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Abstract

Two years after the deregulation of the German interurban bus industry in January 2013, two new entrants emerged as market 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, centrally located routes with large shares of young inhabitants; however, they both avoid entries into routes including an airport or with low quality rail connection. Furthermore, both market leaders refrain from entering small and medium-sized routes in which another provider is already operating. In large markets, however, they both show an increased entry probability independent of the presence of a competitor.

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1 Introduction

The importance of market entry for competition and innovation is mainly twofold. On the one hand, entry plays a crucial role as an equilibrium force in that it competes away excess profits to an equilibrium level. Such imitative entry occurs when the entrant can reap profits by copying the established firms product or method of production. On the other hand, entry also plays a creative role in markets, serving as a vehicle for the introduction and diffusion of innovations. Such innovative entry occurs when the entrant either finds new ways to saturate a certain customer's need or is able to produce a given product with less input. Innovative entry is seen as a disequilibrium force that propels the industry from one equilibrium state to another (see, e.g., Geroski, 1991, 1995, and Hüschelrath and Müller, 2013).

Although both imitative and innovative entry are common occurrences in many industries and markets, recently deregulated industries provide a particularly appealing environment to study both types of entry – 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 (i.e., imitative entry) and new markets (i.e., innovative entry). 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 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 are 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 market leaders, the question whether and how the entry strategies of MeinFernbus (MFB) and FlixBus (FB) differ suggest itself. In this respect, it is especially interesting to investigate whether the two providers actively promoted competition by entering each other's routes (i.e., imitative entry) or whether they preferred to avoid direct confrontation wherever possible (i.e., innovative entry).

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 two years of the deregulated industry. Applying survival models, we find that both companies show an increased probability to enter populous, centrally located routes with large shares of young inhabitants; however, they both avoid entries into routes including an airport or with low quality rail connection. Furthermore, both market leaders refrain from entering small and medium-sized routes in which another provider is already operating. In large markets, however, they both show an increased entry probability independent of the presence of a competitor.

The remainder of the paper is structured as follows. In the second section, we provide an initial characterization of the German interurban bus industry, subdivided further into a description of the deregulation movement, a high-level perspective on general post-deregulation entry activities as well as the resulting degree of competitive interaction. In the third section, we present our empirical analysis of the determinants of route entry. Based on an initial discussion of general determinants of entry into interurban bus markets, we subsequently develop our empirical strategy and provide a description of our data set. Following a detailed characterization of our main estimation results and a discussion of important implications for business strategy and public policy, the final fourth section concludes the paper with a review of its main insights and the derivation of several avenues for future research.

2 The German Interurban Bus Industry

In this section, we provide an initial characterization of the German interurban bus industry. Following a description of the deregulation movement in Section 2.1, we present a high-level perspective on general post-deregulation entry activities in Section 2.2 and the resulting degree of competitive interaction in Section 2.3.

2.1 Deregulation

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 towards 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 Berlin

Linien Bus), routes to/from airports with no rail connection[1] and international routes (by providers such as Eurolines Germany).

In parallel to initiatives by the European Commission to liberalize the international carriage of passengers by coach and bus[2], in 2009, the German government announced plans to liberalize 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[3] 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 (‘Passenger Transportation Act’) national scheduled transport with passenger vehicles is allowed for routes above a distance of 50 kilometers and where no regional rail connection with up to one hour travel time is offered.

2.2 Deregulation and entry

Prior experiences with deregulation processes in transport industries in general[4] and interurban bus industries in particular[5] raise the expectation that – at the early stages of a deregulated industry – substantial market entry by both new and incumbent firms will lead to both the creation of new lines and routes[6] and an increase in the number of competitors on existing lines and routes.

The German interurban bus industry meets these expectations. Following full liberalization in January 2013, many (potential) providers decided to apply for an operating license. According to the Office for Goods Transport (2014, p. 15), the number of licenses increased from 86 in December 2012 to 158 in June 2013 and finally 301 in September 2014 (an overall increase of 350 per cent). The increase in licenses is also reflected in an increase in both

1 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 kilometers (that cannot be undertaken by rail).

2 Regulation (EC) No 1073/2009 of the European Parliament and of the Council of 21 October 2009 on common rules for access to the international market for coach and bus services, and amending Regulation (EC) No 561/2006, Official Journal of the European Union L 300/88-105. During the legislative process, the European Commission commissioned a study on passenger transport by coach in the European Union (see Steer Davies Gleave (2009)).

3 The most important change – leading to the liberalization of the interurban bus industry – referred to §13(2) Personenbeförderungsgesetz (‘Passenger Transport Act’) in which the strict entry regulations were codified.

4 See, e.g., Williams (1993), Morrison and Winston (1986, 1995) or Borenstein and Rose (2007) for the US airline industry.

5 See, e.g., Robbins and White (1986, 2012) for Great Britain or Aarhaug et al. (2012) for Norway.

6 In the remainder of this article, a line is defined as an offered regular (scheduled) service from a particular departure city to a particular arrival city, for example, from Hamburg to Munich. A line usually contains several stops, that is, passengers are able to board the bus at a later city and/or get off the bus at an earlier city than the final destination. We therefore define each combination between two different stops on a line as route, that is, if a line has N stops, the number of routes is $\sum_{i=1}^{N-1} i$. The route is our unit of observation and analysis in both the descriptive and the econometric approaches.

available lines and daily frequency of service on these lines. Comparing a week in August 2013 with the same week in August 2014 reveals that the number of lines increased from 113 to 244 (an increase of about 116 per cent) while the number of trips jumped from 2,360 to 7,088 (an increase of about 300 per cent; see Office for Goods Transport (2014), p. 17).

In terms of served routes, the availability of an exhaustive data set of all route entry decisions in the first two years after deregulation – provided by Simplex Mobility and characterized in more detail in Section 3.3 below – allows a much more detailed qualitative assessment of route-level entry activity in the industry. In this respect, Figure 1 shows the number of served routes in the German interurban bus industry on the monthly level from January 2013 to December 2014.

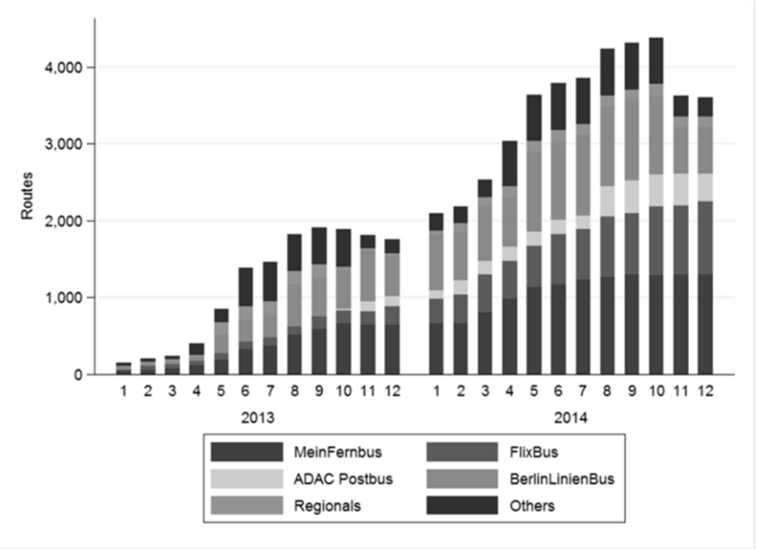

Figure 1: Number of served routes in the German interurban bus industry

Source: own figure based on Simplex Mobility schedule data

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 3,603 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. This is particularly obvious in the second year after deregulation were a larger number of (partly permanent, partly only temporary) route exits by BerlinLinienBus (and a few smaller operators including particularly DeutscheTouring) led to a clear decrease in the number of served routes.

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), three (eventually larger) new entrants (MeinFernbus, FlixBus and ADAC Postbus) who constructed nation-wide networks in the first two years after deregulation, regionals (providing specific regional services such as, e.g., transfers to secondary airports) and others who 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 MeinFernbus. While the former company had substantial prior experiences in operating bus services from the regulatory era, also MeinFernbus started operating (on a small scale though) still in the regulatory era in April 2012. FlixBus 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 FlixBus and ADAC Postbus but also fortified by further expansions of BerlinLinienBus and MeinFernbus. Eventually, in December 2014, MeinFernbus was the market leader providing services on 1,296 routes (i.e., a share of 36 percent), followed by FlixBus which was present on 947 routes (i.e., a share of 26 percent) and BerlinLinienBus and ADAC Postbus with 603 and 369 routes (i.e., 17 percent and 10 percent), respectively.[7]

Despite the clear growth trend in the German interurban bus industry in the first two years after deregulation, its absolute size – in terms of passengers carried – must still be considered as rather small. For example, according to data from the Federal Statistical Office of Germany, the number of passengers travelled by regular interurban buses increased from 8.2 million in 2013 to about 20 million passengers in 2015. Although these numbers are still moderate compared to the about 131 million passengers which travelled on long-distance railway routes in 2015[8], the initial expectation of about 25 million passengers in the German interurban bus industry until the year 2030 – communicated as part of the most recent traffic forecast conducted by a consortium that was commissioned by the German Federal Ministry of Transport and Digital Infrastructure (2014) – is likely to be realized in 2016 already.

[7] Generally, it is important to remark that the rather quick extension of the respective route networks of particularly the new entrants was possible through the introduction of a subcontractor-type business model in which already existing local bus companies – typically operating in the non-scheduled segment of the market for bus services before – agree to offer services under the respective (regional or national) interurban bus brand.

[8] See https://www.destatis.de/DE/PresseService/Presse/Pressemitteilungen/2016/02/PD16_052_461.html (last accessed on 5 July 2016).

2.3 Deregulation, entry and competitive interaction

Although the prior analysis of post-deregulation entry activities provides first important insights into industry developments, the study of competition in general and competitive interaction in particular demands a more detailed assessment of especially the relation between monopoly and competitive routes on the one hand and the degree of overlap of the respective providers' route networks on the other.

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[9], Figure 2 below plots the number of monopoly and competitive routes between January 2013 and December 2014.

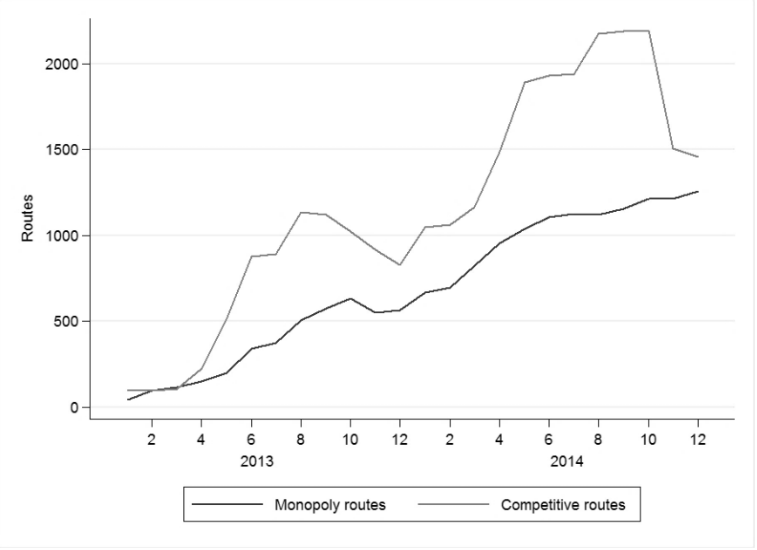

Figure 2: Number of served monopoly and competitive routes

Source: own figure based on Simplex Mobility schedule data

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 1,259 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 1,457 served competitive routes in December 2014.

9 From an antitrust perspective, it is an ex ante open question whether the German interurban bus market constitutes an own relevant market or must be considered as a (rather small) fraction of a much larger transportation market (possibly including car sharing agencies, railway services etc.). While the narrow delineation of the relevant market would (by construction) lead to high market shares and therefore competition concerns, the latter broader delineation is likely to result in the conclusion that anticompetitive effects are unlikely to exist. In this respect, it should also be taken into account that the demand for interurban bus travel must be considered as highly elastic and market entry barriers as rather low (thereby reducing the possibilities to abuse market power through the implementation of permanent price increases).

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 1.080 competitive routes (about 40 percent) were operated by two providers, compared to 164 routes (about 6 percent) by three providers, 140 routes (about 5 percent) by four providers and 73 routes (about 2 percent) were served by five or six providers.

Although both the existence and the number of competitors at the route-level are likely to be important determinants of market competition, research in industrial economics also suggests that the degree of competitive interaction can have an important effect on market conduct and market performance. For example, providers that meet on many routes may behave differently than providers who interact on a couple of routes only. In order to allow a more detailed study of these relationships for the German interurban bus industry, Table 1 shows a matrix of monopoly routes and competitive route overlaps in December 2014.

Table 1: Matrix of monopoly routes and competitive route overlaps (December 2014)

	Mein Fernbus	FlixBus	ADAC Postbus	Berlin LinienBus	Others	Regionals
Mein Fernbus	806	411	148	72	126	14
FlixBus	411	446	159	69	138	6
ADAC Postbus	148	159	177	14	75	5
BerlinLinienBus	72	69	14	498	19	5
Others	126	138	75	19	79	3
Regionals	14	6	5	5	3	118

Note: Number of monopoly routes displayed in shaded cells; number of competitive routes displayed in remaining cells

Starting off with a discussion of monopoly routes, Table 1 shows that, in December 2014, MeinFernbus was the leader with 806 routes, followed by BerlinLinienBus with 498 routes and FlixBus with 446 routes. ADAC Postbus is ranked fourth with in sum 177 monopoly routes. With respect to pair-wise overlaps on competitive routes – shown in the white cells in Table 1 – MeinFernbus and FlixBus met most often (on in sum 411 routes), followed by FlixBus and ADAC Postbus (159 routes) and MeinFernbus and ADAC Postbus (148 routes). Ceteris paribus, these findings suggest that competition between MeinFernbus and FlixBus is the by far fiercest. Furthermore, the level of direct competition with the third largest new entrant – ADAC Postbus – appears similar for both market leaders while the only incumbent –

BerlinLinienBus – is only met (by both market leaders) on a comparably small number of about 70 routes.[10]

Complementary to studying the degree of pair-wise overlap for all major providers at one discrete point in time, Figure 3 below provides additional evidence for the two market leaders, MeinFernbus and FlixBus, by plotting both the respective monthly entry activities and the resulting route overlap for both providers.

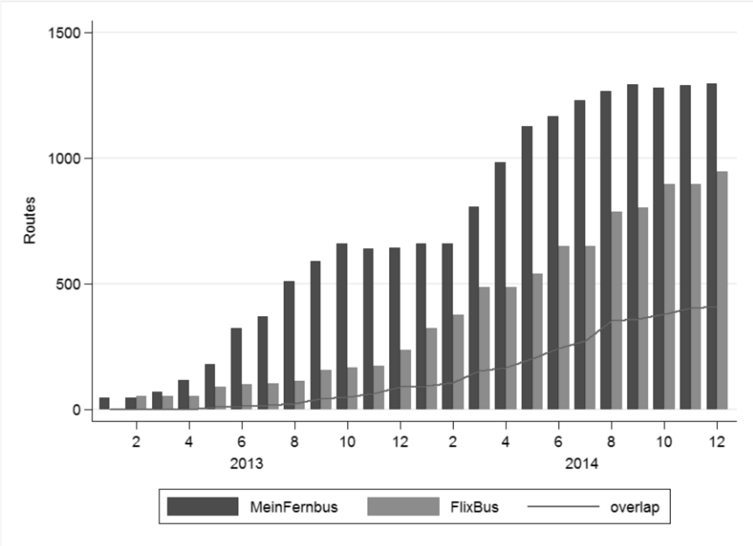

Figure 3: Number of served routes by MeinFernbus and FlixBus and route overlap

Source: own figure based on Simplex Mobility schedule data

As shown in Figure 3, the route overlap between MeinFernbus and FlixBus increased with a roughly constant rate over the entire observation period reaching 411 route overlaps (i.e., about 23 percent of all routes) in December 2014. While there was hardly any overlap in the first few months after liberalization, growth aspirations of both companies made an increasing overlap unavoidable – particularly in medium and large markets. Ceteris paribus, it is therefore reasonable to assume that competition between both companies became fiercer over time.

Additionally, Figure 3 shows the different entry activities of the two major players. While MeinFernbus substantially extended the number of the routes in spring and summer in the years 2013 and 2014, FlixBus applied more of a sustainable growth strategy in the sense that it constantly added new routes (even in the fall and winter months). Although still being number two in terms of number of routes operated in December 2014, FlixBus successfully

[10] Comparing the number of route overlaps in December 2014 with February 2014 reveals an increase by the factor 3.8 with respect to MFB/FB, compared to 2.6 for MFB/ADAC, 1.9 for MFB/BLB, 1.9 for FB/ADAC, 1.4 for FB/BLB and -2.8 for BLB/ADAC.

managed to close the gap to MeinFernbus significantly in the ‘number of routes served’ category compared to the situation in 2013.

Due to the importance of both market leaders – MeinFernbus and FlixBus – for competition in the German interurban bus industry, our subsequent empirical analysis of the determinants of entry explicitly focuses on these two companies. In addition to an investigation of the main determinants of entry – and the potential identification of differences in the respective entry strategies – we also aim at increasing our knowledge on competitive interaction in the recently deregulated German interurban bus industry. Such an analysis gains further importance with the additional information that, in January 2015, MeinFernbus and FlixBus announced their plan to merge. Although an analysis of the merger and its consequences on competition in the industry is beyond the scope of this paper (see Dürr et al. (2016) for further information and analysis), our assessment of the entry strategies of the merging parties will also allow drawing several conclusions on the (anti-) competitiveness of the announced merger plans.

3 Empirical analysis

In this section, we provide an empirical analysis of the entry behavior of the two industry leaders MeinFernbus and FlixBus. While Section 3.1 discusses important determinants of entry into transport markets in general and interurban bus markets in particular, Section 3.2 develops our empirical strategy. Following a description of our data set in Section 3.3 and the presentation of our main estimation results in the Section 3.4, the final Section 3.5 provides a discussion of important implications for business strategy and public policy.

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 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 (see, e.g., Spulber (2009), pp. 433ff.).

Limiting our further assessment to the external attractiveness of candidate markets, prior research particularly on the determinants of entry in airline markets (see, e.g., 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?'. 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 post-entry profits is greater than the sunk costs of entry. As post-entry profits depend on post-entry competition, the entry decision therefore is 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 (see, e.g., Besanko et al. (1996), pp. 396 ff.). 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.

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.

Applying the general separation of entry possibility and entry profitability to the (German) interurban bus industry, there are currently 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 the entry to the industry as such, the existing obligations of any new interurban bus company to apply for an operating license is unlikely to be a significant entry barrier (as also reflected in the rise in new licenses issued after deregulation described in Section 2.2 above).

Furthermore, although smaller bus companies as subcontracting partner – 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 currently 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. Additionally, 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, there have been instances reported in particular cities that the respective main bus stations reached capacity limits during certain times of the day (and the respective providers were forced to use secondary bus stations in the suburbs of the respective cities). However, currently, these instances appear to be exceptions rather than the rule. Furthermore, although brand recognition is likely to become an entry barrier in the future – as particularly the market 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). Last but not least, although network size and frequency of service is an important advantage of larger providers, the current absence of a hub-and-spoke concept in the industry reduces the size of the entry barrier created by both characteristics.

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 (1) the presence and characteristics of competitors, (2) spatial structure, (3) demographics, and (4) 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 (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 (who meet frequently in a larger number of routes) are expected to be avoided in small markets, however, attacked in larger markets – as they generally contain 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 three variables:

– 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.
– 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).
– The *length of the route* (distance), as the competitive advantage of bus travel is particularly well developed in the short- 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 the population under 24 years of age*, 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 discuss the empirical strategy to investigate our research questions.

3.2 Empirical strategy

Based on the derivation of important general determinants of entry in the German interurban bus industry, we continue with the development of 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. From a methodological perspective, these contributions can broadly be sub-divided 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 estimate 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 predominantly apply survival models rather than probit models as part of our subsequent empirical analysis. While Section 3.2.1 discusses our baseline model of the general determinants of entry, Section 3.2.2 continues with the derivation of an extension of the baseline model (allowing further insights into the competitive interaction of particularly MeinFernbus and FlixBus, but also BerlinLinienBus and ADAC Postbus as the third and fourth largest providers).

3.2.1 Baseline model: General determinants of entry

Survival analysis – also referred to as 'time to event' analysis or more generally duration analysis – represent 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 (see Allison 2010, pp. 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: 1) the time to event and 2) 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 non-parametrically, parametrically or semi-parametrically (see 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 market leaders (and main competitors) MFB and FB. For this purpose, we estimate both survival 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 afterwards 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 two 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 sub-markets that have been populated by MFB versus sub-markets that have been populated by FB. In our baseline specification, we therefore estimate a survival 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 3.1, 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 discussed in the previous section and specified further in Section 3.3 below.

3.2.2 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:

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

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.

3.3 Data set and descriptive statistics

Our main data set was provided by Simplex Mobility and consists of all route[11] entries of all interurban bus providers 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 3,402 routes. We added to this route-level data all additional routes that were entered in the third year of the deregulation era in order 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 two years after deregulation. Our final data set therefore consists of in sum 4,159 city pairs that either have been served within the first two 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 market leaders MeinFernbus (MFB) and FlixBus (FB), ADAC Postbus as further larger new entrant with a national route presence as well as 13 other providers[12] and 11 regional providers[13] – resulting in a balanced panel data set for the first 24 months of the industry with a total of 99,816 observations. Furthermore, we have collected additional data – obtained from the Federal

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11 Generally, three different levels of analysis can be differentiated: the line, the route and the trip. A line is defined as an offered regular (scheduled) service from a particular origin (departure) city to a particular destination (arrival) city, for example, from Hamburg to Munich. A line usually contains several stops, that is, passengers are able to board the bus at a later city and/or get off the bus at an earlier city than the final destination. Each combination between two different stops on a line is defined as a route, that is, if a line has N stops, the number of routes is $\sum_{i=1}^{N-1} i$. The (non-directional) route is our unit of observation and analysis.

12 The group of 'others' mostly provides services on a small selection of lines connecting urban areas (as well as international services) and consists of City2City, DBFernbus, DeinBus, DeLuxExpress, DeutscheTouring, FassReisen, MatzesMiniBus, Megabus, PublicExpress, SchnurstracksBus, Seelandexpress, SprintBus and UniversReisen.

13 The group of 'regionals' mostly provides specific regional services (e.g., transfers to secondary airports) and consists of AllgaeuAirportExpress, Autobus Oberbayern, CuxBus Express, Innliner, Muenchenlinie, Omnibus Wunder, Ostfriesland Express, Regionalverkehr Erzgebirge, Trier Koeln Express, Usedomer Baederbahn and Vogtland Express.

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 characteristics variables. Last but not least, road distances between the respective origin and destination city centers were retrieved from Google Maps. Table 2 below present the descriptive statistics together with a brief description of the construction of our main variables.

Table 2: Descriptive statistics

Variable	Description	Mean	Std. dev.	Min.	Max.
Competitor presence variables					
Present MFB	= 1 if MeinFernbus already served the route upon entry	0.17	0.38	0.00	1.00
Present FB	= 1 if FlixBus 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	0.26	0.44	0.00	1.00
Spatial structure variables					
Centrality in Germany	Maximum linear distance (in km) to the center of Germany for either origin or destination city	-280.38	90.51	-438.14	-39.82
Max. motor-way distance	Maximum distance to next motorway of origin or destination city (in minutes)	14.52	210.72	1	70
Distance	Road distance (in km) 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 under 24	Maximum share of population 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 orig. or dest. 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

Without aiming at providing a detailed discussion of Table 2, it is important to briefly point to the descriptive statistics of our main variables. For example, as revealed by the *Present MFB, Present FB* and *Present others* variables, in 17 percent of all route entries, MFB was already operating on the respective route (compared to 9 percent for FB and 26 percent for other providers). Consequently, 52 percent of all entries took place in existing markets while the remaining 48 percent of all entries created new markets (by being the first provider operating on the respective route). The corresponding absolute numbers of entries into existing and new markets in the first two years after deregulation are provided in Table 3 below.

Table 3: Matrix of entries into existing and new markets (in 2013 and 2014)

	Mein Fernbus	FlixBus	ADAC Postbus	Berlin Linien Bus	Others	Regionals	*Total entries*
MeinFernbus	1,178	189	59	147	105	17	*1,526*
FlixBus	277	641	74	149	130	22	*1,110*
ADAC Postbus	143	136	287	78	97	3	*532*
BerlinLinienBus	48	56	9	1,231	68	27	*1,384*
Others	90	112	30	74	629	5	*825*
Regionals	1	2	2	7	4	262	*273*

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

As revealed by the respective shaded cells in Table 3, BerlinLinienBus had most entries into new markets (1,231 route entries), however, closely followed by MeinFernbus showing 1,178 'innovative' entries. All other providers show substantially smaller entry activities into such markets. With respect to entry into existing markets, i.e., imitative entry, FlixBus entries into markets in which MeinFernbus was already present appeared most often (277 entries), followed by 189 entries of MeinFernbus into FlixBus markets and 149 entries by FlixBus into BerlinLinienBus markets. Finally, referring to the 'total entries' column in Table 3, it is important to remark 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.

Turning to the spatial structure variables, 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 kilometers.[14] The average distance to the next motorway (*Motorway distance*) is about 14 minutes and the average distance of an interurban bus trip (*Distance*) is 278 kilometers (however, with a rather large spectrum from 50.2 kilometers to 1080.0 kilometers).

The *Market size* variable – 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 thousand inhabitants).[15] The average maximum share of population under 24 years (*Max. share under 24*) is about 25 percent, compared to an average maximum share of population with A levels (*Max. higher education*) of about 40 percent. Furthermore, the

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[14] 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.

[15] 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.

maximum value of overnight stays per inhabitant (Max. tourism) is found to be slightly higher than 3 overnight stays.

Finally yet importantly, Table 2 shows that about 7 percent 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)*).

3.4 Estimation results

In this section, we present our estimation results. While Section 3.4.1 presents and discusses the results for our baseline model, Section 3.4.2 continues with a discussion of the estimation results for the extended version of the model. Section 3.4.3 closes the section by reporting the results of several robustness checks.

3.4.1 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 4. In interpreting the reported coefficients, it is important to note that the probability of entering a market is β-1. Accordingly, coefficients below 1 indicate a lower probability to enter and values above 1 imply a higher probability compared to the counterfactual.

Table 4: Estimation results for baseline model (semi-parametric)

	(1a) Entry FlixBus	(1b) Entry MeinFernbus	(1c) Entry FlixBus	(1d) Entry MeinFernbus
Competitor presence variables				
Any competitor present	**0.9302**	**0.7478*****		
	(0.0630)	(0.0554)		
Any present =1 # Small market			**0.1907*****	**0.0801*****
			(0.0733)	(0.0403)
Any present =1 # Medium market			**0.7485****	**0.6359*****
			(0.0847)	(0.0856)
Any present =1 # Large market			**1.1747****	**1.0173**
			(0.0930)	(0.0878)
Spatial structure variables				
Centrality in Germany	1.0021***	1.0011***	1.0021***	1.0010***
	(0.0004)	(0.0003)	(0.0004)	(0.0003)
Max. motorway distance	0.9629***	0.9953*	0.9623***	0.9958
	(0.0051)	(0.0026)	(0.0051)	(0.0026)
Distance	1.0004*	1.0002	1.0004*	1.0002
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Demographic variables				
Market size (ln)	1.3936***	1.2116***	1.2904***	1.1673***
	(0.0509)	(0.0297)	(0.0489)	(0.0289)
Max. share under 24	1.1262***	1.0746***	1.1220***	1.0841***
	(0.0282)	(0.0196)	(0.0280)	(0.0197)
Max. higher education	1.0032	1.0170***	1.0040	1.0179***
	(0.0041)	(0.0037)	(0.0041)	(0.0037)
Max. tourism	0.7244***	1.1720***	0.7372***	1.1789***
	(0.0316)	(0.0348)	(0.0321)	(0.0351)
Mode characteristics variables				
Airport shuttle	0.7872**	0.2129***	0.7786**	0.2089***
	(0.0936)	(0.0384)	(0.0925)	(0.0377)
Changes (train)	0.5966***	0.7255***	0.6020***	0.7382***
	(0.0257)	(0.0228)	(0.0260)	(0.0233)
LR χ^2	1263.39	729.72	1304.77	788.67
$p>\chi^2$	0.0000	0.0000	0.0000	0.0000
# subjects	4,159	4,159	4,159	4,159
# of failures	1,110	1,526	1,110	1,526
# observations	89,835	81,737	89,835	81,737

Exponentiated coefficients Standard errors in parentheses, clustered at route-level * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Starting with a high-level perspective, our estimation results generally suggest very similar entry strategies for FB and MFB. In fact, Table 4 reveals that there is only one variable (Max. tourism) where the estimation results for the two main providers show opposite directions (with MFB having an increased interest in entering these routes while FB avoids them). Although the sizes (and partly also the significance levels) of all other coefficients partly diverge – suggesting different intensities of the desire to enter/not to enter routes with the respective characteristics – they all point into the same direction.

Focusing on the regression results in columns (1a) and (1b), we further find that, on the one hand, four variables have a significantly negative effect on the probability to enter: the presence of a competitor in small and medium markets, maximum motorway distance (only FB significant), services to an airport and services into/from cities with a low quality rail connection. On the other hand, six variables show a clear positive effect on the probability to enter: the presence of a competitor in a large market (only FB significant), an increasing centrality of the route within Germany, the length of the route (only FB significant) and the three demographic variables market size, max. share under 24 and max. higher education (only MFB significant).

Starting a more detailed assessment of our estimation results with the *competitor presence variables*, columns (1a) and (1b) in Table 4 reveal that the probability of entering a route is generally decreasing with any other provider being active in the market already. Interestingly, the effect is found to be significant for MFB – the respective probability decreases by about 25 percent (1-0.7478=0.2522) – however, does not affect FB's entry probability significantly. However, if we interact the information on whether any competitor is active in the market already with terciles of market size – as shown in columns (1c) and (1d) in Table 4 – the identified effects differ substantially (particularly for FB). Both main competitors' probability to enter a small market is reduced by about 81 percent (FB) and 92 percent (MFB), respectively. While for medium markets, this general effect is still found to a lesser degree (25 percent for FB and 36 percent for MFB), the probability of entry switches to a positive impact (FB) or no impact (MFB) on the probability to enter for large markets.

The *spatial structure variables* all show the expected directions, however, partly differ between both main providers. While both FB and MFB show a (slightly but highly significant) increased probability to enter routes more centrally located in Germany, FB shows a decreasing interest in entering routes the farther they are away from the next motorway. Furthermore, while the probability to enter a route increases with its distance in the case of FB, MFB's entry probability remains unaffected.

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 29 percent for FB and 17 percent for MFB. Second, our results also reveal that the probability increases substantially for both main providers with an increase in the maximum share of under 24 year olds living in either the origin or destination city. However, third, the broader variable of maximum share of higher education only shows a significant (but rather small) coefficient for MFB. Fourth, with respect to the impact of tourism on the probability to enter, we find the diametrically opposing results already discussed above: while FB avoids entering touristic markets, MFB shows a substantially increased probability to enter those markets.

Last but not least, the *mode characteristics 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 79 percent reduced probability) compared to FB (showing a reduction in the probability of only about 22 percent). With respect to entry into routes with a low quality rail connection, both main providers show a reduced probability in entering those routes (about 40 percent for FB and about 26 percent for MFB).

In addition to estimating the determinants of entry for the two market leaders – MeinFernbus and FlixBus – we also ran the respective regressions for the two runner-up providers BLB and ADAC Postbus. We find that both companies avoid entering all existing markets already populated by either MFB or FB – however, smaller and medium-sized markets with higher probabilities than large markets. Furthermore, on the one hand, BLB shows an increased interest in entering touristic markets and a reduced interest to enter routes with larger maximum shares of young inhabitants. ADAC Postbus, on the other hand, is found to have no particular interest in touristic markets, however, serves routes to/from an airport with a higher probability.[16]

3.4.2 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 4 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.

In order to closer investigate these important aspects of competitive interaction, 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 5

[16] The underlying regression tables are available from the authors upon request.

below. Please note that – although all control variables discussed above are included – we refrain from reporting them.

Table 5: Estimation results for model extension (semi-parametric)

	(2a) Entry FlixBus	(2b) Entry MeinFernbus	(2c) Entry FlixBus	(2d) Entry MeinFernbus
FB # Small Market		**0.4988** (0.2507)		**0.4643** (0.2334)
FB # Medium Market		**0.8537** (0.1277)		**0.7961** (0.1196)
FB # Large Market		**1.5109***** (0.1468)		**1.4086***** (0.1418)
MFB # Small Market	**0.1373***** (0.0693)		**0.1202***** (0.0607)	
MFB # Medium Market	**0.7619**** (0.0939)		**0.7125***** (0.0885)	
MFB # Large Market	**1.1525*** (0.0989)		**1.1334** (0.0975)	
Others present	1.3735*** (0.1327)	0.5757*** (0.0601)	1.2888*** (0.1263)	0.5360*** (0.0567)
ADAC # Small Market			0.0000 (0.0000)	0.0000 (0.0000)
ADAC # Medium Market			**0.1336***** (0.0775)	**0.5301** (0.2193)
ADAC # Large Market			**0.9865** (0.1287)	**1.2964*** (0.1985)
BLB # Small Market			**0.3001***** (0.0943)	**0.2038***** (0.0498)
BLB # Medium Market			**0.7750** (0.1318)	**0.6101***** (0.1048)
BLB # Large Market			**1.2386*** (0.1427)	**0.7845**** (0.0890)
Control variables	Yes	Yes	Yes	Yes
LR χ^2	1313.14	761.42	1363.57	846.76
p>χ^2	0.0000	0.0000	0.0000	0.0000
# subjects	4,159	4,159	4,159	4,159
# of failures	1,110	1,526	1,110	1,526
# Obs.	89,835	81,737	89,835	81,737

Exponentiated coefficients Standard errors in parentheses, clustered at route-level * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Technically, considering the high values for χ^2, all eight models presented in Tables 4 and 5 show a very good fit. We further assess the goodness of fit based on Cox-Snell residuals (see Cox and Snell, 1968)[17]. The graphical representation is provided in Figure 4 in the Annex.

[17] For models which fit the data well, the Cox-Snell residuals ought to have a standard exponential distribution with a hazard function of one for all *t*. Accordingly, the cumulative hazard of the Cox-Snell residuals should result in a 45 degree line. Usually, the cumulative hazard function of the Cox-Snell residuals is estimated with the Nelson-Aalen estimator.

Starting our discussion of the main results with the specifications in columns (2a) and (2b), we see our findings of the baseline model 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.

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 5, 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 exception of the 'FB entry into large MFB markets' coefficient turning insignificant – the coefficients for BLB and ADAC reveal additional interesting insights. While ADAC is largely treated no differently than other competitors – with the only exception of FB avoiding entry into medium markets already operated by ADAC – the results for BLB look partly different. While both FB and MFB show a significantly reduced probability to enter BLB markets in small and – in the case of MFB – also medium markets, the respective large market BLB coefficients show opposing results. While FB shows an about 24 percent increased probability to enter large markets in which BLB is already present, MFB shows an about 25 percent reduced probability to enter such markets. In other words, while FB applies an aggressive entry strategy towards BLB, MFB tries to avoid a direct confrontation with BLB.

3.4.3 Robustness checks

The presentation and discussion of our estimation results so far was based on the application of semi-parametric survival models. However, as already discussed in Section 3.2 above, survival models can also be estimated fully parametrically (with good reasons to apply one or the other). Furthermore, despite its inability to take adequate account of the timing of entry decisions, our data structure and the empirical strategy as such also allows an application of probit models. In this section, we therefore briefly discuss the results of applying, first, a fully parametric survival model and, second, a probit model to our baseline model plus extension.

In applying a fully parametric survival model, we first have to identify the most appropriate distribution. As shown in Table 6 in the Annex, the Weibull distribution as well as the Log Logistic distribution fit best for both providers. The fully parametric estimation results are shown in Table 7 in the Annex. Although significance levels partly differ, the qualitative findings are in line with the results of the semi-parametric model discussed above.[18]

Technically, applying a fully parametric model allows us to predict durations needed for a provider to populate the entire market given the other provider is present or absent. Using the Weibull distribution, we find a prediction of 40 months for MFB if FB is not present and 55 months if FB is present. Accordingly, in the absence of FB, MFB would need another 16 months after our observation period to offer a service on each route in our sample. This timeframe increases to 31 months if FB would be present in each market. For FB, we find a slower entry activity reflected in a prediction of 53 months to populate all routes if MFB is not present and 85 months if MFB is present. In other words, if MFB was not present, FB would need another 29 months to populate the entire market and even 61 additional months if MFB was present.

Turning from the fully parametric survival model to an application of a probit model, we provide the respective estimation results in Table 8 in the Annex. The results reported in columns 1 and 2 are derived with exactly the same specification as used in our survival analysis and show a few differences with respect to significance levels but only one difference with respect to direction: the respective coefficient for FB entry into medium markets of MFB is found to be positive (yet insignificant).

In columns (3) and (4) in Table 8, we have added the further control variable 'number of large cities still available'[19] – for which survival models implicitly control for – to the probit model. Interestingly, the inclusion of this further variable changes the direction of the only qualitatively different coefficient in the original probit specification – reported in columns (1) and (2) – now leading to results perfectly in line with the semi-parametric estimation results.

[18] In column 1 and 2, this result can be identified immediately, in case of the log logistic distribution, it is necessary to calculate $1 - \beta$ to receive the usual interpretable coefficients. Doing so in our case leads to negative coefficients for small and medium markets and a positive coefficient for large markets.

[19] The inclusion of the variable is equivalent to adding a non-linear time trend.

The identified inconsistency of our survival specification – when applied to a probit model – can be attributed to the right-censoring of the data – which is not captured by this kind of model – however, in our case, was resolved by the inclusion of an additional variable that controls for the number of large cities still available.

3.5 Implications for business strategy and public policy

In this section, we make use of our econometric and descriptive results to discuss several key implications for business strategy and public policy. From a business strategy perspective, our econometric results suggest that both market leaders – MFB and FB – reached their respective positions by applying very similar entry strategies. They both show an increased probability to enter populous, centrally located routes with large shares of young inhabitants; however, they both avoid entries into routes including an airport or with low quality rail connection. Furthermore, both market leaders refrain from entering small and medium-sized routes in which another provider is already operating. In large markets, however, they both show an increased entry probability independent of the presence of a competitor.

In terms of network construction, our econometric results are consistent with a strategy of both competitors to serve the important 'backbone' markets between larger cities (i.e., facing competition), however, to differentiate themselves (i.e., avoiding competition) on routes between small- and medium-sized cities. This general strategy of substantial route entry into both existing and new markets also separates the two market leaders from other providers who mostly decided to concentrate on certain regions (such as, e.g., the incumbent BerlinLinienBus with its strong presence on routes to/from Berlin but weak presence anywhere else in the country) or have a focus on 'backbone' markets (such as, e.g., ADAC Postbus). However, as suggested by the increasing route overlap over time – particularly between the two market leaders but also in relation to other competitors – the number of attractive new locations became more and more limited making it unavoidable to reach further route growth by entering into already existing medium-sized or even small markets. These developments may also have played a role in generating the desire of both market leaders to join forces in the form of a merger (discussed further below).

Despite the high degree of similarity between the entry strategies of MeinFernbus and FlixBus, our empirical analysis also reveals several differences. In particular, our econometric analysis showed that MeinFernbus has an increased interest to enter touristic routes while FB avoids them. This empirical finding is fully in line with the web presences of MFB and FB – with particularly the former actively promoting interurban bus trips to a large selection of holiday regions in the North (sea) and South (mountains) of Germany. Furthermore, our extension of the econometric model revealed that both market leaders partly differ in their entry behavior towards other (significant) competitors in particularly large markets: while MFB shows an increased probability to enter ADAC Postbus markets, FB concentrates its entry activities on large markets in which BerlinLinienBus is already operating.

Still aiming at investigating differences in the entry activity of both market leaders, our descriptive analysis of network construction over time also revealed mentionable differences. While MeinFernbus had a first mover advantage in the sense that the company entered the industry several months before FlixBus, the first few months in the deregulation era showed a rather comparable development of both firms in terms of the number of route entries. However, while FlixBus followed a rather sustainable entry strategy, i.e., the company constantly added a few routes in almost every month, MeinFernbus decided – in the spring and summer months of 2013 and 2014 – to massively extend its route network; however, put its entry activity on hold in the respective fall and winter months. In sum, measured in terms of number of served routes (in December 2014), MFB's strategy has proven more effective than FB's strategy. However, both companies were successful in making use of the entry opportunities in the early days of the deregulated industry to extend their route networks with a much higher pace than any of their remaining competitors.

In this context, the merger plans of both companies – announced in January 2015 and already realized through the integration of both route networks in fall 2015 – demand a more detailed treatment from both a business strategy and a public policy perspective. With respect to the former, our empirical results suggest that the two merging companies followed comparable entry strategies – suggesting that an integration of both networks is a rather easy exercise. However, as well known from the respective management literature, mergers contain many other integration challenges – particularly when it comes to firm culture. Although these aspects are outside the scope of this paper, it appears reasonable to assume that the young age of both industry and merging companies ease the necessary integration process.

Turning from business strategy to public policy implications of the merger, it can generally be said that mergers between close competitors raise the question after their competitive effects in general and their price effects in particular. Although the compulsory assessment of the potential price effects of the merger is outside the scope of this paper (see Dürr et al., 2016, for a detailed investigation), our descriptive analysis revealed a substantial number of 411 route overlaps between the merging parties in December 2014. Although on the surface, such a constellation would speak for market-power induced price increases on the respective routes post-merger, the low market entry barriers in combination with the generally high price elasticity of demand speak against larger (permanent) increase in prices. Furthermore, the merger might allow customers to enjoy the benefits of demand- and/or supply-side efficiencies realized by, e.g., a better network connectivity or cost reductions passed-on in the form of price reductions.[20]

In terms of the broader implications of our empirical results for public policy, one key aim of the deregulation of the interurban bus industry was an increase in the mobility of citizens with lower income levels living in larger urban areas. In this respect, our descriptive results of substantial entry activities in the first two years – leading to a quick extension of the interurban bus network – provides strong evidence that this key aim of deregulation has already been reached. It therefore appears likely that the deregulation of the industry creates substantial and clearly positive welfare effects – also by imposing increasing pressures on intermodal competitors such as particularly railway services to operate more efficiently and to fight for particularly price sensitive customers (e.g., through a restructuring of price differentiation strategies).

In addition to an increase in the mobility options between larger urban areas, the deregulation of the interurban bus industry also raised expectations of an improved connectivity of particularly smaller cities with either no or low quality rail connections. In this respect, our econometric results suggests that (at least) the two market leaders clearly avoided entry into such markets. However, in putting this result into perspective, it is important to remind that our empirical analysis only covers the first two years of the deregulation era. In this early stage of the deregulated industry, it is perfectly rational from the provider's perspective to enter the (presumably) more profitable and strategically more important larger markets first. As a consequence, future years might witness an increased entry activity also into smaller city markets, especially if the major providers consider implementing hub-and-spoke network architectures. Furthermore, a significant number of smaller cities is – although not connected to the network of the two largest providers – nevertheless already been served by smaller regional interurban bus companies.

Lastly and more generally, it is worth mentioning further that certain economic characteristics of cities – such as the mere size of the population but also, e.g., the share of young inhabitants – determine their attractiveness to be included into a provider's network (see Dürr and Hüschelrath, 2016, for a detailed assessment). In this respect, it appears

[20] Interestingly, the merger was not investigated by the German Federal Cartel Office as the worldwide cumulative turnover threshold of EUR 500 million – set out in German merger control – was not reached by the two merging parties.

unrealistic to expect that the majority of all 2,060 German cities will be connected to the interurban bus network anytime soon. In case the government identifies a need to connect certain rural areas to the interurban bus network – including the possibility to replace expensive (and partly subsidized) rail services with (presumably cheaper) bus services – it will have to consider paying a sufficient amount of subsidies to motivate the most efficient interurban bus provider to offer the respective service.

4 Conclusion

In the first two 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 (see Dürr and Hüschelrath, 2016). On the route-level, deregulation-induced growth was even more pronounced showing an increase in the number of served routes from 151 routes in January 2013 to 3,603 routes in December 2014. Although a larger number of new entrants contributed to this substantial overall growth, two providers – claiming roughly half of all 5,560 entries into either existing or new routes – emerged as clear market leaders: MeinFernbus (MFB) and FlixBus (FB).

In this context, we have used a comprehensive route-level data set to investigate the determinants of route entry of the two market leaders in the first two years after deregulation. Applying survival models, we find that both companies show an increased probability to enter populous, centrally located routes with large shares of young inhabitants; however, they both avoid entries into routes including an airport or with low quality rail connection. Furthermore, both market leaders refrain from entering small and medium-sized routes in which another provider is already operating. In large markets, however, they both show an increased entry probability independent of the presence of a competitor.

Based on these key results of our empirical analysis – and our complementary discussion of important implications for business strategy and public policy in the preceding section – several avenues for future research suggest itself. 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 recent merger between MFB and FB. In 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.

Annex

Table 6: Information criteria for parametric model extension

		Exponential	Log Logistic	Log Normal	Weibull	Gamma	Gompertz
AIC	FlixBus	4,992.33	4,492.11	4,605.16	4,494.50	4,495.16	4,545.24
	MeinFernbus	7,332.47	7,059.12	7,067.81	7,132.22	7,065.58	7,249.22
BIC	FlixBus	5,124.01	4,633.20	4,746.25	4,635.58	4,645.66	4,686.32
	MeinFernbus	7,462.83	7,198.79	7,207.48	7,271.89	7,214.56	7,388.89

Table 7: Estimation results for model extension (parametric)

	Weibull		**Log logistic**	
	(1) Entry FlixBus	(2) Entry MeinFernbus	(3) Entry FlixBus	(4) Entry MeinFernbus
FB # Small Market		**0.3851***		**2.0295****
		(0.1890)		(0.6603)
FB # Medium Market		**0.6694*****		**1.2698***
		(0.0979)		(0.1596)
FB # Large Market		**1.3203*****		**0.6623*****
		(0.1197)		(0.0609)
MFB # Small Market	**0.1267*****		**2.5963*****	
	(0.0641)		(0.5575)	
MFB # Medium Market	**0.7180*****		**1.1918*****	
	(0.0882)		(0.0721)	
MFB # Large Market	**1.1048**		**0.9232***	
	(0.0917)		(0.0441)	
Others present	1.2804**	0.6444***	0.8340***	1.5304***
	(0.1303)	(0.0644)	(0.0462)	(0.1164)
Control variables	Yes	Yes	Yes	Yes
LR χ^2	930.19	761.19	628.83	704.39
$p>\chi^2$	0.0000	0.0000	0.0000	0.0000
# subjects	4,159	4,159	4,159	4,159
# of failures	1,110	1,526	1,110	1,526
# Obs.	89,835	81,737	89,835	81,737

Exponentiated coefficients Standard errors in parentheses, clustered at route-level * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 8: Estimation results for model extension (probit)

	(1) Entry FlixBus	(2) Entry MeinFernbus	(3) Entry FlixBus	(4) Entry MeinFernbus
Present FlixBus=1 # Small market		**-0.2527**		**-0.3395***
		(0.1844)		(0.1858)
Present FlixBus=1 # Medium market		**-0.0287**		**-0.1238****
		(0.0592)		(0.0619)
Present FlixBus=1 # Large market		**0.2499*****		**0.1818*****
		(0.0400)		(0.0423)
Present MeinFernbus=1# Small market	**-0.5563*****		**-0.7551*****	
	(0.1611)		(0.1642)	
Present MeinFernbus=1 # Medium market	**0.0548**		**-0.1240****	
	(0.0468)		(0.0501)	
Present MeinFernbus=1 # Large market	**0.2274*****		**0.0742****	
	(0.0330)		(0.0366)	
Others present	0.1675***	-0.1451***	0.1176***	-0.1691***
	(0.0380)	(0.0397)	(0.0421)	(0.0407)
# Large cities still available			-0.0010***	-0.0003***
			(0.0001)	(0.0000)
Control variables	Yes	Yes	Yes	Yes
Constant	-3.0387***	-3.3693***	-2.4297***	-3.2005***
	(0.2510)	(0.1956)	(0.2718)	(0.2050)
LR χ^2	1077.53	839.81	1045.66	816.42
$p>\chi^2$	0.0000	0.0000	0.0000	0.0000
Pseudo R^2	0.1017	0.0498	0.1300	0.0532
# Obs.	91,777	84,077	91,777	84,077

Standard errors in parentheses * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

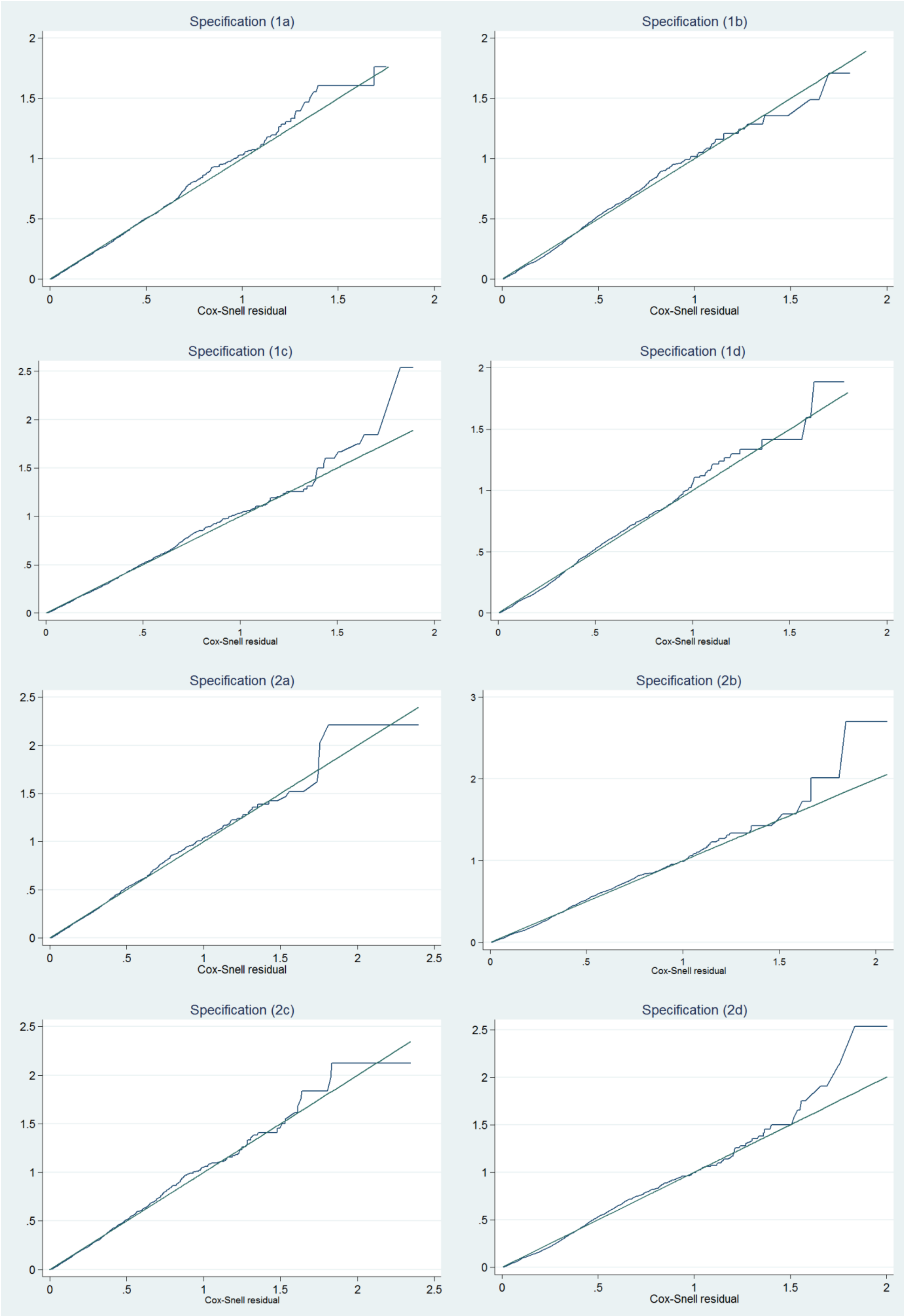

Figure 4: Goodness of fit – Cox-Snell residual

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