increasing switching costs for travellers).

Finally yet importantly, although network size and frequency of service are important advantages of larger providers—allowing them to profit from economies of scale and scope—the current absence of a clear hub-and-spoke concept in the industry reduces the size of this potential entry barrier.

3.2.2 Profitability of entry

Due to the (current) absence of severe entry barriers, it is reasonable to assume that the entry decisions of interurban bus companies are mainly guided by the profits expected to be earned. In thinking further about how meaningful profit drivers look like, we introduce a differentiation into (i) the presence and characteristics of competitors, (ii) spatial structure, (iii) demographics, and (iv) mode characteristics.

With respect to the *presence and characteristics of competitors*, we expect that the probability of route entry is influenced by the following two variables:

- The general *presence of competitors*. Ceteris paribus, other firms in the market reduce profit expectations due to competition and its expected pressure on market price (thus suggesting a negative relationship with entry activity). However, as medium and large markets typically allow more than one provider to make a positive profit—and generally offer substantially larger revenue potentials—the presence of competitors is expected to have either no or a substantially alleviated negative effect on the probability to enter such larger markets.
- The *different types of competitors*. Although it is reasonable to assume that both cost and quality levels do not differ greatly between interurban bus providers, the existing competitors still differ with respect to both overall size (strength) and degree of competitive interaction. We therefore expect that the probability of entry of a certain provider differs between different types of competitors already operating on the respective route. Ceteris paribus, closer competitors (that meet frequently in a larger number of routes) are expected to be avoided in small markets, however, attacked in larger markets—as they generally inhere the possibility of positive profits for more than one provider and are also likely to be important “backbones” in the construction of a national interurban bus network.

With respect to *spatial structure characteristics*, we expect that the probability of route entry depends on the characteristics of the following four variables:

- The *present in origin or destination location*. Whenever a provider is already present in either the origin or the destination of a route, the probability of organic growth by just adding routes to that existing base is increased—compared to setting up a completely new route—due to the possibilities to realize economies of scale and scope. In other words, the variable aims at capturing the fact that route entry decisions are typically not made independently of each other but are guided by the respective provider’s existing network (and the further network expansion plans).[6]
- The *geographical development of the route* (within Germany), as more centrally located origin or destination cities can be served at lower costs and are more likely to pass larger urban areas in Germany.

6 We are indebted to an anonymous reviewer for raising this important point.

- The *distances to the next motorway* (of the respective origin and destination cities), as the closeness to motorways determines the costs of serving the respective cities from the perspectives of both the provider (through an increased fuel use) and its (transit) customers already on the bus (through increased opportunity costs of time incurred by the trip). Both variables, i.e., *geographical development of the route* and *distances to the next motorway* also serve the purpose of taking the interdependence of route entry decisions into account.
- The *length of the route* (distance), as the competitive advantage of bus travel is particularly well developed in the short distance and medium distance (as long-distance travel increases the trip duration of the bus substantially (compared to the train) due to the frequent stops and an increased likelihood of delays through unexpected traffic jams).

Turning to *demographic characteristics* that might affect entry profitability and therefore entry probability, we consider the following four variables as important drivers:

- The *market size*, as, ceteris paribus, a higher absolute population makes it more likely that a sufficiently large share of potential bus customers exists.
- The *share of young population*, as particularly this fraction of the population is expected to have an increased likelihood to consider the bus as mode of transportation (due to both, an existing demand for medium- and long-haul travel and a typically constrained monthly travel budget).
- The *share of the population with higher education*, as, on the one hand, an increasing share reduces the likelihood that a sufficiently large share of potential bus customers exist (e.g., due to the availability of a car or a preference to travel by train). However, on the other hand, students at or above the age of 24 years—together with environmental-friendly professionals without an own car—may create a countervailing effect (generating a sufficient demand for interurban bus travel).
- The *share of tourism-related travel*, as a significant fraction of holiday locations in the North (sea) and the South (mountains) of Germany are not well connected to the railway network, and the bus therefore is the only public transportation mode available.

Last but not least, we expect that the following two-*mode characteristics* have an impact on the probability of entry:

- The *inclusion of an airport* (as either origin or destination), as at least some airports are not well connected to the railway network and bus connections therefore have the potential to offer a competitive service on particularly short- and medium-haul routes.
- The *quality of existing railway connections*—measured by the number of train changes needed to travel from the origin to the destination city—as it can be expected that the bus gains in attractiveness with a decreasing quality of railway travel.

Based on this general discussion of possible key drivers of a decision to enter an interurban bus market, the following section will present our empirical analysis of such determinants in the German interurban bus industry.

4. Empirical analysis

In this section, we provide our empirical analysis of the entry behavior of the two industry leaders MFB and FB. While Section 4.1 develops our empirical strategy, Section 4.2 continues with a description of our data set. Following the presentation and discussion of our main estimation results in Section 4.3, the final Section 4.4 discusses the results of several robustness checks.

4.1 Empirical strategy

Based on the derivation of important general determinants of entry in the German interurban bus industry, in this section, we develop our empirical strategy. Although we provide—to the best of our knowledge—the first empirical assessment of the determinants of entry in the interurban bus industry, the development of a consistent empirical strategy can build on a rather rich related literature on entry in airline markets.[7] From a methodological perspective,

7 Although prior research in airline markets is of relevance for our research question, it is important to clearly point to significant differences. In particular, while the clear majority of airline flights are direct flights, interurban bus markets are typically characterized by lines and routes; i.e., an interurban bus company opens a line from Hamburg to Munich and

these contributions can broadly be subdivided further into structural models and reduced form approaches (see Müller *et al.* (2012) for more detailed information).

The first group of papers focuses on the estimation of structural models of entry decisions and consists of contributions by Bresnahan and Reiss (1990, 1991); Reiss and Spiller (1989); Berry (1992); Dunn (2008), or Ciliberto and Tamer (2009). The second group of papers—represented by studies such as Sinclair (1995); Boguslaski *et al.* (2004); Goolsbee and Syverson (2008); Morrison and Winston (1990); Lederman and Januszewski (2003), or Müller *et al.* (2012)—follows reduced form approaches and estimates the likelihood of entry as a function of firm and market characteristics through an application of either probit or survival models.

Comparing the general specificities of these two reduced form model types a little further, an important disadvantage of the probit model is its inability to take adequate account of the timing of entry decisions (possibly leading to unreliable results as soon as the problem of right censoring plays a significant role). As, by construction, survival models take this timing of entry decisions into account—a crucial aspect having in mind our own research questions—we apply survival models rather than probit models as part of our subsequent empirical analysis. While Section 4.1.1 discusses our baseline model of the general determinants of entry, Section 4.1.2 continues with the derivation of an extension of the baseline model (allowing further insights into the competitive interaction of particularly MFB and FB, but also BerlinLinienBus and ADAC Postbus as the third and fourth largest providers).

4.1.1 Baseline model: general determinants of entry

Survival analysis—also referred to as "time to event" analysis or more generally duration analysis—represents a common tool to analyze the time until the occurrence of an event and is frequently applied not only in economics but also in a variety of other disciplines such as pharmaceutical statistics (e.g., to assess the efficacy of a new therapy in a clinical trial) or engineering (e.g., to study the lifetime of machine components).

There are two main concepts in the field of survival analysis. The first is the survivor function which is used to determine the probability of an individual to survive beyond a certain point in time (i.e., a firm is still refraining from entering the market). The second concept is the hazard rate or hazard function which is the probability that an individual will experience the event, while that individual is at risk for having an event (i.e., the probability that a firm will enter the market in t and was not serving it in $t-1$).

Survival analysis enables us to effectively consider right censoring. Right censoring means that some individuals or routes do not experience the event until the end of the observation period (Allison, 2010: 413ff). In our case, routes are said to be right censored if they have not been entered until the end of our observation period, however, potentially will experience entry afterwards. To adequately consider right censoring, the dependent variable in survival analysis has two components: (i) the time to event and (ii) the event status, which records if the event of interest occurred during the observed time period or not. Generally, survival analysis can be either conducted nonparametrically, parametrically, or semi-parametrically (Cox, 1972). As the Cox model imposes no restrictions on the shape of the baseline hazard, the baseline hazard can be as flexible as possible.

Bringing survival analysis to our research question, we aim at identifying the determinants of entry in general and differences in entry behavior between the two industry leaders (and main competitors) MFB and FB in particular. For this purpose, we estimate both hazard functions and hazard rates, where each city pair is regarded as a subject that can "die" within the observation period but can also "die" afterwards. "Dying" is this case means that a route r is entered by a competitor i. Entry can happen only once as afterward the respective route cannot be populated again and is therefore considered as "dead" for competitor i. However, competitor j might still enter the route. Technically speaking, the concept of survival models takes into account the right censoring of the data, i.e., a route can still "die" after our observation period of 2 years. In fact, this appears to be a reasonable assumption, as we in fact observe additional entry activity in the year 2015 as well.

The ultimate goal of survival models is to determine and compare survival functions and hazard functions of two disjunct groups of subjects. In our case, these two groups are submarkets that have been populated by MFB versus

thus factually enters many different routes (depending on the number of stops undertaken on the respective line). Consequently, this interdependency of route entry decisions must be reflected in the empirical strategy (as implemented through the inclusion of our "present in origin or destination" and "centrality in Germany" variables discussed in Section 3.2.2 above).

submarkets that have been populated by FB. In our baseline specification, we therefore estimate a hazard function of provider i in month t with the following form:

$$h_i(t) = h_0(t) \cdot exp(\beta_1 present_{other\ t} * l_{market} + \beta_2 present_{\ other\ t} * m_{market} + \beta_3 present_{other\ t} * s_{market} + \sum_{i=1}^{N} \gamma_n X_{nr}) \quad (1)$$

where the term $h_0(t)$ can be seen as a representation of the intercept, as it can be found in linear or logistic regression models. Accordingly, $h_0(t)$ gives the hazard—in our case the entry into a market—in t in case all other control variables are equal to zero. Furthermore, guided by our expectations discussed in Section 3.2.2—namely, that the survival probability of a market is expected to be related to the size (and therefore attractiveness in terms of revenue potential) of the market—we split the presence of any provider into three subgroups: large, medium, and small markets (as measured by the sum of inhabitants in both origin and destination cities). $\sum_{i=1}^{N} \gamma_n X_{nr}$ includes the control variables generally introduced in the previous section and specified further in Section 4.2 below.

4.1.2 Model extension: differentiating between different types of competitors

In addition to our baseline model, we implement a model extension in which we enlarge our perspective on the determinants of entry by splitting up the highly aggregated $present_{other}$ variable into the more meaningful variables FB or MFB, respectively, as well as BerlinLinienBus and ADAC Postbus (as the third and fourth largest competitors on the national level). Technically, in Equation (1), we replace $present_{other\ t}$ with $present_{jt}$, where j represents the respective other provider. The model specification accordingly changes to the following form:

$$\begin{aligned} h_i(t) = h_0(t) \cdot exp(&\gamma_1 present_{jt} * l\_market + \gamma_2 present_{jt} * m\_market + \gamma_3 present_{jt} * s\_market \\ &+ \gamma_4 present_{others\ t} + \sum_{i=1}^{N} \gamma_n X_{nr}) \end{aligned} \quad (2)$$

As one control variable, we still include whether any of the remaining 26 competitors is present already (regardless of market size). In the next section, we will provide a detailed description auf our data set in general and the construction of our main dependent and independent variables in particular.

4.2 Data set and descriptive statistics

Our main data set was provided by Simplex Mobility and consists of all route entries—i.e., each (nondirectional) direct[8] combination between two different bus stops on a provider's line—of all interurban bus companies from the beginning of the deregulation era in January 2013 to the end of the second year of deregulation in December 2014. In sum, the raw data set consists of 3402 routes. We added to this route-level data all additional routes that were entered in the third year of the deregulation era to identify a population of routes with a significant probability of entry but which were, for profitability or other reasons, not entered in the first 2 years after deregulation. Our final data set therefore consists of in sum 4159 city pairs that either have been served within the first 2 years after deregulation or were populated in the subsequent year 2015.

We define these routes between cities as submarkets which have been gradually entered by 28 different providers—the incumbent BerlinLinienBus, the (eventually) two industry leaders MFB and FB, ADAC Postbus as further larger new entrant with a national route presence, as well as 13 other providers and 11 regional providers—resulting in a balanced panel data set on the monthly level for the first 2 years of the deregulated industry with 99,816 observations. Furthermore, we have collected additional data—obtained from the Federal Statistical Office of Germany and the Federal Office for Building and Regional Planning—to be able to construct the respective spatial structure, demographic, and mode characteristic variables. Last but not least, road distances between the respective origin and destination city centers were retrieved from Google Maps. Table 2 below presents the descriptive statistics together with a brief description of the construction of our main variables. Furthermore, a correlation matrix of all variables is provided in Table A1.

8 Please note that our data set solely consists of direct (or nontransfer) routes between two cities; i.e., passengers do not have to change buses to reach their final destination (although the bus may have additional stops during the trip). Consequently, a route from A to B and a route from B to C do not allow the conclusion that a direct (non-transfer) route from A to C exists. Route A to C would only be in our data if there exists a direct connection between the respective two cities.

Table 2. Descriptive statistics

Variable	Description	Mean	Standard deviation	Minimum	Maximum
Competitor presence variables					
Present MFB	= 1 if MFB already served the route upon entry	0.17	0.38	0.00	1.00
Present FB	= 1 if FB already served the route upon entry	0.09	0.29	0.00	1.00
Present others	=1 if at least one competitor other than MFB or FB served the route upon entry	0.11	0.31	0.00	1.00
Present ADAC	= 1 if ADAC already served the route upon entry	0.03	0.18	0.00	1.00
Present BLB	= 1 if BLB already served the route upon entry	0.14	0.35	0.00	1.00
Any competitor present	= 1 if any other competitor was present except for FB/MFB itself	0.15/0.27	0.38/0.44	0.00	1.00
Spatial structure variables					
Present in origin or destination	=1 if FB/MFB was present in either the origin or the destination in month $m-1$	0.53/0.47	0.50/0.50	0.00	1.00
Centrality in Germany	Maximum linear distance (in kilometers) to the center of Germany for either origin or destination city	−280.38	90.51	−438.14	−39.82
Max. motorway distance	Maximum distance to next motorway of origin or destination city (in minutes)	14.52	210.72	1	70
Distance	Road distance (in kilometers) between origin and destination city centers	278.03	182.56	50.20	1080.00
Demographic variables					
Market size (ln)	Logarithm of the sum of city populations in origin and destination cities	5.45	1.85	−0.66	8.53
Max. share young population	Maximum share of population aged under 24 years in either origin or destination city	24.95	1.68	18.70	28.90
Max. higher education	Maximum share of population with A levels in either origin or destination city	39.62	9.92	13.20	65.20
Max. tourism	Maximum value of overnight stays per inhabitant at either origin or destination city	3.24	1.08	1.60	6.20
Mode characteristics variables					
Airport shuttle	=1 if the origin and/or destination city is an airport	0.07	0.26	0.00	1.00
Changes (train)	Number of train changes needed to travel from origin to destination city by rail	1.98	1.23	0.00	7.33

The boldness is used to point to the key coefficients in the respective regressions.

Without aiming at providing a detailed discussion of Table 2, it is important to briefly point to the descriptive statistics of our main variables. Starting with the competitor presence variables, as revealed by *Present MFB*, *Present FB*, and *Present others*, in 17% of all route entries, MFB was already operating on the respective route, compared to 9% for FB and 11% for (at least) one other provider.

Turning to the spatial structure variables, the *Present in origin or destination* variable shows that—for both MFB and FB—roughly half of their entries took place in routes in which they were already present (in either the origin or the destination of the route) in the preceding month. Furthermore, as reflected in the values of the *Centrality in Germany* variable, the origin and destination cities of our routes show an average linear distance to the central point in Germany of 280 km.[9] The average distance to the next motorway (*motorway distance*) is about 14 min and the average distance of an interurban bus trip (*distance*) is 278 km (however, with a rather large spectrum from 50.2 to 1,080.0 km).

Turning to the demographic variables, *market size*—defined as the sum of the inhabitants at the origin and destination city—shows a mean ln value of 5.45 (corresponding to an absolute average market size of about 232,000 inhabitants).[10] The average maximum share of young population aged under 24 years (*Max. share young population*) is about 25%, compared to an average maximum share of population with A levels (*Max. higher education*) of about 40%. Furthermore, the maximum value of overnight stays per inhabitant (Max. tourism) is found to be higher than three overnight stays.

Finally yet importantly, for the mode characteristic variables, Table 2 shows that about 7% of all routes include an airport (*airport shuttle*) as either origin or destination of the route. On average, almost two train changes are necessary to travel from the origin to the destination by rail (*change (train)*).

4.3 Estimation results

In this section, we present our estimation results. While Section 4.3.1 presents and discusses the results for our baseline model, Section 4.3.2 continues with a discussion of the estimation results for the extended version of the model.

4.3.1 Baseline model: general determinants of entry

In a first step, we apply a semi-parametric survival model with the regression results being shown in Table 3.[11] In interpreting the reported coefficients, it is further important to note that we report hazard ratios, i.e., the probability of entering a market is $\beta-1$. Accordingly, coefficients below 1 indicate a lower probability to enter and values above 1 imply a higher probability compared to the counterfactual. Furthermore, we allow our covariates to vary over time, as their effect might change during the time of observation. By doing so, we pass the test of the underlying proportional hazard assumption. Accordingly, we linearly interact the coefficients with the time dimension, i.e., the running months, and incorporate them in the model.[12] In Table 3 we present the marginal effect evaluated at the mean, i.e., coefficients are only significant if they do not change their sign over time and the coefficient represents the average effect over the entire observation period. In other words, the presented coefficients represent the distinct behavior of a player over the entire observation period.[13]

Starting with an initial high-level perspective, our estimation results generally suggest similar entry strategies for FB and MFB. Although the sizes (and partly also the significance levels) of the respective coefficients often diverge statistically significantly[14]—suggesting different intensities of the desire to enter/not to enter routes with the respective characteristics—they mostly point into the same direction.

Continuing with a more detailed assessment of our estimation results with the *competitor presence variables*,[15] Columns (1a) and (1 b) in Table 3 reveal that the probability of entering a route in which a competitor is already

9 Please note that we have constructed different measures of centrality such as, e.g., a measure indicating the average additional time if one would take a detour via the respective city as well as various regional centrality measures. However, as it turned out that these more sophisticated measures had no major impact on our estimation results, we decided to follow the rather simple approach described above.

10 The maximum value of 8.53 corresponds to a market size of 5 million, which is the market between the two largest cities in Germany: Berlin and Hamburg.

11 Although we are confident to follow a sophisticated empirical approach, it is important to state upfront that we cannot completely rule out that endogeneity problems (e.g. due to unobserved route-specific variables) might affect our estimation results.

12 Aiming at achieving the best results in terms of the underlying proportional hazard assumption, the interacted Max. motorway distance, centrality in Germany, Max. tourism, and airport shuttle variables are also included in quadratic terms and the Max. share under 24 variable in logarithmic terms.

13 Please note that the coefficients do not change significantly if no time interaction is included.

14 Please see the robustness check Section 4.4 for a detailed discussion.

15 Although it would generally be desirable to include detailed (route-level) price information as separate profit driver, the absence of such detailed information for our observation period forecloses such an endeavor as part of our empirical

Table 3. Estimation results for baseline model (semi-parametric)

Variable	(1a) Entry FB	(1b) Entry MFB	(1c) Entry FB	(1d) Entry MFB
Competitor presence variables				
Any competitor present	**1.4173*****	**0.6716*****		
	(0.1057)	**(0.0487)**		
Any present = 1 # small market			**0.1787*****	**0.1130*****
			(0.0690)	**(0.0467)**
Any present = 1 # medium market			**1.1802**	**0.5688*****
			(0.1689)	**(0.0729)**
Any present = 1 # large market			**1.6641*****	**0.9024**
			(0.1416)	**(0.0781)**
Spatial structure variables				
Present in origin or destination	1.2640**	1.5125***	1.2532*	1.4893***
	(0.1451)	(0.0935)	(0.1453)	(0.0920)
Centrality in Germany	1.0028***	0.9999	1.0027***	0.9998
	(0.0005)	(0.0004)	(0.0005)	(0.0004)
Max. motorway distance	0.9744***	0.9945**	0.9741***	0.9953*
	(0.0057)	(0.0027)	(0.0057)	(0.0027)
Distance	0.9999	1.0001	0.9999	1.0001
	(0.0003)	(0.0002)	(0.0003)	(0.0002)
Demographic variables				
Market size (ln)	1.4831***	1.1808***	1.3883***	1.1371***
	(0.0691)	(0.0306)	(0.0672)	(0.0300)
Max. share young population	1.0568**	1.0331*	1.0559**	1.0351*
	(0.0288)	(0.01919)	(0.0287)	(0.0193)
Max. higher education	0.9920*	1.0108***	0.9929	1.0120***
	(0.0047)	(0.0038)	(0.0048)	(0.0038)
Max. tourism	0.6466***	1.0198	0.6549***	1.0263
	(0.0380)	(0.0382)	(0.0384)	(0.0384)
Mode characteristics variables				
Airport shuttle	0.8764	0.0257***	0.8712	0.0256***
	(0.1079)	(0.0177)	(0.1074)	(0.0177)
Changes (train)	0.5810***	0.7305***	0.5848***	0.7377***
	(0.0285)	(0.0230)	(0.0289)	(0.0234)
Global test of proportional hazard assumption $P > \chi^2$	✓	✓	✓	✓
LR χ^2	1587.59	1041.40	1614.82	1089.32
$P > \chi^2$	0.0000	0.0000	0.0000	0.0000
# subjects	4159	4159	4159	4159
# of failures	1110	1526	1110	1526
# observations	89,835	81,737	89,835	81,737

Note: Exponentiated coefficients, standard errors in parentheses. The boldness is used to point to the key coefficients in the respective regressions.
$^{*}P < 0.1$; $^{**}P < 0.05$; $^{***}P < 0.01$.

present[16] shows different effects for the two providers: while the coefficient is found to be significant and negative for MFB—the respective probability decreases by about 33% (1−0.6716 = 0.3284)—it is significant and positive for FB's entry probability (an increase of about 42%). However, if we interact the information on whether any

analysis. However, as shown econometrically in Dürr *et al.* (2016) as well as descriptively in Dürr and Hüschelrath (2015), average prices in the German interurban bus industry typically decline with the presence of one or more competitors on a route—thus allowing the conclusion that our focus on the presence and characteristics of competitors implicitly also includes expectations on the achievable market prices.

16 Please note that our empirical results hold if we replace our four "present" dummy variables with information about the number of competitors that are already serving a route. The respective estimation results are reported in Table A2.

competitor is active in the market already with terciles of market size—as shown in Columns (1c) and (1d) in Table 3—the identified effects differ substantially. Both main competitors' probability to enter a small market is reduced by about 82% (FB) and 89% (MFB), respectively. While for medium markets, this general effect is still found to a lesser degree (not significant for FB and 43% reduction for MFB), the probability of entry switches to a positive impact (FB) or no impact (MFB) for entering large markets. Although this finding could generally be interpreted as FB having the more aggressive entry strategy, it must be reminded that, first, they entered the industry after MFB and thus had limited choices to grow without entering MFB routes and, second, that we do not differentiate here between different types of competitors (see Section 4.3.2 below).

The *spatial structure variables* all show the expected directions, however, partly differ between both main providers. While both providers show an increased probability to enter routes in which they were already present in the month before (either in the origin or destination), only FB shows a (highly significant) increased probability to enter routes more centrally located in Germany. Furthermore, while both providers show a decreasing interest in entering routes the farther they are away from the next motorway, the effect of distance on entry probability is insignificant for both providers.

Turning to the *demographic variables*, we first find that the probability to enter a route increases substantially with growing market size showing an increase of 39% for FB and 14% for MFB. Second, our results also reveal that the probability increases substantially for both main providers with an increase in the maximum share of young population living in either the origin or destination city. However, third, the broader variable of maximum share of higher education only shows a significant and positive coefficient for MFB. Fourth, with respect to the impact of tourism on the probability to enter, we find that while FB avoids entering touristic markets, the coefficients for MFB show positive but insignificant results.

Finally yet importantly, the *mode characteristic variables* both show identical directions of the coefficients, however, partly substantial differences with respect to their size. While both main competitors have a reduced probability to serve a route with an airport as either origin or destination, the effect is substantially larger for MFB (an about 97% reduced probability) compared to FB (showing a (statistically insignificant) reduction in the probability of only about 13%). With respect to entry into routes with a low-quality rail connection,[17] both main providers show a reduced probability in entering those routes (about 42% for FB and about 26% for MFB).

4.3.2 Model extension: differentiating between different types of competitors

In this section, we report the estimation results of our model extension. Starting from the baseline model, we particularly redefine our competitor presence variable in the following. Although our analysis—summarized in Table 3 above—provided useful first insights into competitive interaction in the industry, the highly aggregated category of "any competitor present" is likely to hide important variation in the competitive interaction between MB and MFB, but also with respect to the runner-up providers BerlinLinienBus and ADAC Postbus.

Aiming at investigating these important aspects of competitive interaction further, in a first step, we run a specification of the baseline model in which we only differentiate between MB, FB, and all other providers. In a second step, we further split up the category of all other providers into BerlinLinienBus as incumbent and ADAC Postbus as larger additional competitor with a nation-wide network. The remaining "other" and "regional" providers remain in the "others present" category. The respective estimation results are shown in Table 4 below. Please note that—although all control variables discussed above are included—we refrain from reporting them.

Technically, considering the high values for χ^2, all eight models presented in Tables 3 and 4 show a very good fit. Furthermore, the underlying test of the proportional hazard assumption is fulfilled in all specifications. Starting our discussion of the main results with the specifications in Columns (2a) and (2 b), we see our findings of the baseline model mostly confirmed for FB in both direction and size of the respective coefficients. The provider avoided MFB in small and medium markets and has an increased probability to enter large markets in which MFB already operated. In that respect, we can conclude that FB treats MFB no different from any other competitor.

17 An alternative measure of intermodal competition by railway connections would simply be travel time. However, as travel time is found to be highly correlated with distance, we decided to use the number of train changes as independent variable in our empirical analysis. However, including train travel time as quality measure for existing train connections does not change our main results.

Table 4. Estimation results for model extension (semi-parametric)

	(2a) Entry FB	(2b) Entry MFB	(2c) Entry FB	(2d) Entry MFB
FB # small market		0.4771		0.4095*
		(0.2402)		(0.2063)
FB # medium market		0.7980		0.7310**
		(0.1201)		(0.1106)
FB # large market		1.3690***		1.3207***
		(0.1362)		(0.1356)
MFB # small market	0.1334***		0.1112***	
	(0.0674)		(0.0563)	
MFB # medium market	0.6836***		0.6114***	
	(0.0847)		(0.0765)	
MFB # large market	1.4474***		1.3898***	
	(0.1442)		(0.1385)	
Others present	1.7921***	0.5631***	1.6440***	0.5630***
	(0.1729)	(0.0553)	(0.1642)	(0.0517)
ADAC # small market			0.0000	0.0000
			(0.0000)	(0.0000)
ADAC # medium market			0.0933***	0.4962*
			(0.0543)	(0.2056)
ADAC # large market			1.0331	1.2686
			(0.1376)	(0.1965)
BLB # small market			0.2774***	0.1734***
			(0.0880)	(0.0432)
BLB # medium market			0.8026	0.5263***
			(0.1359)	(0.0909)
BLB # large market			1.1672	0.7738**
			(0.1421)	(0.0884)
Control variables	Yes	Yes	Yes	Yes
Global test of proportional hazard assumption $P > \chi^2$	✓	✓	✓	✓
LR χ^2	1637.07	1059.91	1717.78	1161.36
$P > \chi^2$	0.0000	0.0000	0.0000	0.0000
# subjects	4159	4159	4159	4159
# of failures	1110	1526	1110	1526
# observations	89,835	81,737	89,835	81,737

Note: Exponentiated coefficients, standard errors in parentheses. The boldness is used to point to the key coefficients in the respective regressions.
*$P < 0.1$; **$P < 0.05$; ***$P < 0.01$.

For MFB, however, our estimation results suggest partly diverging results when comparing baseline results with the results of the model extension. While in small and medium markets, the probability of entering a particular route is not affected significantly by the presence of FB, in large markets, we now find, ceteris paribus, a large and highly significant increase in the probability of entry for routes in which FB already operates. This finding allows the conclusion that, for MFB, FB is not an ordinary "faceless" competitor but a "special" competitor in the sense that MFB's entry behavior deviates substantially from the typical behavior identified in the baseline specification.

In Columns (2c) and (2d), the perspective on competitive interaction in the industry is broadened further by decomposing the still highly aggregated group of providers other than FB and MFB used in specifications (1) and (2). As shown in Table 4, we now additionally differentiate between entries in route markets with a prior presence of the incumbent BerlinLinienBus as third largest provider and the (eventually fourth largest) new entrant ADAC Postbus.

While the results for FB and MFB largely remain unchanged—with the only exceptions of the "MFB entry into small and medium FB markets" coefficients turning significant—the coefficients for BLB and ADAC reveal additional interesting insights. While ADAC is largely treated no different than other competitors—with the only exception that FB is avoiding entry into particularly medium markets to a larger degree than MFB—the results for BLB look partly different. While both FB and MFB show a significantly reduced probability to enter BLB markets in the small and—in the case of MFB—also the medium category, the respective large market BLB coefficients show opposing results. While FB shows no change in the probability to enter large markets in which BLB is already present (compared to the counterfactual), MFB shows an about 23% reduced probability to enter such markets. In other words, while FB treats BLB no different from others, MFB avoids a direct confrontation with BLB.

4.4 Robustness checks

The presentation and discussion of our estimation results so far were based on the application of semi-parametric survival models. However, as already discussed in Section 4.1 above, survival models can also be estimated fully parametrically (with good reasons to apply one or the other). Aiming at applying a fully parametric survival model as first robustness check, we first have to identify the most appropriate distribution. As shown in Table A3, the Weibull distribution as well as the log logistic distribution fit best for both providers. The corresponding fully parametric estimation results are shown in Table A4. Although significance levels partly differ, the qualitative findings are in line with the results of the semi-parametric model discussed above.[18]

For our second robustness check,[19] it is important to remind upfront that both the fully parametric survival model and the Cox model presume a continuous underlying time period. Given the fact that we only have 24 observation periods (i.e., each month over 2 years), the question is raised whether a sufficient level of continuity is reached to achieve reliable results. As robustness check, we therefore apply two discrete time proportional hazard models with two different specifications: one logit model with a quadratic and a complementary log-log model with a logarithmic underlying functional form. The respective estimation results—provided in Table A5—confirm our main findings.

Turning to our last robustness check, in the main part of the article, we run separate regressions for the two industry leaders MFB and FB and subsequently discuss the observed differences between the two sets of estimation results. However, the finding that the estimated effect of a variable is statistically significant in one regression but not in the other does not necessarily imply that the estimated coefficients differ significantly. Aiming at providing such a test, we make use of the discrete survival model just discussed and provide the results of tests whether the respective differences between each of the estimated effects differ statistically significantly in Table A6. As shown in the table, this is found to be the case for the majority of variables.

Before we turn to our concluding section, it is crucial to remind the reader of the importance of the interdependence of entry decisions undertaken by interurban bus providers—particularly reflected in the differentiation between "lines" and "routes." Although our empirical approach is based on the route as unit of observation, we have introduced several spatial variables (i.e., "present in origin and destination," "centrality in Germany," and "Max. motorway distance") as controls to account for the interdependence issue.

Although we are therefore confident that our (more generic) empirical approach leads to reliable estimates for our main determinants of entry in the German interurban bus industry, the question remains whether the inclusion of information on the respective lines would be desirable. Although we fully agree that future research from both theoretical and empirical perspectives appears desirable, we also see particularly two challenges in an implementation—leading to the decision to follow the route-based approach in our article. First, the decision of lines is endogenous, i.e., where to start and end a line and where to stop in between is a strategic decision made by the respective providers. Therefore, including particular line-specific characteristics in our empirical models would have likely imposed a particular structure on the creation of lines and therefore contains the danger of leading to biased estimates. Second, the definition of lines changes frequently on a month-to-month basis by either adding individual stops, extending the line, or setting up an entire new line. Observing all these three types of growth generates sufficient variation to identify individual route effects.

5. Conclusion

In the first 2 years after its deregulation in January 2013, the German interurban bus industry experienced a substantial growth in the size of its network—reflected, for example, in an increase in the number of connected cities from 56 cities to 222 cities (Dürr and Hüschelrath, 2016). On the route level, deregulation-induced growth was even more

18 Please note that—for the fully parametric models—we did not interact the coefficients with a time dimension.
19 We are indebted to two anonymous reviewers for suggesting the second and third robustness check.

pronounced showing an increase in the number of served routes from 151 routes in January 2013 to 3603 routes in December 2014. Although a larger number of new entrants contributed to this substantial overall growth, two providers—claiming roughly half of all 5560 entries into either existing or new routes—emerged as clear industry leaders: MFB and FB.

In this context, we use a comprehensive route-level data set to investigate the determinants of route entry for both providers. Applying survival models, we find that both companies show an increased probability to enter populous routes with large shares of young inhabitants; however, they both avoid entries into routes with low-quality rail connection as well as cities located farther away from the next motorway. Furthermore, both industry leaders largely refrain from entering small- and medium-sized routes in which the other provider is already operating. In large markets, however, they both show an increased entry probability independent of the presence of the other provider.

Based on these key results of our empirical analysis, several avenues for future research suggest themselves. From a business strategy perspective, it is important to note that we focused on the external attractiveness/possibilities as key driver of entry decisions. However, the existing business strategy literature also puts particular emphasis on the importance of internal capabilities in deciding on the most promising entry strategy. Future research could therefore complement our external approach with such an internal capabilities-oriented perspective. Additionally, taking account of the large literature on competitive rivalry and competitive dynamics, a more detailed investigation of particularly the role of entry attacks and counterattacks by the main providers appears as a fruitful area of future research.

From a public policy perspective, our focus on the determinants of entry in a recently deregulated network industry immediately suggests a complementary investigation of the effects of entry as part of future research. Although such a perspective is likely to generate further interesting insights—particularly on the importance of entry for the overall contribution of the industry to economic welfare—it could explicitly include an *ex post* assessment of the effects of the merger between MFB and FB that was announced in January 2015. From this perspective, it would not only be interesting to identify possible short-term effects on prices but especially to study the long-term implications of the deal through its impact on competition and competitive interaction in the German interurban bus industry in the years to come.

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Appendix

Table A1. Correlation matrix

	Centrality in Germany	Max. motorway distance	Distance	Market size (ln)	Max. share young population	Max. higher education	Max. tourism	Airport shuttle	Changes (train)	Present in origin or destination (FB)	Present in origin or destination (MFB)	Present MFB	Present FB	Present ADAC	Present BLB	Present others
Centrality in Germany	1															
Max. motorway distance	−0.3425	1														
Distance	−0.293	0.0299	1													
Market size (ln)	0.0158	−0.4234	0.3008	1												
Max. share young population	−0.0173	−0.3226	−0.0588	0.0572	1											
Max. higher education	0.0005	−0.3918	0.1869	0.6355	0.2294	1										
Max. tourism	−0.3117	0.5486	−0.0397	−0.3729	−0.2365	−0.407	1									
Airport shuttle	0.0269	−0.0672	0.0084	0.1709	−0.0787	0.0189	−0.0304	1								
Changes (train)	−0.1852	0.4194	0.16	−0.5004	−0.0824	−0.3888	0.4001	0.0325	1							
Present in origin or destination (FB)	0.0766	−0.3115	0.1795	0.5702	0.1052	0.3873	−0.3027	0.0396	−0.3479	1						
Present in origin or destination (MFB)	0.0239	−0.227	0.1529	0.465	0.0902	0.4023	−0.2135	−0.0695	−0.2997	0.5335	1					
Present MFB	0.0153	−0.0949	0.0227	0.1884	0.0662	0.1745	−0.0491	−0.0947	−0.1904	0.2646	0.4501	1				
Present MFB	0.0929	−0.1781	0.018	0.1962	0.0562	0.158	−0.2097	−0.0038	−0.223	0.2848	0.2255	0.1725	1			
Present ADAC	0.0219	−0.1219	0.0455	0.1462	0.0134	0.1126	−0.1514	0.0655	−0.1598	0.1721	0.1547	0.1174	0.2379	1		
Present BLB	0.0833	0.0693	−0.1138	−0.0984	−0.1046	−0.1513	0.089	0.0139	0.0759	−0.0333	−0.0644	−0.0717	0.0029	0.0042	1	
Present others	−0.1536	0.1139	−0.0466	−0.0313	0.0082	−0.0053	−0.0028	0.004	−0.0071	0.0309	−0.0187	−0.0185	0.0889	0.1058	−0.0431	1

Table A2. Robustness check with number of competitors

	(1a°) Entry FB	(1b°) Entry MFB	(1c°) Entry FB	(1d°) Entry MFB
Competitor presence variables				
Number of competitors	**1.1624** ***	**0.7911*****		
	(0.0357)	**(0.0232)**		
Number of competitors # small market			**0.7217****	**0.3435*****
			(0.1120)	**(0.0391)**
Number of competitors # medium market			**1.0792**	**0.6864*****
			(0.0670)	**(0.0399)**
Number of competitors # large market			**1.2582*****	**0.9522**
			(0.0422)	**(0.0302)**
Spatial structure variables				
Present in origin or destination	1.2646**	1.4885***	1.2428*	1.4335***
	(0.1449)	(0.0914)	(0.1443)	(0.0880)
Centrality in Germany	1.0029***	0.9999	1.0029***	0.9999
	(0.0005)	(0.0004)	(0.0005)	(0.0004)
Max. motorway distance	0.9727***	0.9953*	0.9721***	0.9955
	(0.0058)	(0.0027)	(0.0058)	(0.0027)
Distance	1.0001	0.9999	1.0001	1.0000
	(0.0003)	(0.0002)	(0.0003)	(0.0002)
Demographic variables				
Market size (ln)	1.4198***	1.1931***	1.3039***	1.0789***
	(0.0662)	(0.0313)	(0.0646)	(0.0295)
Max. share young population	1.0609**	1. 0213	1.0553**	1.0237
	(0.0290)	(0.0188)	(0.0288)	(0.0188)
Max. higher education	0.9935	1.0108***	0. 9939	1.0114***
	(0.0047)	(0.0038)	(0.0047)	(0.0038)
Max. tourism	0.6647***	1. 0216	0.6717***	1.0424
	(0.0390)	(0.0380)	(0.0395)	(0.0387)
Mode characteristics variables				
Airport shuttle	0.9437	0.0267***	0.9310	0.0261***
	(0.1160)	(0.0183)	(0.1144)	(0.0179)
Changes (train)	0.5993***	0.7335***	0.6069***	0.7437***
	(0.0294)	(0.0234)	(0.0298)	(0.0237)
Global test of proportional hazard assumption $P > \chi^2$	0.6956	0.1675	0.7674	0.1642
LR χ^2	1666.74	1079.81	1717.68	1194.89
$P > \chi^2$	0.0000	0.0000	0.0000	0.0000
# subjects	4159	4159	4159	4159
# of failures	1110	1526	1110	1526
# observations	89,835	81,737	89,835	81,737

Note: Exponentiated coefficient, standard errors in parentheses.
$^{*}P < 0.1$; $^{**}P < 0.05$; $^{***}P < 0.01$.

Table A3. Information criteria for parametric model extension

		Exponential	Log logistic	Log normal	Weibull	Gamma	Gompe BIC rtz
AIC	FB	4832.55	4489.00	4602.38	4493.74	4494.05	4538.59
	MFB	7213.23	7010.09	7020.46	7086.39	7016.97	7175.67
BIC	FB	4973.64	4639.49	4752.88	4644.23	4653.94	4689.08
	MFB	7352.90	7159.07	7169.44	7235.37	7175.26	7324.65

Table A4. Estimation results for model extension (parametric)

	Weibull		Log logistic	
	(2a°) Entry FB	(2c°) Entry MFB	(2a°°) Entry FB	(2c°°) Entry MFB
FB # small market		0.3706**		0.3095**
		(0.1805)		(0.7456)
FB # medium market		0.6530***		0.7377**
		(0.0957)		(0.1754)
FB # large market		1.2824***		1.4034***
		(0.1160)		(0.0648)
MFB # small market	0.1275***		0.2046***	
	(0.0645)		(0.5550)	
MFB # medium market	0.7205***		0.8291***	
	(0.0892)		(0.0727)	
MFB # large market	1.1091		1.0819*	
	(0.0924)		(0.0441)	
Others present	1.3241***	0.5906***	1.2079***	0.5217***
	(0.1302)	(0.0560)	(0.0441)	(0.1231)
Control variables	Yes	Yes	Yes	Yes
LR χ^2	672.36	761.19	964.10	704.39
$P > \chi^2$	0.0000	0.0000	0.0000	0.0000
# subjects	4159	4159	4159	4159
# of failures	1110	1526	1110	1526
# observations	89,835	81,737	89,835	81,737

Note: Exponentiated coefficients, standard errors in parentheses.
$^{*}P<0.1$; $^{**}P<0.05$; $^{***}P<0.01$.

Table A5. Estimation results for discrete time models

	Logit regression		Complementary log-log regression	
	(2a°) Entry FB	(2c°) Entry MFB	(2a°°) Entry FB	(2c°°) Entry MFB
Present FB = 1 # small market		0.5426		0.5662
		(0.2766)		(0.2845)
Present FB = 1 # medium market		0.9557		0.9861
		(0.1467)		(0.1470)
Present FB = 1 # large market		1.4657***		1.4567***
		(0.1490)		(0.1408)
Present MFB = 1# small market	0.1215***		0.1236***	
	(0.0614)		(0.0623)	
Present MFB = 1 # medium market	0.7711**		0.7765**	
	(0.0971)		(0.0958)	
Present MFB = 1 # large market	1.2051**		1.1939**	
	(0.1070)		(0.1022)	
Others present	1.4636***	0.5728***	1.4305***	0.5907***
	(0.1391)	(0.0574)	(0.1310)	(0.0579)
Control variables	Yes	Yes	Yes	Yes
LR χ^2	13,772.22	17,647.63	14,356.42	18,415.06
$P > \chi^2$	0.0000	0.0000	0.0000	0.0000
Pseudo R^2	0.1017	0.0498	0.1300	0.0532
# observations	91,777	84,077	91,777	84,077

Note: Standard errors in parentheses.
$^{*}P<0.1$; $^{**}P<0.05$; $^{***}P<0.01$.

Table A6. Differences between FB and MFB entry determinants

Variables	Logit	Complementary log-log
Present = 1 # small market	**	**
Present = 1 # medium market		
Present = 1 # large market		*
Others present	***	***
Spatial structure variables		
Present in origin or destination		
Centrality in Germany	**	*
Max. motorway distance	***	***
Distance	***	***
Demographic variables		
Market size (ln)		
Max. share young population	***	***
Max. higher education		
Max. tourism	***	***
Mode characteristic variables		
Airport shuttle	***	***
Changes (train)	***	***

$^{*}P<0.1$; $^{**}P<0.05$; $^{***}P<0.01$.