Effects of the elimination of train path charges on the competition between bus and train – Development of travel activities and the choice of means of transport in German long-distance passenger transport

BY CHRISTIAN BURGDORF, ALEXANDER EISENKOPF
AND ANDREAS KNORR[1]

Abstract

In our study, we used a system dynamics model to analyze how a reduction of train path charges to the level of direct operational costs of trains and the additional introduction of an infrastructure cost-related mileage charge for intercity bus services would affect the choice of means of transport and the travel activities of long-distance passenger transport users in Germany. In particular, we have analyzed how the modal split will change, whether rail transport can benefit from a reduction of train path charges or the increased burden on its intermodal competitor. Our simulations show that a reduction of infrastructure charges increases the transport performance of passenger rail traffic by 12.5 percent compared to the benchmark case (in 2025). This means an improvement of the modal share from 10.74 percent to 11.73 percent, accordingly. An additional toll for intercity buses, however, will improve market performance of railways only marginally compared to this scenario, whereas the intercity bus suffers from strong losses of passengers. To reduce train path charges to the level of direct operational costs would

Addresses of the authors:

Christian Burgdorf
KCW GmbH
Bernburger Straße 27
10963 Berlin, Germany
e-mail: burgdorf@kcw-online.de

Alexander Eisenkopf (corresponding author)
Zeppelin University
Am Seemooser Horn 20
88045 Friedrichshafen, Germany
e-mail: alexander.eisenkopf@zu.de

Andreas Knorr
German University of Administrative Sciences Speyer
Freiherr-vom-Stein-Straße 2
67346 Speyer, Germany
e-mail: knorr@uni-speyer.de

[1] We would like to thank Christian Böttger for valuable input and his critical and constructive comments on our paper.

mean a massive subsidy to the rail sector, however, and will increase competitive distortions with respect to infrastructure cost coverage.

1 Introduction

Since the liberalization of the German market for intercity bus services there is a debate on the competitive relationship between intercity buses and railways and the character of potential competitive distortions between these means of transport. Therefore, in an earlier paper we discussed the influence of toll rates for intercity bus services on the choice of means of transport and the travel activities of long-distance passenger transport users in Germany (see Burgdorf / Eisenkopf 2018). We found that the introduction of distance-related road tolls in intercity bus transport (if they are completely shifted to customers in the form of surcharges) will result in significant changes: Thus, at a toll rate of .6 ct per passenger kilometer – reflecting infrastructure costs of buses – the modal share of intercity buses (by passenger kilometers) in the German long-distance passenger transport sector will drop by about 12 percent to 2.44 percent in the year 2025. At .4 ct per passenger kilometer, the share drops by almost three percent. Rail passenger transport, however, will not benefit significantly from this; the increase of the toll rate has hardly any effect on the transport performance of trains.

The introduction of a road toll for intercity buses is not the only possible way to support modal shift from road to rail in passenger transport. Another option could be to reduce or eliminate train path charges to be paid by railway undertakings. After controversial discussions on the relevance of infrastructure charges for intermodal competition in the freight market, the German government decided to reduce infrastructure charges for freight trains by 50 percent (see VDV 2018). Reducing train path charges is expected to improve the competitive position of rail freight companies in the freight market and to support the politically intended modal shift to rail. The same underlying idea could be adopted to long-distance passenger transport. If distortions in intermodal competition are caused by the fact that railways have to pay for their infrastructure and buses do not, a reduction of train path charges could be a feasible option to remove competitive distortions and to generate a level playing field for bus and train. This approach takes account of the demands of various NGO's and political parties, whose purpose is to protect the railway sector. Their core argument is that rail transport services, which are considered to be environmentally friendly and / or climate-friendly, should be strengthened compared to the road transport sector in order to achieve the ambitious climate protection targets[2].

[2] According to "Klimaschutzplan 2050" ("Climate Action Plan 2050"), which was adopted by the Federal Government at the end of 2016 (cabinet decision), the greenhouse gas emissions of the transport sector should be reduced by at least 40 to 42 percent by 2030 compared to 1990. By 2050, the goal is to reduce total greenhouse gas emissions by 80 to 95 percent (see BMUB, 2016).

As we resumed in Burgdorf / Eisenkopf (2018) the road network in Germany can currently be used free of charge with the exemption of tolls for heavy goods vehicles weighing at least 7.5 tons on highways and certain federal roads.[3] There is no charge for cars, motorcycles and buses at the moment. The planned implementation of a car vignette for the use of federal highways (Bundesautobahnen) and federal roads (Bundesstraßen) was stopped in June 2019 by the European Court of Justice. However, a mileage-related toll for intercity buses has also been discussed repeatedly since the start of the liberalization process in Germany in 2009.

In the light of previous and current political debates, we have investigated the possible effects of a reduction of train path charges and a combination of this measure with a mileage-related toll for intercity buses on the choice of means of transport and travel activities of users in long-distance passenger transport in Germany. In particular, we analyzed how a reduction of infrastructure charges to the direct costs of train operations (economical: marginal costs) will change the modal split, whether rail transport can benefit from the increased burden on the intermodal competitor, or whether the passenger car, for which no mileage-related toll is planned at this time, is the biggest beneficiary. Our research is based on a system dynamics simulation model, which was developed to analyze the market potential of intercity bus services in Germany and has been modified for this analysis.

Our analysis expands the research currently available dealing with the impact of liberalization in the intercity bus market and focusing on the development of the intercity bus market after the start of liberalization and addressing patterns of intramodal and intermodal competition. However, a reduction of train charges was not previously addressed in the discussion with respect to the degree of intermodal competition. Bataille and Steinmetz (2013) develop a model explaining intermodal competition between intercity bus services and rail services. Their main finding is that external effects of individual routes of the rail network are fundamental for the profitability of the network as a whole; therefore, the introduction of intermodal competition on single routes may affect other rail services not directly facing competition by buses; however, the model does not take care of the influence of train path charges and road tolls.

Knorr and Lueg-Arndt (2016) explain short term intermodal and intramodal effects of the intercity bus market deregulation in Germany, but do not consider a reduction of train path charges and its potential effects on the development of the market. This is the same with Dürr, Heim and Hüschelrath (2016) and Dürr and Hüschelrath (2017) who mainly focus on patterns of market entry. To sum up we can say that our paper contributes to an important

[3] Infrastructure charges for heavy goods vehicles (above 7.5 tons) has be extended to the whole network of federal roads by July 2018. However, users of vehicles have to pay vehicle taxes and mineral oil taxes which can be offset against the infrastructure costs caused by them.

research gap concerning intermodal competition in the German long-distance passenger transport market and follows the findings in Burgdorf / Eisenkopf (2018).

The rest of our paper is organized as follows. First we outline the situation in the German long-distance passenger transport sector after the liberalization of intercity bus services in January 2013 and trace the debate on the competitive distortions between bus and train. We then present the structure of our model and show how this model is suitable to explain the effects of policy measures to remove these (asserted) distortions of competition. Suitable policy measures are a reduction of train path fees (case A) and a combination of case A and the levying of road tolls for buses (case B). Finally, we will present the results, draw a conclusion and give an outlook on the economic framework for the political decision-making process.

2 Starting point

In this section of the paper, we briefly analyze competition and market structure in the long-distance passenger transport market with a special view on the competitive relationship between long-distance bus and train.

2.1 GERMAN LONG-DISTANCE PASSENGER TRANSPORT – CURRENT STATUS

As we explained in Burgdorf / Eisenkopf (2018) the German long-distance passenger transport market has fundamentally changed since the liberalization of intercity buses in 2013. Until 2012, intercity buses played a minor role in national long-distance passenger traffic in Germany. According to the traffic statistics collection of the BMVI ("Verkehr in Zahlen"), some 130 million persons traveled by rail in 2012, and almost 24 million people used planes for domestic routes, while the number of intercity bus passengers was only three million (see BMVBS 2013). Transport performance of the intercity bus in 2012 was about 1.2 billion pkm, while the rail sector showed 37.3 billion pkm, and air transport 10.3 billion pkm (see BMVBS 2013). In 2017, about 24 million persons made use of the long-distance bus, whereas 142 million travelers went by rail. Transport performance of long-distance rail traffic was about 40 billion pkm and intercity buses reached 7.1 billion pkm (see BMVI 2018).

After the start of the liberalization several providers began to build up nationwide networks, primarily between metropolitan areas.[4] The number of scheduled trips per week increased from 770 pairs in the first quarter of 2013 to a maximum of 4,653 in the second quarter of 2015; afterwards we observe a strong consolidation. In the third quarter of 2017 about

[4] See Dürr, Heim and Hüschelrath (2016) and Dürr and Hüschelrath (2017) respectively, who derive route entry and exit patterns empirically.

3,200 pairs of trips were offered. Consolidation took also place with respect to the market structure. FlixMobility (Flixbus) dominates the German market so clearly that one can speak of a quasi-monopoly position on the intramodal level (see Knorr / Lueg-Arndt 2016). In addition to the acquisition of the once-biggest competitor MeinFernbus, the Munich-based provider also took over Postbus, while BerlinLinienBus ceased operations. At the moment market share of FlixMobility is about 93 percent in Germany (see Alvares de Souza Soares 2019).

Deregulation has significantly intensified intermodal competition in national long-distance passenger transport, and the monopolist Deutsche Bahn AG in particular had to make numerous competitive adjustments. In December 2014, for example, the company surprisingly refrained from raising prices in the second class and announced that it would improve WLAN and catering on long-distance trains. In addition, special offers ("Sparpreise") were significantly extended (see Schlesiger 2014, Deutsche Bahn AG, 2014, N. U. 2014). Additionally, the growth of the intercity bus market initiated a quality initiative and strong investments of the market-dominating player Deutsche Bahn AG (IGES-Institut 2015). Since March 2017, FlixMobility also offers a *Flixtrain* from Hamburg to Cologne and Berlin to Stuttgart. Looking at these new passenger train services we find for the first time serious competition on the tracks in Germany (Balser 2018).[5]

The main competitive advantage of intercity buses compared with passenger cars, trains and planes is above all the significantly lower price: According to our surveys, in summer 2014 a national long-distance trip by train was on average almost twice as expensive as a trip by intercity bus (EUR 30.10 vs. EUR 16.24). A flight trip was almost four times more expensive (EUR 58.94). The costs for a corresponding long-distance journey by car were EUR 19.79.[6] As current market surveys show, the price of bus services slightly rose in the meantime, but the increase does not reflect the market structure with a quasi-monopoly. The price advantage of the long-distance bus on the routes served by the railway has not been significantly reduced. Obviously, the scope for price increases remains limited because of strong intermodal competition (Krämer / Bongaerts 2019).

[5] Long distance services from Interconnex, HKX, Locomore and others were not really threatening.

[6] In the survey, factors such as travel distance, time of booking choice of comfort class, customer loyalty instruments, rate of occupation (car) and type of trip were taken into account. The determination of the provider prices is based on a total of 484 start-to-finish connections. When determining car prices, only fuels and lubricants were taken into account. We assume that most users only consider these "out of pocket" costs when choosing a means of transport or when comparing costs with intermodal competition. The costs of maintenance and modernization, for example, are also considerable, but they are more related to car ownership than to its use. This is particularly true for long-distance trips, which are relatively rare compared to local trips.

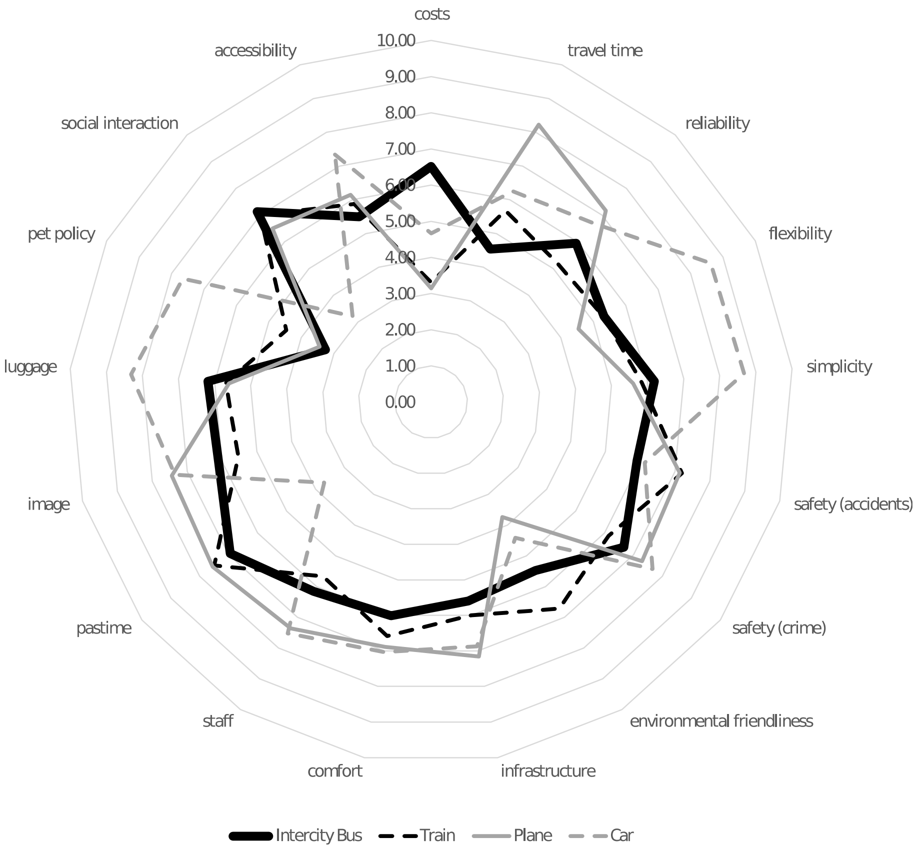

Fig. 1. Assessment of transport modes (long-distance passenger transport). Average values, 0 ("transportation mode is very bad") – 10 ("transportation mode is very good"). Source: Own figure based on our own survey in Q1 2014, n=900 / n=300 (specific substudy).

In the users' assessment, which is decisive for the actual choice of means of transport, the intercity bus also achieves the best rating when it comes to the factor *price* (see Fig. 1), but only there and in *social interaction*. In all other areas, other means of transport show competitive advantages over the bus.

The development of the German intercity bus market is pretty much in line with the results of the liberalization of long-distance bus services in other European Countries. Aarhaug and Fearnley (2016) state that liberalization of long-distance bus transport activities caused a rapid growth of services and has the potential to make long-distance passenger transport more efficient and more sustainable.

With the revision of their 1986 study White and Robbins (2012) find that long-distance bus markets in England, Wales and Scotland, followed by a period of growth, price and frequency competition, are now dominated by one major operator. Alexandersson et al. (2010) report that the Swedish express coach market is dominated by privately owned coach operators running services to and from the capital Stockholm ten years after deregulation. Blavac and Bougette (2017) report positive results of the recently initiated liberalization process in France in terms of fares, market entry, frequency, and quality. Last but not least one can make a comparison with the well-established long-distance bus market in the US. As Augustin et al. (2014) show, the German market is in its first phase of liberalization. As average travel distances in Germany are much lower than they are in the US, the intercity bus should have even higher potential than in the US.

2.2 UNFAIR COMPETITION BETWEEN BUS AND TRAIN?

In Germany, there is a controversial debate whether competition between bus and rail is unfair. The main argument is that trains have to pay infrastructure charges on the whole network, whereas buses do pay road tolls not at all. On the other hand, you have to bear in mind that long-distance buses have to pay fuel tax for their operations and vehicle taxes. According to the latest available infrastructure cost calculations, tax payments exceed the road costs to be allocated to buses.[7]

Notwithstanding, politicians and lobby groups like Allianz pro Schiene claim for road tolls to create a single level playing field between road and rail. Pro Bahn, Deutscher Städtetag, Deutscher Städte- und Gemeindebund, Deutsche Bahn AG and numerous politicians also published corresponding claims. All in all, the discussion is becoming more intense and controversial with the success of intercity buses.

Additionally, lobby groups request a reduction of the infrastructure fees for the long-distance rail passenger traffic as it has been politically agreed to in the freight sector. According to their belief, a general 50 percent reduction of train path charges would increase the competitiveness of the rail sector against roads and lead to a modal shift from road to rail (Mofair 2017). Therefore, we will analyze the effects of a reduction of train path fees to the direct costs of train operation to get an impression of the maximum achievable effects on travel activities and modal split. This analysis will be completed by the supplementary introduction of a road toll for buses at the level to .6 ct per pkm which represents the current infrastructure costs of buses in Germany.

[7] For details see Section 5.

3 Analysis

3.1 GOALS AND CHARACTERISTICS

A basic assumption of our analysis is that reducing infrastructure charges for trains will lead to price cuts for rail services and imposing a mileage-based road toll will lead to price increases for intercity bus services on the other hand. This may cause significant effects on the choice of means of transport and travel activities in national passenger transport. In particular, rail transport could benefit from this, and also motorized private transport by car. Against this background, it was a core objective of our study to assess the long-term impact of a reduction of train path charges on modal shift and travel activities in German long-distance passenger transport.

In order to assess the long-term potential of intercity bus transport in Germany and the development of the domestic passenger transport sector, we have developed a system dynamics model which has been previously described in Burgdorf / Eisenkopf (2018).

The simulation method is based on the central assumptions of cybernetics (see Forrester 1969, Sterman 2004). The actual decision-making rules can be derived from different concepts. In our model, the neoclassical theory represents the essential theoretical basis: the economic entities (providers and demanders) act as rational benefit maximizers – although certain restrictions apply in particular to the demand side of the model. Ultimately, we describe the passenger transport sector as a set of rules, whose effects and interactions determine the behavior of individual system components as well as ultimately the entire system.

In total, we investigate a period of 15 years (2019—2033), but our target year is 2025[8]; the road charge and the reduction of the trans path charges are introduced in 2019. The step size (integration step) is one year. The variables of interest are *market volume* (in passenger kilometers, pkm) and *modal share* of the relevant modes in domestic long-distance passenger transport. In addition to intercity buses and trains, the model also includes passenger cars and aircraft. In our study, we consider long-distance activities only – which includes all journeys with a travel distance of at least 50 kilometers (single route), with a distinction between vacation, business and private trips.[9] In addition, a certain degree of stability with regard to the macroeconomic, technical, political, social and infrastructural

---

[8] This year was chosen because it is far enough away from the present and it can be assumed that there is a "running system" in the sector, but it is not yet so far into the future that the economic, political or legal framework will change fundamentally. Of course, disruptive events or exogenous shocks can occur in reality, but they are not simulated at first.

[9] Multimodal trips using several main means of transport are excluded explicitly; however, shuttle services by bus, taxi, etc. are taken into account. Capacity bottlenecks (related to infrastructure, vehicles, personnel, etc.) are also not relevant.

development is assumed. However, demographic change and the resulting impacts on the transport market are taken into account. Microsoft Excel and the system dynamics simulation tool Vensim 6.0 were used as main applications. A detailed description of the simulation model can be found in Section 3.3.

A system dynamics approach was chosen mainly because it makes it possible to represent certain feedback loops relatively simple. In our model, for example, such loops exist between the choice of means of transport for travelers and the offer of long-distance trips by intercity bus. In addition, there are links between the demand for specific means of transport and the general need for mobility (see Section 3.3). Generally, developments over time can be mapped easily using the system dynamic approach, such as the influence of societal composition on the choice of means of transport (see also Section 3.2). Overall, our approach is focusing on the demand side. Travelers' decisions are at the center of the analysis. Since this is a new field of research, a great deal of basis work had to be done in addition to the actual model construction and the subsequent simulations as well as the evaluation of the results. The essential steps are briefly described in the following section.

3.2 PREPARATORY WORK

Because much data required for our simulation was not available in official public statistics or other sources, we had to do a lot of preparatory work. In the course of an empirical price analysis, kilometer prices were determined for all four means of transport. An online survey was used to determine the mobility behavior of long-distance travelers in Germany and, in particular, their mode choice. In addition, a sensible structuring of the investigation area was undertaken and the spatial / temporal mobility demand of the travelers as well as the corresponding mode-specific offers were determined. Finally, population archetypes were also formed, which ultimately allowed the use of the selective survey results over the entire simulation period.

Within the framework of the price analysis, a total of 484 routes (start-destination connections) were analyzed. In the subsequent mode-specific kilometer price formation, different booking times and comfort classes, discounts and, finally, distance-related price advantages were taken into account.[10] Corresponding information about the booking behavior, the choice of comfort classes and the use of discount cards was obtained in advance in the context of the survey (see below).

Fuel prices for petrol and diesel (per kilometer, golf class) were taken into account when modelling the price of travelling by car. Prices were updated by means of suitable indices, the price development was continuously checked by random sampling to ensure the best fit to the development in reality. The kilometer prices for the four modes of long-distance

[10] The same distance categories were used as for the demand for mobility (see below). Thus, both aspects could be combined in the model without any problems.

transportation (buses, railways, airplanes and passenger cars) are of considerable importance in the simulation model. They are a dynamic determinant in the choice of means of transport and they are also necessary for the calculation of transport demand in the whole passenger transport sector.

In order to make specific statements on the distribution of the general or mode-specific mobility demand as well as the mobility offers in the investigation area, the connections between the 412 counties and urban municipalities (NUTS3-level) in Germany were evaluated. The spatial distribution of the mobility demand was determined by a gravity model (for further information see Aberle 2009), with different masses being used for the three relevant types of trips. The distance-related results were summarized to shares of 11 (long-distance transport) and 12 (local and long-distance transport) distance categories (see Fig. 2), which were used in the simulation model. The mode-specific mobility offer was also determined per connection and per distance category. Here the decisive factor was how far away the existing supply is from a fictitious optimum. While the offers for trips by train and plane were kept constant and the passenger car was exogenously set to the optimum, a development path was used for the intercity bus.

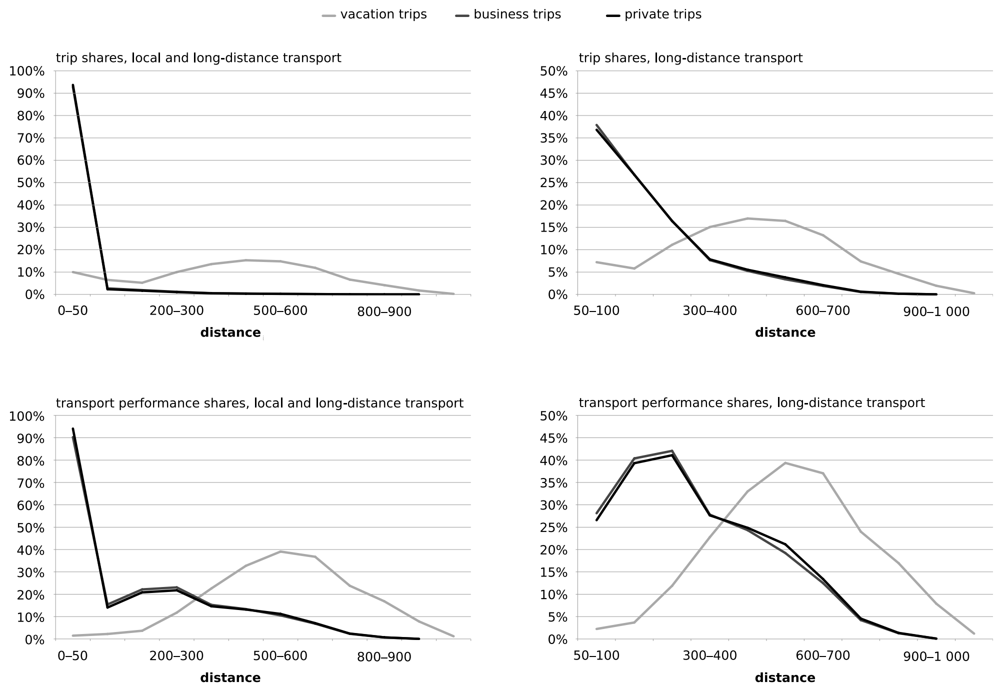

Fig. 2. Shares per distance category, gravity model, trips and transport performance. Source: Own figure.

Our online survey should provide information on the mobility behavior of domestic passenger transport users. Among other things, questions were asked on the frequency of travel, on the choice of means of transport, on booking behavior and on specific travel habits. Due to the large number of relevant aspects, the survey was divided into three partial studies. The participants were distributed evenly so that there were 300 records per partial study. 25 minutes were scheduled for the survey / partial study, it was conducted in February and March 2014.[11]

In order to obtain a representative sample, gender distribution and proportions of certain age and educational groups should be identical in the sample and the population (German resident population aged 15 and over; for the distribution in the survey see Tab. 1).

Various tests were carried out to assess the quality of the sample. Among other things, it was examined to what extent the voting behavior of the survey participants differed from that of all citizens entitled to vote in the 2013 Bundestag elections. The regional distribution of respondents was also analyzed. It was found that there were considerable deviations beyond the three quota criteria in some cases, but overall there was sufficient agreement.

As in the population, 49 percent of the participants are male, 51 percent female. The average age was 47.56 years. 24 percent lived in a one-person household, 41 percent in a two-person household, 18 percent in three-person household, 12 percent in a four-person household – and finally 5 percent in a household with five or more persons. About half of the participants (51 percent) were married or lived in a registered civil partnership, 32 percent were single, 17 percent divorced or widowed.

Although the data were gathered several years ago, we assume that they are still usable. This is due in particular to the fact that no massive changes have been observed in users' travel and means of transport choices and there have been no massive changes in the transport sector.

[11] Detailed information on the survey, especially on the methodology, can be found in Burgdorf (2017).

Tab. 1. Survey: Distribution of participants, full study, quality buffer included (n=90)

Gender	*Age*	in school	Hauptschulabschluss	Abschluss der poly-technischen Oberschule	Realschulabschluss	Abitur (or Fachhochschulreife)	not stated	unqualified	graduated (university, university of applied sciences)
Male	under 15	–	–	–	–	–	–	–	–
	15 to 20	18	3	0	6	0	0	0	0
	20 to 30	0	15	0	21	24	0	3	6
	30 to 50	0	45	15	39	27	0	6	30
	50 to 65	0	45	18	18	12	0	3	21
	over 65	0	63	3	12	6	0	3	15
Female	under 15	–	–	–	–	–	–	–	–
	15 to 20	18	3	0	6	3	0	0	0
	20 to 30	0	9	0	21	24	0	3	9
	30 to 50	0	33	12	48	30	0	6	27
	50 to 65	0	45	18	27	12	0	6	15
	over 65	0	93	6	21	6	0	6	6

n=990

Our preparatory work also included a comprehensive structural analysis of the intercity bus sector. In particular, we intended to gain knowledge of the market development after the liberalization in January 2013 in order to be able to estimate the further development (scope, prices, comfort, etc.) during the simulation period. In order to be able to use the individual snapshots from the survey for the entire investigation period, an auxiliary construction was used, which in the end allows both time-related statements on the mode choice as well as linking the results from different sub-studies. If one assumes that there are certain groups within the population, whose representatives are generally similar in economic life (and thus also in the area of mobility) and maintain their behavior over a longer period, and if we are able to assign the survey participants to these population groups, it is now possible to derive longitudinal cutouts from the cross-sectional data at the aggregate level. In the course of our investigations, seven archetypes were used whose share development over the course of time was derived from official statistical forecasts (see Fig. 3).

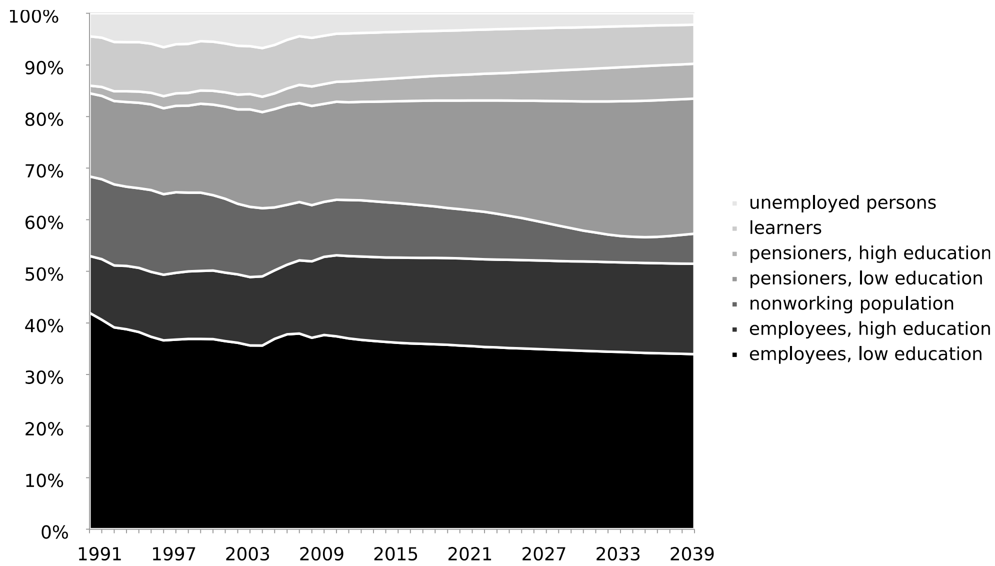

Fig. 3. Population archetypes, development of shares of total population, 1991 to 2040. Source: Own figure.

Since our basic empirical surveys were carried out several years ago, we regularly check whether the model results still correspond to current developments in order to determine whether there is a need for updating. In 2018, we compared the model results with Telefónica NEXT's current mobile network data (see Burgdorf / Beige / Lange 2018). We found high matches between the relevant parameters of long-distance trips per year, choice of transport mode and spatial distribution of trips in relation to the 11 distance categories used in the model.

There are significant differences between the values listed in the BMVI transport statistics and the model values. "Verkehr in Zahlen" shows a transport performance of 7.1 billion pkm for intercity buses in 2017 (see BMVI 2018), while in the model (benchmark case, i.e. without further measures; see Section 4) it was 8.49 billion pkm. The train's transport performance is 40.4 billion pkm according to "Verkehr in Zahlen" and 38.5 billion pkm according to our model. The difference was most marked for planes, where the model has a value of 5.4 billion pkm, “Verkehr in Zahlen” 10.4 billion pkm. In the BMVI transport statistics, no long-distance figures are given for passenger cars; in our model, the transport performance was 296.8 billion pkm.

It must be noted that the values are only comparable to a limited extent, as there are methodological differences: “Verkehr in Zahlen” looks at the type of train, whereas in our model the distance is decisive. It is also clear that the intercity bus market has developed weaker in reality than in the benchmark case of our model. This is mainly due to the fact that in our model the market is organized as an oligopoly. As a result, prices are lower and supply (network density) greater than in the current situation. The sector also remains on a growth path throughout the entire evaluation period. It is likely that our model currently overestimates the performance. However, the current situation in the German intercity bus sector may change again. It is possible that vital intramodal competition will develop (again) in the coming years. Moreover, the effects of the current monopoly must not be overestimated: The assumed market structure has an influence on the price as well as on the network density, but both factors are also strongly influenced by intermodal competition. For the reasons given above, we have refrained from adapting the model at this point and stick to the oligopolistic structure.

In our opinion, deviations in the transport performance of planes are mainly due to the fact that the model only takes into account national trips. This also excludes domestic feeder flights to flights abroad – which, however, are included in the official statistics. However, the deviations described are of little relevance for the purpose of this study – the decisive factor here is that a consistent comparison between the benchmark case and other cases is possible. This is the case because all figures are generated with the same simulation model. The model premises and the (possibly resulting) deviations should, however, be kept in mind when comparing our results directly with external figures.

3.3 THE SIMULATION MODEL

Our simulation model consists of three different modules (see Fig. 4): The first module calculates the total number of passenger kilometers demanded in the national long-distance sector, taking into account the effects of price changes. For this purpose, the total expenditure on long-distance trips within one year is divided by an average price based on the current prices charged by the public transport operators and car fuel prices (taking into account consumption, engine type, occupancy rate, etc.). The calculated price is also influenced by the distance traveled and demographic and modal share development. The result of this calculation is the overall transport performance (expressed in pkm) per time step.

In the second module, the total transport performance is distributed among the relevant means of transport: intercity buses, trains, planes and cars. The selection of the means of transport is carried out in a three-step process, separately in a total of 231 segments, resulting from the inclusion of eleven distance categories, three types of trips and seven user archetypes. Each segment has a corresponding (dynamic) share of the total transport performance, the segment-specific values are aggregated for the evaluation into total values for the relevant modes. The differences between the relevant means of transport in terms of competitiveness are taken into account to the extent that distance-related prices, the perception of speeds / travel times, differences in comfort and, last but not least, general reservations ("I do not travel within Germany by plane") are considered in the second module of the model. The same applies to the temporal / spatial availability of the relevant modes. These differences are recorded for each segment, that is, they do not only relate to distances, but to the types of trip and the population archetypes.

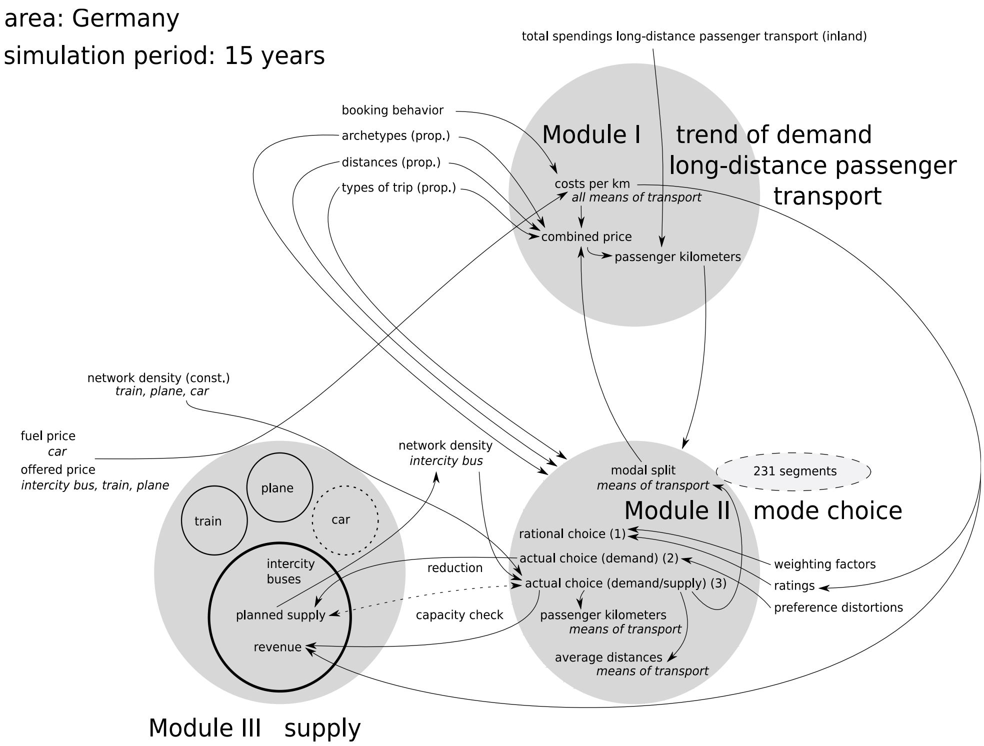

Fig. 4. Simulation Model, Composition.
Source: Own figure.

At the first level of the decision-making process, a completely rational choice of mode is simulated. In this case, individual preferences are established for each segment, which result from the addition of mode-specific values of benefit for each of the relevant 17 choice factors (see Section 2.1 / Fig. 1). These values, in turn, result from the mode-specific evaluations of the respondents as well as their factor-specific weightings.[12] Although the basic decision rules are identical in all segments, the specific weightings and evaluations differ. For each individual person there is a clear selection at the first level ("The Winner Takes It All"). However, the individual results are aggregated into specific-mode values per segment, which can be used on the second level.

At the first level, all results are based on the premise that the economic entities act as "homines oeconomici". In principle, the mode choice at the first level is an ordinary discrete choice approach, although it lacks the stochastic component. Instead, the relevant information has been replaced by an empirical analysis at the second level of the transport choice model.

The second level takes account of the fact that economic entities often make seemingly irrational, intuitive decisions. Habits, fears or prejudices can distort the previously determined preferences, resulting in changes in modal split and transport performance. We assume that every traveler has exactly one preferred mode for certain types of travel or distances. If he / she does not inform himself / herself about the travel conditions or if the information only has little influence on the decision, the user will choose this mode of transport. Only when the favorite mode is not available, a rational choice process will follow. However, certain means of transport may be excluded from the outset – because the selection process is not entirely rational. The relevant data were collected as part of the online survey.

Finally, at level three the temporal / spatial availability of the four relevant means of transport is included. For this purpose, it was determined in advance how extensively the considered means of transport can cover the mode-specific demand in the distance categories ("network density"). The determination was carried out on NUTS3-level, but was compacted into a distance-category-related measurement before feeding into the model.

The third part of the simulation model focuses on the supply side, in particular the scope of service (spatial / temporal) and the price. The spatial / temporal availability of the intercity bus services is an endogenous part of the model: First, it is determined which transport services are offered by the companies. The offer is based on the demand, which is independent of the network density (mode choice process, level 2), but the demand orientation is limited by business aspects as well as the demand potential in the investigation area. The network density values for the intercity bus, which determine the

[12] The price is an exception to this rule: There is no evaluation made by the respondents, but actual prices from the modeling are used instead. At this point, the price takes on a special role because it ultimately changes nearly continuously. We assume that users will primarily find out about prices in the run-up to a trip if they obtain information. Even with travel times, an objective, route-related comparison is rarely made, but general assumptions are used instead. The price depends on distance category ("kilometer degression"), booking time, comfort class and discount options.

network-density-dependent demand at the third level of the mode choice process, are again determined by the mode-specific scope of service. The kilometer prices as well as the network density values for the other means of transport were determined exogenously and are constant at the level of the distance categories during the simulation period.

The quality of the simulation model was checked on several levels (in addition to the empirical checks, see Section 3.2): Initially, a permanent plausibility check was carried out in the course of the model construction. The basic assumptions, the data used and their derivation as well as the structure and functionality of the model components were examined. In addition, the simulation model was examined for mathematical or technical errors that may have occurred during model creation in the text editor of the simulation software. Finally, the simulation results were checked for consistency. In particular, it was tested whether the values and the development of the key variables are plausible both within the scenarios and across all cases.

In its current form the model is designed to capture the effects of relatively small changes in the transport sector. For example, since the expenditure in the first module is extrapolated on the basis of past developments and its development is not influenced by other variables within the model, there is a possibility that the model will no longer provide reasonable results in the event of major changes (and subsequent major shifts in expenditure). Corresponding effects can also to be expected in relation to the choice of means of transport and travel behavior (see also Section 3.2). The model is, however, well suited to the question posed here.

3.4 ASSUMPTIONS: REDUCING TRAIN PATH CHARGES AND INTRODUCING ROAD TOLLS FOR BUSES

Within the scope of our analysis, we examined the effects of a reduction of train path charges for passenger trains to the level of direct costs of train operation (DCO) and additionally the introduction of a toll rate of .6 ct / pkm for intercity buses. DCO were calculated as follows. First, we used figures from the Annual Report of DB Fernverkehr AG for 2018. Total costs in that year have been about EUR 4.118 billion. Of this amount, EUR 984 million related to train path charges (see DB Fernverkehr AG 2018, 45-46). According to the Germany regulatory body (Bundesnetzagentur, BNetzA) the share of direct cost of infrastructure operations is 16.7 percent (see Bundesnetzagentur 2018, 127),[13]

[13] The price in total is EUR 7.25 per train path kilometer, the direct costs are EUR 1.214. Direct operating costs largely correspond to the economic idea of marginal costs which are the guideline for minimum infrastructure charges according to the relevant EU-rules.

so that train operating costs can be lowered by a maximum of EUR 819 million or 20 percent for passenger rail traffic in in our model (case A). This is the maximum cost reduction achievable by a reduction only of train path charges. We assume that cost cuts will be passed to the users and result in lower ticket prices for passenger rail traffic because of the strong intermodal competition by the intercity bus.

Additionally, we examined the effect of the introduction of a toll rate for intercity buses at the level of the infrastructure cost of intercity buses (case B). With a calculated toll rate of 10.9 ct / vkm (motorways) and 26.2 ct / vkm (major federal roads) as well as 37.3 ct / vkm (all other federal roads), the average toll rate amounts to .6 ct / pkm if one assumes again 60 seats per intercity bus and an average utilization rate of 60 percent (Alfen Consult et al., 2014). This toll rate would be a true equivalent to the German truck toll, since the rates used there also rely on the official calculation of infrastructure costs.

In our model, the road toll has to be paid for every single passenger kilometer on the entire road network; there is no discount for rides on roads that are neither federal motorways nor federal roads. We assume that the additional costs arising from the road toll will be passed on to the users in full via the ticket price. This is a realistic assumption both for the implied competitive oligopoly and the current quasi-monopolistic situation. An intercity bus monopolist like FlixMobility is also exposed to intermodal competition and therefore has limited opportunities to set a monopolistic price. If he does not want to lose the profit margin completely, he must pass on the additional costs to his customers. The current development of ticket prices in the intercity bus market confirms that the scope for price increases in the market is limited.

In both cases the changes take place as of January 1st, 2019. For the simulation period the cost reduction of 20 percent because of the reduction of infrastructure charges is held stable (total cost of operation will rise equivalent to the expected growth rate). Since it is not known how the toll rates will rise during the investigation period, we assume an increase with a mode-specific price index which is also used for the estimation of the development of the fare.

4 Results

In the following section we present the results of our simulations. Overall, it has been shown that the impact of a reduction of infrastructure charges is remarkable, albeit not dramatic or even threatening the existence of the branch. The massive reduction of rail infrastructure fees assumed is much more suitable to increase transport performance and modal share of railways than a road toll for buses.

Benchmark case

The benchmark case is modelled as a market without any tolls for intercity bus transport. In this case, our calculations show a transport performance of 10.2 billion pkm for intercity buses and 39.6 billion pkm for trains in 2025 (see Fig. 5). The market share of intercity buses is expected to be 2.8 percent in 2025, compared with 10.7 percent for long-distance trains. Total passenger traffic is dominated by cars (313.4 billion pkm or 85 percent of transport performance), while planes will only play a minor role (5.6 billion pkm).

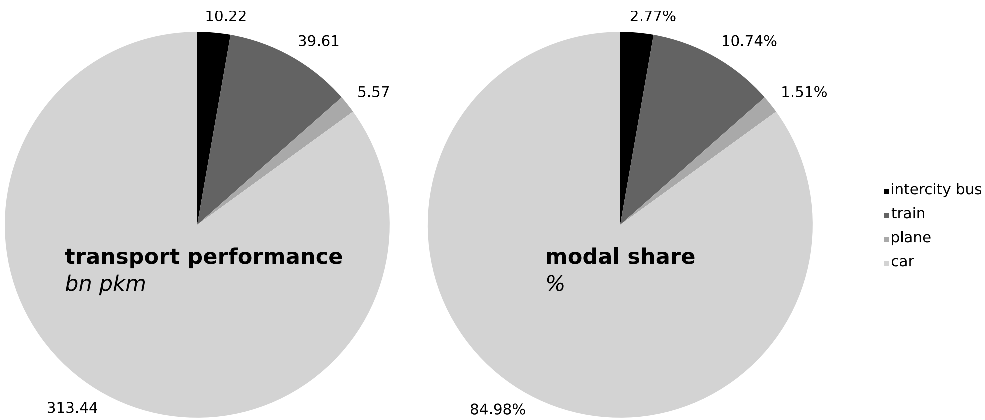

Fig. 5. Transport performance and modal share in 2025 (benchmark case).
Source: Own figure based on own calculations.

Our simulation shows an annual growth of the overall market of 1.7 percent by 2025. The transport performance of the intercity bus sector will increase by an average of 4.2 percent, while long-distance rail passenger traffic will only grow by 1.3 percent. The development of the transport performance of all relevant means of transport over the entire investigation period is shown in Fig. 6, while Fig. 7 shows development of the intercity bus sector.

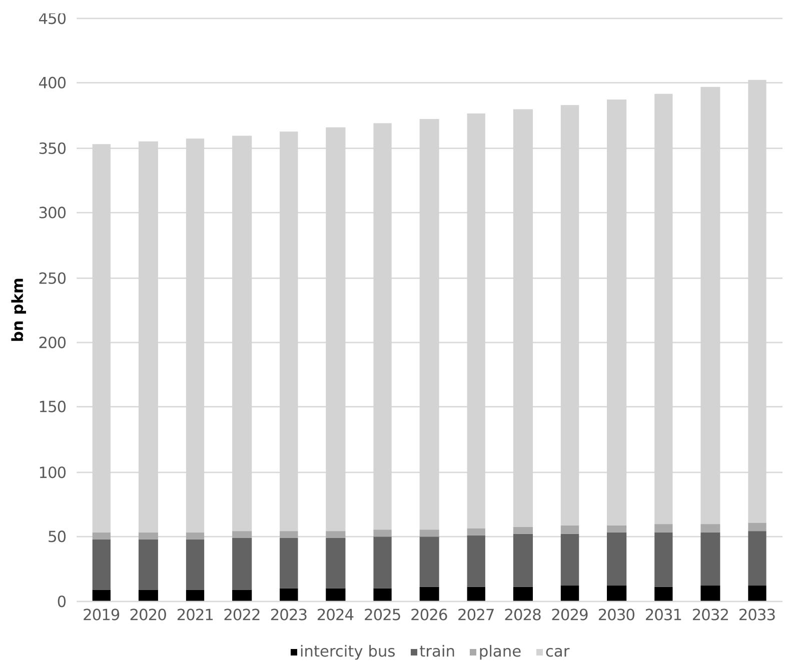

Fig. 6. Transport performance (benchmark case, all modes).
Source: Own figure based on own calculations.

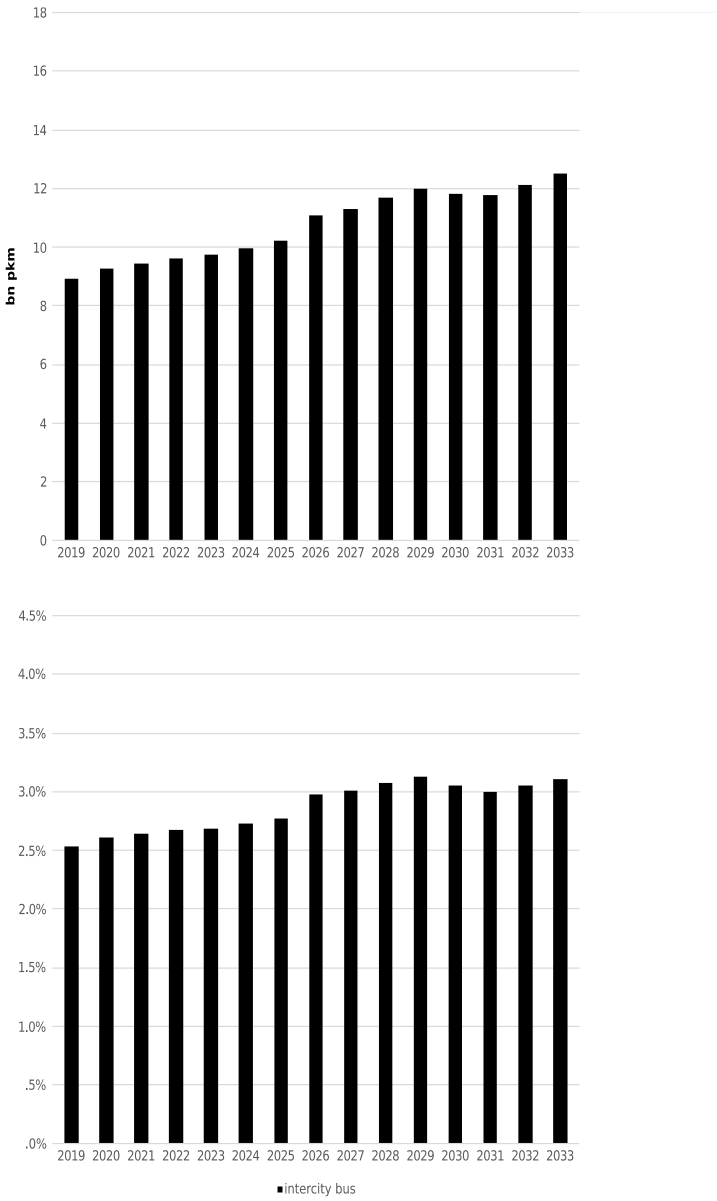

Fig. 7. Transport performance and modal share (benchmark case, intercity bus). Source: Own figure based on own calculations.

Case A: Reduction of train path charges to the level of direct operational cost

The reduction of train path charges to the level of direct operational costs causes a significant modal shift towards rail traffic. According to our simulation, transport performance of long-distance buses will reach only 9.3 billion instead of 10.2 billion pkm. This corresponds to a performance level which is 9 percent lower than in the benchmark case (see Tab. 2).

Tab. 2. Reduction of train path charges (Case A)

transport performance, bn pkm

mean of transport	benchmark case	Case A	+ / –
intercity bus	10.22	9.29	–9.10%
train	39.61	44.57	+12.52%
car	313.44	320.61	+2.29%

modal share, %

mean of transport	benchmark case	Case A	+ / –
intercity bus	2.77	2.44	–11.91%
train	10.74	11.73	+9.22%
car	84.98	84.35	-0.74%

On the other hand, rail passenger transport benefits remarkably. Its transport performance, 44,6 billion pkm, is 12.5 percent higher compared with the benchmark case. Car travel is slightly higher because mobility becomes cheaper with less expensive rail tickets and people can also afford to make more trips by car; however, the modal share of the car is minimally lower because of the strong growth of rail services.[14] Accordingly, the modal

[14] At a first glance, it seems strange that the transport performance of cars is increasing, although no car-specific factors change and the train becomes relatively cheaper. One possible explanation for this could be that the decrease in the price of train use will also reduce the total price of mobility. For example, a commuter could use the train from Hamburg to Munich on a weekly basis. These trips become less expensive, but the number

shares of the various means of long-distance transport change noticeably. The market share of the intercity bus is expected to be lower at 2.44 percent in 2025 (benchmark case: 2.77 percent). On the other hand, the market share of the rail sector increases from 10.74 percent to 11.73 percent. The revenue of the intercity bus market decreases from EUR 1.16 billion to EUR 1.05 billion. Altogether the reduction of train path charges to the level of DCO – which means a massive cost reduction of 20 percent – will stimulate rail passenger traffic. The reduction of transport performance and revenue in the intercity bus market, however, are remarkable but will not threaten the existence of the branch.

Case B: Reduction of train path charges plus road toll of .6 ct / pkm

As we noticed in case A, the reduction of train path charges has remarkable consequences for transport performance and modal split. These effects may be enhanced by an additional road toll charging intercity buses and lead to a better market position of passenger rail traffic. However, case B only reduces the level of intercity bus activity noticeably, but passenger rail traffic is not able to derive a relevant benefit from the additional toll on intercity buses.

In the scenario of case B, the intercity bus would only reach 8.38 billion pkm (18 percent below the level of the benchmark case) in 2025 (see Tab. 3). On the other hand, long-distance railway services would increase to 44.72 billion pkm (plus 12.9 percent compared to the benchmark case). Again, car traffic is largely unaffected; its market share, however, diminishes slightly to 84.5 percent. The modal shares of intercity buses and trains are 2.21 percent and 11.78 percent, respectively. Overall, an additional toll rate of .6 ct / pkm would largely stifle the growth prospects of the intercity bus sector in the future but will not really help the rail sector to get passengers.

A comparison of the cases A and B shows clearly that the main driving force to increase transport performance and modal split of rail passenger traffic is a lowering of train operating costs via a reduction of train path charges. The change of the market share of trains from case A to B is within the statistical blur of the model, and transport performance only rises by .34 percent. Transport performance of intercity buses, however, is massively decreasing because of the additional burden. Market shares diminishes by 20.22 percent (case B) instead of 11.91 percent (case A) because of a sharply lower transport performance (8.38 instead of 9.29 billion pkm).

---

of trips remains unchanged. Due to the reduced costs over the year, however, an additional holiday trip can be executed – and the car will be used for this trip.

Tab. 3. Reduction of train path charges and road toll (Case B)

transport performance, bn pkm

mean of transport	benchmark case	"infrastructure costs"	+ / –
intercity bus	10.22	8.38	–18.00%
train	39.61	44.72	+12.90%
car	313.44	320.89	+2.38%

modal share, %

mean of transport	benchmark case	"infrastructure costs"	+ / –
intercity bus	2.77	2.21	–20.22%
train	10.74	11.78	+9.68%
car	84.98	84.52	-0.54%

5 Conclusion and discussion

The strong growth and the successful development of intercity bus services after liberalization has lead to a strong demand for protecting measures to save and improve the market position of railways. Railway lobbyists and politicians with a heart for the state-owned railways complain about competitive distortions at the expense of the railways. The core argument of them is that rail companies would have to pay a fee for each track kilometer while buses do not pay any infrastructure charges at the moment. Because of this disadvantage in intermodal competition passenger railways would not be able to develop as expected of them by transport and climate policy, and the modal shift from road to rail is not getting going. From a political-economic point of view, such complains are easy to understand. Deutsche Bahn AG as a near monopolist in rail passenger transport and its associated interest groups and politicians call for a "guard fence" against the disruptive competitive threat potential of the intercity bus, which puts the railway sector under pressure and has already had a remarkable disciplining effect.

To relieve railways and to improve their competitive position in the long-distance passenger transport market one can either reduce their burden in the shape of track charges or put infrastructure charges on intercity buses. As demonstrated in Burgdorf / Eisenkopf (2018), a toll based upon actual infrastructure costs will dampen the development in the intercity bus sector but will not lead to a modal shift in favor of long-distance trains.[15] Therefore, this argument is ultimately weak.

Different results could be achieved with a systematic reduction of train path charges to the minimum of direct operating costs. As our calculations for case A show, such a reduction of infrastructure charges increases the transport performance of passenger rail traffic by 12.5 percent compared to the benchmark case (in 2025). This means an improvement of the modal share from 10.74 percent to 11.73 percent, accordingly. Looking at case B we can observe that an additional toll for intercity buses will improve market performance of railways only marginally compared to case A, whereas the intercity bus suffers from strong losses of passengers. Therefore, the introduction of a toll for intercity buses should be based only on a consistent infrastructure pricing and financing strategy and not be designed for the protection of the railway sector, as it has been already pointed out in Burgdorf / Eisenkopf (2018).

Should the conclusion be that transport policy reduces the train path charges to the level of direct operating costs and refund the ceasing revenues by tax money? In the end, this a question to be answered by politicians and / or voters. From an economic point of view railway policy will remove more and more from efficiency terms with such measures because the cost coverage ratio of the railway sector is already very poor at the moment, although railways pay infrastructure cost charges.

According to the latest infrastructure cost estimates for the rail infrastructure (reference year 2007) Deutsche Bahn's long-distance rail passenger transport services have reached a cost coverage ratio of only 56 percent (see DIW Berlin 2009). The rationale behind this is that since 1998 rail infrastructure in Germany is almost exclusively funded by the government making use of lost grants. These investments don’t have to be recovered by infrastructure charges because they are not part of the balance sheet of Deutsche Bahn (see Eisenkopf 2016).

There is little evidence that this value has improved over the past ten years. On the other hand, domestic motor coaches achieved a road coverage ratio of 141 percent over the entire road network, and even 306 percent on federal motorways, due to their specific motor vehicle and fuel tax revenues. Only foreign buses did not cover their route costs on the entire road network (63 percent); for federal highways, the infrastructure costs of these buses had been covered (see DIW Berlin 2009).

To reduce train path charges to the level of direct operational costs would mean a further massive deterioration of the cost coverage ratio and will lead to a severe distortion of intramodal competition in terms of efficiency. The subsidy requirement of about EUR 800

---

[15] Despite of potential competitive effects, infrastructure charge for intercity buses should be raised for basic and systematic reasons within the framework of an infrastructure policy based on the principle of user financing (this should be done with all modes of transport inclusive private cars).

million per year – to achieve at least the current nonetheless unsatisfactory level of cost coverage – has to be funded by taxes or other public sources: a policy measure that will inevitably cause additional allocative inefficiencies. From an economic point of view the calculated remarkable but limited increase of the railways' modal share will very likely not withstand a rigorous economic cost-benefit analysis.

References

Aarhaug, J. and Fearnley, N., 2016. Deregulation of the Norwegian Long Distance Express Coach Market. Transport Policy, 46, 1–6.

Aberle, G., 2009. Transportwirtschaft. Einzelwirtschaftliche und gesamtwirtschaftliche Grundlagen. Oldenbourg, München.

Alexandersson, R.G., Hultén, St., Fearnley, Longva, F., 2010. Impact of regulation on the performances of long-distance transport services: A comparison of the different approaches in Sweden and Norway. Research in Transportation Economics, 29, 212–218.

Alfen Consult et al., 2014. Berechnung der Wegekosten für das Bundesfernstraßennetz sowie der externen Kosten nach Maßgabe der Richtlinie 1999/62/EG für die Jahre 2013 bis 2017. Zusammenfassung des Endberichts.

Alvares de Souza Soares, P., 2019. FlixBus Co-Gründer droht – jeder dritte Haltepunkt könnte entfallen. Manager Magazin October 23th. URL: https://www.manager-magazin.de/unternehmen/artikel/flixbus-jeder-dritte-haltepunkt-in-deutschland-koennte-entfallen-a-1292792.html (last accessed on December 08, 2019).

Augustin, K., Gerike, R., Martinez Sanchez, M.J., Ayalac, C., 2014. Analysis of intercity bus markets on long distances in an established and a young market: The example of the U.S. and Germany. Research in Transportation Economics 48, 245–254.

Balser, M., 2018. Flixbus kann der Deutschen Bahn richtig gefährlich werden. Süddeutsche Zeitung March 8th. URL: https://www.sueddeutsche.de/wirtschaft/flixbus-deutsche-bahn-konkurrenz-1.3895979 (last accessed on July 26, 2019).

Bataille, M. and Steinmetz, A., 2013. Intermodal competition on some routes in transportation networks: The case of inter urban buses and railways, DICE Discussion Paper No. 84.

Blayac, T. and Bougette, P., 2017. Should I go by bus? The liberalization of the long-distance bus industry in France. Transport Policy, 56, 50–62.

Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit (BMUB), 2016. Klimaschutzplan 2050. Klimaschutzpolitische Grundsätze und Ziele der Bundesregierung, November 2016. URL: https://www.bmub.bund.de/fileadmin/Daten_BMU/Download_PDF/Klimaschutz/klimaschutzplan_2050_bf.pdf (last accessed on July 26, 2019).

Bundesministerium für Verkehr, Bau und Stadtentwicklung (BMVBS), 2013. Verkehr in Zahlen 2013/2014. DVV Media Group, Hamburg.

Bundesministerium für Verkehr und digitale Infrastruktur (BMVI), 2018. Verkehr in Zahlen 2018/2019. Kraftfahrt-Bundesamt, Flensburg.

Bundesnetzagentur, 2018. Beschluss BK10-17-0314_E. https://www.bundesnetzagentur.de/DE/Service-Funktionen/Beschlusskammern/1_GZ/BK10-GZ/2017/2017_0001bis0999/2017_0300bis0399/BK10-17-0314/BK10-17-0314_E_Beschluss_download_bf.pdf;jsessionid=7920207FC2FFE33D5F28A8F205D758CA?__blob=publicationFile&v=3 (last accessed on November 16, 2019).

Burgdorf, C., 2017. Potenziale des Fernlinienbusverkehrs in Deutschland – eine systemdynamische Betrachtung. Springer Gabler, Wiesbaden.

Burgdorf, C. and Beige, S. and Lange, A. 2018. Nutzung von Mobilfunkdaten in der Verkehrswissenschaft – Ein Vergleich mit klassischen Ansätzen am Beispiel des Personenfernverkehrs in Deutschland. Konferenz Verkehrsökonomik und -politik, TU Berlin. http://www.verkehrskonferenz.de/fileadmin/archiv/konferenz_2018/praesentationen/Verkehrskonferenz_2018_DO_16.15_3005_burgdorf.pdf (last accessed on July 26, 2019).

Burgdorf, C. and Eisenkopf, A. 2018. Effects of road tolls for intercity buses on travel activities and the choice of means of transport in German long-distance passenger transport. Research in Transportation Economics, forthcoming. https://doi.org/10.1016/j.retrec.2018.03.005 (last accessed on July 26, 2019).

DB Fernverkehr AG, 2019. Geschäftsbericht 2018. https://ir.deutschebahn.com/fileadmin/Deutsch/2018/Berichte/DB18_Fernverkehr_web.pdf (last accessed on November 16, 2019).

Deutsche Bahn AG, 2014. Nullrunde in der 2. Klasse und bei BahnCards. Press release, September 29, 2014. URL: http://presseservice.pressrelations.de/pressemitteilung/nullrunde-in-der-2-klasse-und-bei-bahncards-stabile-preise-fuer-rund-90-prozent-der-dbfernverkehrskunden-576465.html (last accessed on July 26, 2019).

DIW Berlin, 2009. Wegekosten und Wegekostendeckung des Straßen- und Schienenverkehrs in Deutschland im Jahre 2007. Forschungsprojekt im Auftrag des BGL, ADAC und BDI. Zusammenfassung des Endberichts. October 16, 2009, Berlin.

Dürr, N. S. and Hüschelrath, K. 2017. Patterns of entry and exit in the deregulated German interurban bus industry. Transport Policy, 59, 196–208.

Dürr, N.S., Heim, S. and Hüschelrath, K. 2016. Deregulation, competition, and consolidation the case of the German interurban bus industry. Journal of Transport Economics and Policy, 50, 164–188.

Eisenkopf, A., 2016. Reform statt Rettungspaket. Wirtschaftsdienst, 96, 706.

Forrester, J. W., 1969. Industrial Dynamics. MIT Press, Cambridge (MA).

IGES-Institut, 2015. Faktenpapier Straße-Schiene. Vergleich der Infrastrukturnutzungsentgelte und Besteuerungslasten auf Straße und Schiene mit besonderer Berücksichtigung des Fernbusses. Studienbericht im Auftrag des Bundesverbandes Deutscher Omnibusunternehmer e. V. May 29, 2015, Berlin.

Knorr, A. and Lueg-Arndt, A., 2016. Intercity bus deregulation in Germany – Intramodal and intermodal effects after two years. Research in Transportation Economics, 59, 323–329.

Krämer, A. and R. Bongaerts, 2019. Entwicklungsperspektiven für den Fernlinienbus. Geschäftsmodelle, Wettbewerb und Kundenerwartungen im Wandel, Internationales Verkehrswesen, 71, Nr. 1, 48–51.

Mofair, 2017. Ein kleiner, aber wichtiger Schritt zu mehr Fairness zwischen den Verkehrsträgern, Berlin. URL: https://mofair.de/wp-content/uploads/2017/06/170626_Trassenpreissenkung_wichtiger-Schritt.pdf (last accessed on July 26, 2019).

N. U., 2014. Bahn verspricht kostenloses WLAN. ZEIT ONLINE, December 3, 2017. URL: http://www.zeit.de/wirtschaft/unternehmen/2014-12/bahn-investition (last accessed on July 26, 2019).

Schlesiger, C., 2014. Die Bahn braucht noch mehr Wettbewerb. WirtschaftsWoche Online, September 29, 2014. URL: http://www.wiwo.de/unternehmen/dienstleister/keine-preiserhoehungen-in-der-zweiten-klasse-die-bahn-braucht-noch-mehr-wettbewerb/10769430.html (last accessed on July 26, 2019).

Sterman, J. D., 2004. Business Dynamics. Systems Thinking and Modeling for a Complex World. International Edition, McGraw-Hill Education (Asia), Singapore.

Verband Deutscher Verkehrsunternehmen (VDV), 2018. Erster Schritt: Eisenbahnverbände begrüßen Trassenpreissenkung für Schienengüterverkehr, press release from 20180628. URL: https://www.vdv.de/pm-180628-die-bahnverbaende-zur-trassenpreishalbierung-final.pdfx?forced=false (last accessed on July 26, 2019).

White, P. and Robbins, D., 2012. Long-term development of express coach services in Britain, Research in Transport Economics, 36, 30–38.