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Rafael Lalive and Armin Schmutzler

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Author's addresses Rafael Lalive
rlalive@iew.unizh.ch

Armin Schmutzler
arminsch@soi.unizh.ch

Publisher Sozialökonomisches Institut
Bibliothek (Working Paper)
Rämistrasse 71
CH-8006 Zürich
Phone: +41-44-634 21 37
Fax: +41-44-634 49 82
URL: www.soi.unizh.ch
E-mail: soilib@soi.unizh.ch

Competition for Railway Markets: The Case of Baden-Württemberg

Rafael Lalive, University of Zürich, CESifo and IZA

Armin Schmutzler*,University of Zürich, CEPR and ENCORE

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Abstract: This paper studies the effects of introducing competition for local passenger railway markets in the German state of Baden-Württemberg. We compare the evolution of the frequency of service on lines that were exposed to competition for the market and lines that were not. Our results suggest that competitive lines enjoyed a stronger growth of the frequency of service than non-competitive lines, even after controlling for various line characteristics that might have an independent influence on the frequency of service. Our results further suggest that the effects of competition may depend strongly on the operator and on characteristics of the line.

Keywords: Competition for the market, liberalization, passenger railways, procurement auctions

JEL Classification: D43,D44,R48

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*Corresponding author: University of Zürich, Socioeconomic Institute, Blümlisalpstr. 10, CH-8006 Zürich; tel +41-44-634-22-71; fax +41-44-634-49-07.
e-mail: arminsch@soi.unizh.ch.

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1 Introduction

As a consequence of the railway reforms in the nineteen nineties, the former state monopolies in the industry are facing increasing competition in many European countries. The proponents of the reforms argue that this development will not only lead to decreasing subsidies, but also to a better service quality.[1]

However, this opinion is not undisputed. First, there are serious arguments that cast doubt on the hope that the potential efficiency gains from liberalisation in the railway industry are similar to those in other sectors, most notably telecommunications.[2] Second, it is not obvious that the institutional details in the liberalized railway industry have been chosen in such a fashion that potential efficiency gains are realized.[3] From a-priori considerations, it is impossible to come to a definite conclusion regarding the pros and cons of liberalization as such, let alone the particular institutions chosen in the different European countries.

The empirical evaluation of the railway reforms is still in its infancy. A small number of contributions deals with the efficiency effects of various reforms in an international context on a highly aggregate level (Cantos et al. 1999, Friebel et al. 2003). Our contribution concentrates on a concrete measure, namely the German *Regionalisierungsgesetz*, a law that was passed in 1993.[4] This measure gave the responsibility for the procurement of regional passenger rail transport to the 16 federal states (*Länder*) which, in turn, delegated this task to newly founded agencies. These agencies are now allowed to use competitive franchising to procure the services. Importantly, however, they are not obliged to do so. On 20-25% of the passenger railway lines a substantial part of local passenger services is now procured in a (more or less) competitive fashion. On the remaining lines, all services are still provided by the incumbent without any competition for the market. Typically,

[1] Unsurprisingly, a particularly optimistic perspective on the potential efficiency gains from competition comes from a report commissioned by *MehrBahnen*, the umbrella organisation of competitors of the state enterprise *Deutsche Bahn* (pspc 2004). The report estimates the potential reduction in subsidies from relying on competitive mechanisms for procuring regional passenger services at 18-38%, depending on the type of service.

[2] For instance, there is no reason to expect similar technological improvements as in the telecoms sector, as the railroad technology is comparatively mature.

[3] For instance, there is no consensus as to the right extent of vertical separation. Also, it is not obvious how access prices should best be regulated, for instance in view of the implied investment incentives for network owners and operators. In the case of the British reform, both issues were hotly debated (see, e.g. Bühler et al. 2004).

[4] Officially, the law is known as *Gesetz zur Regionalisierung des öffentlichen Personennahverkehrs.* It was passed on December 27, 1993 as Article 4 of the *Eisenbahnneuordnungsgesetz,* which contains most of the legal foundations for the German railway reform.

the service provider in these cases is *DB Regio*, a subsidiary of *Deutsche Bahn AG*, the succesor of the former state monopolist; in much rarer cases, some other company carries out the service without having obtained the franchise in a competitive fashion.[5]

While DB Regio is still the dominant operator ten years after the reforms were introduced, its competitors, the NE-operators,[6] have expanded their market share from 3% to about 10% (pspc 2004).[7] Moreover, in cases where competitive bidding is applied, the competitors are successful at least as often as DB Regio, suggesting that in the medium term this operator's dominance may well belong to the past.[8] Nevertheless, the partial nature of the introduction of competition for the market has often been criticized by competitors of *DB Regio* (e.g., pspc 2004). For our empirical analysis, however, this state of affairs is very helpful, as it allows a direct comparison between the competitive segment of the market and the control group of remaining railway lines. Our analysis attempts to clarify whether the development of service quality in the competitive segment has been more favorable than in the non-competitive segment, where service quality is defined as the frequency of service on the railway line under consideration.[9]

The paper is part of a larger project that deals with the effect of competition for the market for the entire German regional passenger railway system. Here, we consider preliminary evidence for the state of Baden-Württemberg, one of the largest German states, where the fraction of railway lines that have been exposed to competition is clearly above average. We have collected the data for most other German states as well, and we are in the process of evaluating the data.

Our data strongly suggest that there is a *competition effect*: The quality of service on those lines that were subjected to competition developed more favorably than on those that were not. A natural interpretation of this result is that agencies know they can ask more from railroad operators when there is competition than when there is not. This effect is robust to the introduction of control variables

[5] As will be laid out in Section 2, a considerable number of small operators were already active before the railway reform.

[6] "NE" refers to "nicht-bundeseigen", that is, not belonging to the Federal Republic of Germany.

[7] This market share is expressed in terms of the services supplied (train kilometers). In terms of patronage, the competitors' market share is around 6%.

[8] It should be noted, however, that there is a recent tendency for agencies to write long-time contracts with *DB Regio* which put limits on the extent to which competitive bidding will be used in the future. For instance, in Baden-Württemberg such a contract was signed in 2003 (Stuttgarter Nachrichten 2003).

[9] See Section 3 for a discussion of this definition.

which could have an independent effect on the development of service quality, for instance, the remoteness of the line or the population of the communities cerved.

However, we also show that the effects of competition depends highly on the characteristics of the railway lines. For instance, the potential seems much greater for remote lines than for lines in agglomerations, and much smaller for electrified lines than for those served by diesel trains.

There also appears to be some evidence for ownership effects. On the one hand, NE-operated non-competitive lines tend to grow more rapidly than the corresponding lines operated by *DB Regio*. On the other hand, while the additional effect of competition is strong and significant, for *DB Regio*, it is mixed for the NE-operators. For the largest NE-operator, the Albtalbahn-Verkehrsgesellschaft (AVG) near Karlsruhe, the effect of competition is even stronger, whereas the remaining NE-operators do not develop much differently than their non-competitive counterparts.

The remainder of the paper is organized as follows. In Section 2, we shall sketch some institutional background and develop our hypotheses. Section 3 describes the methods and the data set. In Section 4, we present our econometric results. . Section 5 concludes and describes the next steps of the investigation.

2 Background and Hypotheses

2.1 Institutional Background

As in most other European countries, the railways in Germany were essentially run by state monopolies until the early nineteen nineties. In West Germany, *Deutsche Bundesbahn* owned most of the infrastructure and, at the same time, was the dominant operator for passenger and freight services. In addition, there was a considerable number of minor railroad companies (*NE-Bahnen*) which were typically also vertically integrated and carried out freight and/or passenger transportation on small networks.[10] In East Germany, *Deutsche Reichsbahn* was the integrated operator of the railway system.

Major reforms of the railway system were introduced in Germany in the nineteen nineties. These reforms were induced by the EU-directive 91/440, but there was also some internal pressure to introduce changes to the system. First, after reunification,

[10] "NE-Bahn" stands for *Nichtbundeseigene Eisenbahn,* that is, a railway company that is not owned by the state of Germany. The term contains both privately owned firms and firms that belong to the public sector (e.g., firms that are owned by local authorities).

there was the obvious issue of integrating the East and West German railways. Second, the cumulated debt of the two state railways was immense, amounting to DM 67 Mrd. in 1993 (Greffrath and Lingenthal 1994).

On January 1, 1994, the railway reform became effective. Apart from creating *Deutsche Bahn AG* as a successor of *Deutsche Bundesbahn* and *Deutsche Reichsbahn*, the reform had several elements that were familiar from other countries. First, though *Deutsche Bahn AG* is generally regarded as a vertically integrated company, distinct sub-organisations were introduced at the upstream level (*DB Netz* for the network and *DB Station & Service* for the stations) and the downstream level (*DB Regio* for regional passenger transportation, *DB Reise und Touristik* for long-distance passenger services and *DB Cargo* for freight). Thus, at least a move into the direction of vertical separation was made.[11] Second, some degree of competition was introduced. Infrastructure owners, in particular *DB Netz,* are required to allow freight operators and long-distance passenger operators access onto their network.[12] With respect to local passenger services, an entirely different avenue was pursued. Essentially, the reforms led to the introduction of *competition for the market.*

More specifically, as a consequence of the railway reform, the *Länder* have created agencies whose task it is to procure local passenger services. In Baden-Württemberg, the most important agency is the *Nahverkehrsgesellschaft Baden-Württemberg* (NVBW); in addition, the *Verkehrsverbund Rhein-Neckar* (VRN) and the *Verkehrs- und Tarifverbund Raum Stuttgart* (VVS) are in charge of the services in the agglomerations of Heidelberg/Mannheim and Stuttgart, respectively. In principle, the agencies are free to use competitive bidding to allocate franchises for the local monopoly on a particular line. The extent to which this possibility is used varies considerably across agencies. Moreover, individual agencies like NVBW and VRN use different mechanisms to procure services on different lines within their sphere of influence. The two polar cases are most important. At one extreme, the agencies can negotiate directly with the incumbent supplier, without contacting any potential competitors. At the other extreme, they can resort to open competitive bidding for the market. In the simplest type of bidding procedure, the agency specifies detailed requirements about the level of service quality that it expects. The specifications include the frequency of service, the rolling stock, the prices charged

[11] In 1999, this separation was taken one step further. Deutsche Bahn AG is now a holding company, consisting of five corporations.

[12] In practice, access is negligible for long-distance passenger trains, but substantial for freight trains.

to customers, etc.[13] The contractors' bids are the subsidy levels required to carry out the expected services.[14] The successful bidder is paid his bid and obtains the franchise for a period of typically 5-10 years. He then becomes the residual claimant for the operating profits of the line.[15]

Differences in contractors' bids reflect both differences in their relative efficiencies and in the quality of the estimations of the value of the franchise, which is driven for instance by the expected number of passengers. Thus, the auction has a private-value component as well as a common-value component. For this reason, it is not necessarily clear that the successful bid will come from the most efficient firm. The winner may simply have overestimated the potential gains from the market. To my knowledge, there is only one obvious case of competitive bidding in the German railway market where this kind of "winner's curse" phenomenon played an important role: The winner of an auction for the line Hamburg-Flensburg in Schleswig-Holstein was the newly founded *FlexVerkehrs AG* that went bankrupt within a year after taking up the service in 2002 (derFahrgast 2003).

As a result of the introduction of competition for the market, the market share of DB Regio's competitors has grown substantially. The pool of competitors consists of several types of firms. First, the above-mentioned pre-reform NE-operators play an important role. These firms typically still own their old infrastructure, but they often have expanded their operations onto the network of Deutsche Bahn where they are exclusively responsible for the provision of downstream services.[16] Second, a substantial number of entirely new companies have been formed. Third, some rail-

[13] In Germany, regional public transport organisations (*Verkehrsverbünde*) coordinate timetables, prices etc. on a substantial part of the network. In some cases, but my no means always, these organisations are identical with the agencies that procure services; often they are entirely separate institutions. Either way, the freedom of railway operators to set prices is limited by the existence of the public transport organisations.

[14] In typical textbook treatments of competition for the market (Viscusi et al. 2000), the procedure is slightly different. Contractors do not bid the required subsidy. Instead, they bid the price they want to charge to consumers and the lowest bid wins (Demsetz 1968).

[15] There are also cases where the specifications of the auction are less detailed, leaving some scope for the contractors to compete in other dimensions than the required subsidies. As the exact weighting of the different dimensions is typically left unspecified, the allocation mechanism is closer to a "beauty contest" than to multi-dimensional auction in the sense of Che (1993) and Branco (1997).

[16] In Baden-Württemberg, the main pre-reform operators were *Südwestdeutsche Eisenbahngesellschaft* (SWEG), *Württembergische Eisenbahngesellschaft* (WEG), *Hohenzollerische Landeseisenbahn* (HzL), *Albtalbahn-Verkehrsgesellschaft* (AVG) and *Oberrheinische Eisenbahngesellschaft* (OEG). SWEG, HzL and AVG have expanded their operations onto the Deutsche Bahn network, partly in joint ventures. OEG still concentrates on its old network; WEG has been taken over by *Connex.*

way operators are joint ventures between other companies, in some cases including *DB Regio*.[17] Finally, foreign firms have entered the market. Typically, they have taken over independent local operators; however, there are also examples of entry on lines that were previously operated by *DB Regio*.[18]

2.2 Hypotheses

In the following, we shall show empirically that the introduction of competition has had a positive effect on a suitable measure of service quality. Though we shall be more specific in the empirical analysis, it is useful for the moment to think of service quality in a very broad way, including the frequency of service, reliability, comfort and, in addition, ticket prices, which are often part of the arrangement between agencies and contractors.

When there are direct negotiations with the incumbent supplier, there is usually no immediate threat for the supplier that asking for high subsidies will mean losing the contract. Thus, the incumbent can be expected to have some bargaining power vis à vis the agency. Therefore, compared with the case of competitive bidding, we should expect the required subsidies for each level of service quality to be higher. This not only reflects the *competitive-pressure* effect that all firms, whether incumbents or not, are forced to take the existence of competitors into account. In addition, there may be an *efficiency effect*: Usually, competitive bidding helps to find the most efficient bidder which should also lower bids.[19]

Figure 1 shows how the introduction of competition improves the position of the agency. Line d contains all feasible combinations of subsidies and quality for an agent facing a monopolist; line w is the analogous line for an agent that has introduced competition. Both lines are increasing, as higher quality will require higher subsidies. However, line w lies below line d to capture the hypothesis that competition reduces the required subsidies.[20]

[17] In Baden-Württemberg, there are no examples of entirely new firms in the market. However, for instance, the *Breisgau S-Bahn* was founded jointly by SWEG and the *Freiburger Verkehrs AG,* the municipal transportation firm in Freiburg.

[18] An example of the former case is *Connex*, a multinational company based in France; an example of the latter case is the entry of Swiss firms on lines near the border: the state railway SBB near Basel and its subsidiary *Eurothurbo* near Lake Constance.

[19] However, as procurement auctions typically have private and common value components, relatively inefficient firms may win the bid when the uncertainty about the common value is large (see, e.g., Goeree and Offerman 2003 for a more thorough analysis).

[20] The linearity of the lines d and w is immaterial for the argument.

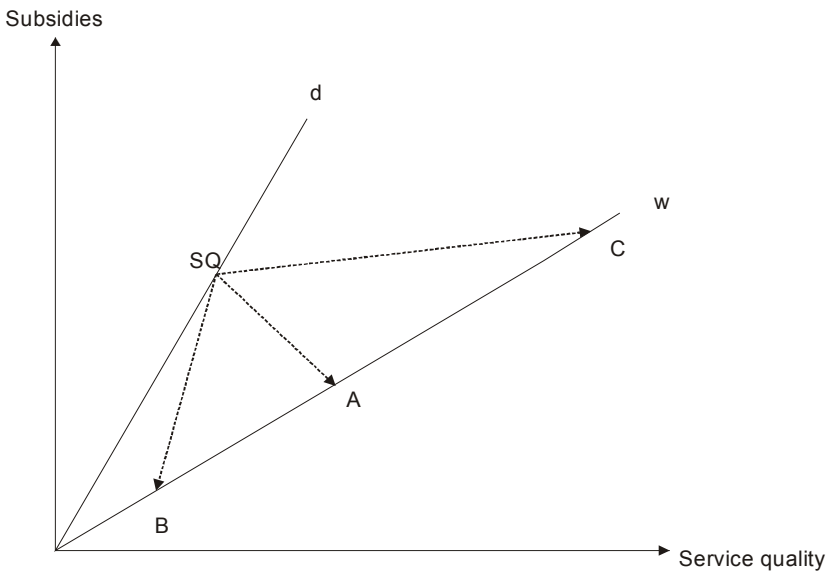

Figure 1: Feasible subsidy/quality-bundles

In principle, there are three distinct possibilities for the agency to reap the harvest of competition. Relative to the Status Quo (SQ), the agency could obtain:

(i) higher quality, lower subsidies (Point A)

(ii) lower quality, much lower subsidies (Point B)

(iii) much higher quality, higher subsidies (Point C)

Without further assumptions about the agency's objective, it is not clear whether it opts for an improvement of the quality of supply after the introduction of competition, that is, whether one of the cases A or C will obtain.

Clearly, however, the agency possesses the option to improve quality without necessarily having to resort to higher subsidies. Whether it actually makes use of this option is precisely the question that this paper attempts to solve.[21]

Thus, we formulate the main hypothesis of this paper:

Hypothesis 1 *Competition increases service quality.*

This hypothesis does not necessarily presuppose that the competitors are more efficient than the incumbent. In principle, competitive pressure alone could force DB Regio to improve its offer so that it wins the bid.

[21] As we shall spell out below, there are limits to our approach which result from the fact that we only have detailed quality data rather than subsidy data.

Nevertheless one might ask whether it is important for quality what kind of operators provide the service. For instance, one might expect that private firms are more efficient than DB Regio, the successor of the former state monopolist Deutsche Bundesbahn. Modifying the argument described above, an agency that faces an NE-operator might ask for higher quality than when he faces DB Regio. The following hypothesis is clearly distinct from the first one:

Hypothesis 2 *Other things equal, firms that are not state-owned supply higher quality.*

Thus our investigation of the two hypotheses can also be regarded as an attempt to contribute to the clarification of the open question whether competition or privatisation is decisive for quality improvements in the public sector (Vickers and Yarrow 1988, ch. 1).

3 Data and Methods

To test our hypotheses, we first require a measure of service quality. Ideally, such a measure should aggregate all relevant aspects of quality, that is, the frequency of service, safety, comfort and prices. A good candidate for such a measure would be the number of passenger kilometers traveled on a line. This measure reflects the conceived service quality from the perspective of the passengers. Unfortunately, however, we only have rudimentary data on passenger kilometers, so that we used a less satisfactory measure, namely the *frequency of service*. We measure this frequency as the ratio between train kilometers per year (tkm) and the length of a line (lkm).[22] The frequency of service is an important aspect of service quality, but obviously not the only one.

To identify competition effects, we use a "Difference-in-Difference"- approach.[23] Essentially, we compare the evolution of the frequency of service in the group of competitive lines and the control group. We first introduce a definition for a competitively served line. To understand this definition, it is important to note that agencies do not necessarily procure all services on one line in the same fashion. For instance, in some cases, the agencies use competitive bidding for higher-level services

[22] Thus, the frequency of service corresponds to the average number of trains per year on each kilometer of tracks.

[23] See Meyer (1995) and Wooldridge (2002) for introductory material on the subject.

(*Regionalexpress),* but procure lower level services on the same level directly from the monopolist.

Definition 1 *A line is* ***served competitively*** *if, for at least 20% of the train kilometers that were provided on these lines in the year 2003/2004, one of the following conditions holds:*[24]
(i) The services were procured using open competitive bidding.
(ii) The services were procured on the basis of offers from at least two firms that were approached directly by the agency.
(iii) Apart from the incumbent, at least one firm approached the agency directly by offering a contract without having been asked to do so.
(iv) For reasons other than those given under (i)-(iii), the services were carried out by another firm than the former incumbent DB Regio.

Case (i) is the most important in quantitative terms. The largest auction in Germany to date was carried out by VRN. *DB Regio* cast the successful bid for the *S-Bahn Rhein-Neckar*, a new metro system in the Heidelberg-Mannheim agglomeration, amounting to approximately 6 Mio. tkm per year (Die Welt 2001). Other major cases of competitive bidding in Baden-Württemberg included metro lines near Freiburg, Karlsruhe and Offenburg and the *Ringzug,* involving 1.258 Mio. tkm/year in the eastern part of the Black Forest (Hohenzollerische Landesbahn 2001).

Case (ii) is quite common in general, but not in Baden-Württemberg.[25]

Case (iii) is rare in general, but it happened in Baden-Württemberg on one occassion: Starting from 2003, the lines Basel SBB – Zell im Wiesental and Weil am Rhein – Stetten were initially supposed to be served by the incumbent *DB Regio* jointly with SBB, the Swiss state railway company. Then SWEG submitted an unsolicited bid for both lines to which SBB reacted by submitting a bid without *DB Regio* (Wirtschafts- und Sozialdepartement Basel-Stadt 2002).

We included category (iv) because it appears plausible that a firm that takes over the duty of operating a line instead of *DB Regio* believes it can carry out the service more efficiently than the incumbent. A typical example is the line Schorndorf-Rudersberg near Stuttgart. In 1996, this line was "sold" for DM 1.-

[24] *The 20% cut-off value is somewhat arbitrary; as, on most lines, the following conditions (i)-(iv) hold either for a very small number of services or for a large number of services, the results are likely to be robust to the exact choice of the cut-off level.*

[25] For instance, in nearby Bavaria, the agency *Bayerische Eisenbahngesellschaft* asked five operators directly to submit bids for about 1 Mio tkm on the line Munich-Oberstdorf (Bayerisches Staatsministerium 2003).

from the infrastructure operator *DB Netz* to the *Württembergische Eisenbahngesellschaft (WEG)* which now belongs to the *Connex* group. The new infrastructure owner also carries out the services on this line.[26]

Finally, we should point out that the group of competitive lines was not exclusively served by competitors of *DB Regio* in the year 2004. When the incumbent *DB Regio* won the bid, the line was obviously also included in the competitive category.

We first start with a simple descriptive approach to the problem. To identify the effect of competition, we compare the difference between the distribution of the frequency of service on the competitive lines in 2004 and 1994 with the corresponding frequencies for the control group. Essentially, we speak of a positive competition effect when the growth in the frequency of service is larger in the competitive group than in the control group. Underlying this approach is the assumption that, without the introduction of competition, there would have been no systematic difference between the evolution of lines in the competitive group and those in the control group. However, the approach does not require the initial distribution of frequencies in the two groups to be similar.

For the simplest version of our investigation, we require the following information:

(1) A division of the passenger railway network in Baden-Württemberg into disjoint lines.

(2) The length of each line.

(3) The total train kilometers for each line in the years 1993/94 and 2003/04.[27]

(4) For each line, information on whether it belongs to the competitive group or to the control group.

Items (1)-(3) were calculated from DB timetables, which involved substantial effort. We included those lines that were predominantly in the influence sphere of the agencies NVBW and VRN. The division of the network into lines follows the 2004 timetable. Some adjustments were necessary, however, to avoid double-counting of trains. Lines that were closed down between 1994 and 2004 were not included.

[26] In this example and several related cases, the new operator is vertically integrated, which is typically not the case in the other examples. There, the infrastructure is owned by *DB Netz*, whereas the services are provided by other firms (except when *DB Regio* is the successful bidder).

[27] The train categories that were included were *S-Bahn*, *Regionalexpress* and *Regionalzug* in 2004. In 1994, the respective categories were *S-Bahn*, *Regionalschnellbahn*, *City-Bahn*, *Eilzug* and *Nahverkehrszug*.

Table 1 summarizes the data. There are 71 lines, 24 of which belong to the competitive category. In terms of length, 37% of the network are served competitively.[28]

Table 1: Local Passenger Lines in Baden-Württemberg

	Number	Percentage of Lines	Line-Kilometers	Percentage of Line-Kilometers
Without competition	47	66	2395	63
With competition	24	34	1396	37
Total	71	100	3791	100

Next, we consider the evolution of frequencies netween 1994 and 2004. We observe:

1. a 30% increase in total transportation

2. a much stronger increase in the competitive group (49% vs. 20% in the control group);

3. an increase in the number of lines operated at least partly by competitors of DB Regio from 17 to 37;[29]

4. an increase in the total services of competitors of DB Regio by 270%.

[28] Recall from our definition of a competitive line that on lines that are served competitively, not all the services are necessarily procured in a competitive fashion.

[29] It might seem contradictory that 37 lines were partly operated by competitors of *DB Regio* in 2004, whereas Table 1 only indicates 24 lines as being competitive. Note, however, that of the 37 lines just mentioned, 17 were already run by NE-operators in 1994 which have not been challenged by competition since then. Thus, there are only 20 NE lines in the competitive category, the remaining 4 lines in this group are run by *DB Regio*.

Table 2: The Evolution of the Market (Overview)

	1994	2004	%-change
Total tkm (/1000)	55'538.832	72'240.916	30%
tkm on lines without competition (/1000)	36'049.874	43'264.548	20%
tkm on lines with competition (/1000)	19'488.958	28'976.368	49%
% tkm with competition	35%	40%	14%
number of NE-lines	17	37	118%
fraction of NE-lines	24%	52%	118%
lkm on which NE-operators are active (/1000)	6'005.119	22'245.015	270%
% of lkm on which NE-operators are active	11%	31%	181%
number of AVG lines	3	11	267%
tkm supplied by AVG (/1000)	3'838.988	14'496.615	278%

Notes: NE refers to all operators except Deutsche Bahn (DB). AVG is a NE operator.

The aggregate results in Table 2 suggest an increasing importance of competitive procurement mechanisms. It is unclear, however, whether this effect merely reflects that a growing number of lines have been exposed to competition or whether the lines that have been subjected to competition have actually grown faster than others.

4 Results

We now present our main observations about the evolution of the frequency of service. Before describing the estimation results, we present our results using simple tables and figures.

4.1 Descriptive Statistics

First, we describe the evolution of total transportation.

Result 1 *In the period under consideration, the frequency of service in Baden-Württemberg has increased substantially.*

Table 3 compares the main indicators of the distribution of the frequency of service for 1994 and 2004. The table shows a clear increase in the various percentiles and the mean.

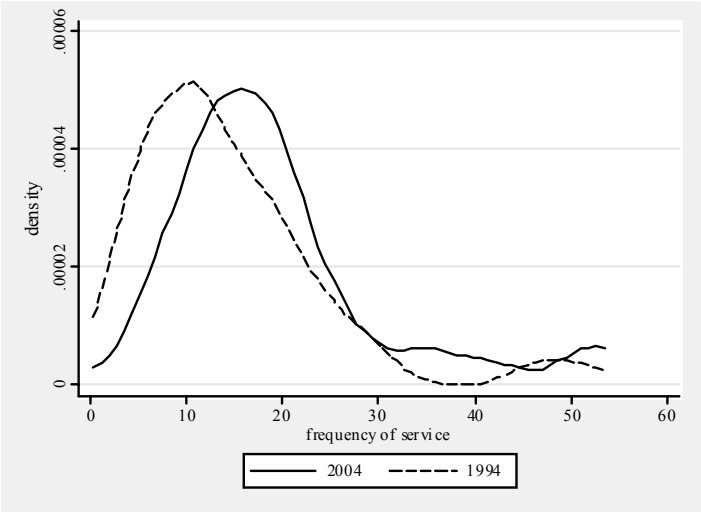

Figure 2: The Overall Change in the Frequency of Service

Table 3: Frequency of Service (Service quality)

	1994	2004
10th percentile	6.227	9.187
Median	12.465	16.989
90th percentile	25.463	38.862
mean	14.496	20.392
standard deviation	9.802	13.045
Number of lines	71	71

Figure 2 confirms this result. It shows that the density function for the frequency of service has moved to the right between 1994 and 2004.[30]

Obviously, this shift of the density of the frequency of service only reflects an expansive policy; in itself, it says nothing about an effect of competition. Figures 3 and 4 are more helpful in this respect.

[30]Here and in the following, the graphs were obtained using Epanechnikov kernel density estimators (with bandwidth $h = 0.9\widehat{\sigma}n^{-1.5}$, where $\widehat{\sigma} = \min\left\{S, \frac{IQR}{1349}\right\}$, S is the standard deviation and IQR the interquartile range).

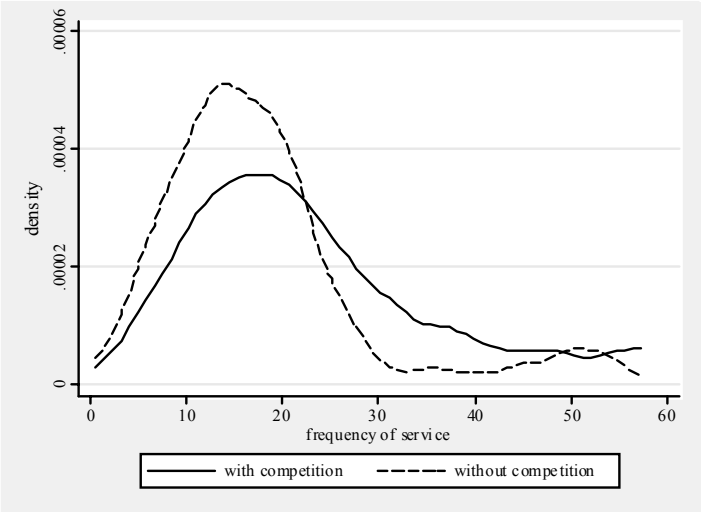

Figure 3: The Frequency of Service on Competitive and Non-Competitive Lines (2004)

Figure 3 compares the estimated densities of the frequency of services for the competitive group and the control group in 2004. The figure suggests the following result.

Result 2 *The frequency of services in the competitive group was higher than in the control group in 2004.*

The result corresponds to the observation that the density for the competitive group lies further to the right than for the control group. Obviously, this observation does not necessarily imply a competition effect in itself. It is conceivable that it merely reflects a selection effect, namely that more attractive lines are exposed to competition more often than less attractive lines. In the concrete example, this natural suspicion turns out to be unjustified, however. On the one hand, on a considerable fraction of lines in the competitive group the frequency of service in 1994 was already substantial, for instance on those lines that were subjected to the competitive bidding for the Rhein-Neckar metro system or on most of the lines that were taken over by the *Albtalbahn-Verkehrsgesellschaft (AVG)* in the Karlsruhe area. On the other hand, many lines in the competitive group had a very low frequency of service in 1994. The most spectacular example is the line from Schorndorf to Rudersberg, on which *DB Regio* offered only 4607 tkm/lkm in 1994, while *Connex* offered 15.558 tkm/lkm in 2004.

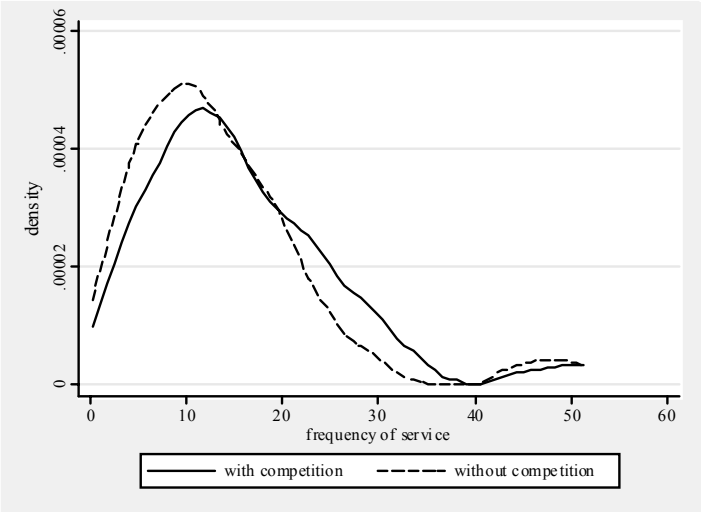

Figure 4: The Frequency of Service on Competitive and Non-Competitive Lines (1994)

Figure 4, which displays the frequencies of service for 1994 and 2004 shows that, contrary to the year 2004, there were hardly any differences between the two groups. Thus, the difference in frequencies of service in the year 2004 cannot be the pure selection effect that high-frequency lines are systematically exposed to competition more often than others.

Result 3 *In 1994, the frequency of services in the competitive group was hardly larger than in the control group.*

The next observation is an immediate corollary of the last two results.

Result 4 *On lines that were exposed to competition between 1994 and 2004, the frequency of services grew more strongly than in the control group.*

As argued earlier, we interpret this as a competition effect. When faced with a set of potential contractors rather than with a monopolist, agencies can ask for better service quality without necessarily having to pay high subsidies.

Several caveats concerning this interpretation are in order. First, from a theoretical point of view, one might ask why agencies do not apply the competitive mechanism more often if it is so successful. One explanation might be that there is

value to experimentation with a relatively unfamiliar allocation mechanism.[31] Second, it is worth bearing in mind that our analysis lacks subsidy data. Thus, we cannot provide evidence for greater "value for money" in the procurement of railroad services. For instance, if for some reasons agencies associate service quality with competition, they might simultaneously opt for competitive procurement and heavy subsidies on lines that they want to expand, whereas they procure from the incumbent on lines where they want to keep low service levels, which makes low subsidies possible.

5 Econometric Analysis

In the following, we shall investigate whether the competition effect suggested by Result 4 survives under closer scrutiny. We shall first analyze more carefully whether the lines subjected to competition are different from the lines in the control group. We shall then use these insights to carry out an econometric analysis of the determinants of the change in service quality. Finally, we consider the effects of ownership.

5.1 Selection of Competitive Lines

Observers of the German railway industry frequently complain that the lines that are procured competitively tend to be "lemons", that is, unattractive lines with low service quality and low growth prospects. Our descriptive analysis in the last section suggests that this is not true for the special case of Baden-Württemberg. Nevertheless, we now analyze more carefully whether the lines in the treatment group are indeed systematically different from those in the control group.

Most of our explanatory variables relate to the attractiveness of the lines which is mostly determined by geography. Specifically, we consider the geographic distance to the nearest city with at most 100,000 inhabitants as a measure of remoteness. Further, we include the size of both the biggest and the second-biggest city in 1994. Next, to deal directly with the idea that there might be a systematic trend difference between lines in the competition group and the remaining lines, we consider the population growth between 1994 and 2004 in the two major cities. In addition, we include a dummy variable to check whether a line is electrified or not. The prime motivation for doing so is that electrified lines are likely to be more attractive

[31] Alternatively, one could cook up political-economy stories about regulatory capture of the agencies by the former state monopolist.

than lines that are not. Also, one might imagine that agencies are more reluctant to subject electric lines to competition because one would imagine that successful bidding by entrants is less likely on these lines.

Table 4 gives simple descriptive statistics. The results support our prior that there is little reason to believe that lines with competition are systematically less attractive than lines without competition. If anything, the evidence suggests the opposite conclusion. First, though this difference is not quite significant, lines that are more remote are less likely to be subjected to competition. Second, concerning the population variables, there is barely any difference in the size of the largest community and the population growth in the second-largest community; and even though the population in the second-largest community and growth in the largest community are higher in the competition group; this difference is not significant. Third, most importantly, a much greater percentage of the lines in the competition group is electrified (70.8% in the treatment group as opposed to 40.4% in the control group), and the difference is highly significant.

A probit analysis reported in Table A1 in the Appendix gives a similar picture, except that, apart from the electrification dummy, there are now two more variables that are significant, at least at the 10%-level. On the one hand, the negative coefficient of the remoteness variable supports the idea that attractive lines are more likely to be procured competitively; on the other hand, the negative coefficient on the variable representing population in the second-largest community suggests the opposite.

We should hasten to add that the picture presented here is likely to be specific to Baden-Württemberg, where in essentially all of the major cities a substantial part of the "S-Bahn" (Metro) traffic is procured competitively. This is highly unusual in the rest of Germany, where there seems to be some evidence for the "lemons"-hypothesis.

Table 4: Characteristics of Lines by Competition Status in 2004

	With competition	Without competition	Difference (abs z-Value)
Distance to nearest city (km)	8.750	18.574	-9.824
			(1.57)
Population in community 1 (1994; 1000)	179.217	177.888	1.328
			(0.03)
Population in community 2 (1994; 1000)	42.568	54.906	-12.339
			(0.81)
Population growth in community 1 (%)	2.231	3.264	-1.033
			(0.95)
Population growth in community 2 (%)	3.228	3.040	0.188
			(0.18)
Electricity	0.708	0.404	0.304***
			(2.50)
Length (km)	58.167	50.957	7.209
			(0.67)
Lines	24	47	

Notes: Community 1 is the largest community, and community 2 is the second largest community along the railway line.

The results in Table 5 extend the point just made. They allow us to understand what the explanatory variables just discussed have to say about differences in ex-ante service quality. The first column in the table reflects our earlier observation that lines with competition have slightly higher ex-ante service quality than lines without competition. The second column introduces further independent variables. These variables do a very good job at explaining the ex-ante service quality. First, the two significant coefficients suggest that electrified lines and lines that are closer to big cities tend to have higher service quality. Second, though the population-related variables are not significant individually, they clearly are jointly significant in a plausible sense: The greater the population of each of the two biggest cities on the line, the higher the ex-ante service quality. Also, the role of the interaction term between population in community 1 and the length of the line is interesting. Though the coefficient is not quite significant, it suggests that the influence of the population in the largest community on service quality is much smaller when the line is longer. This clearly corresponds to intuition: A line that connects the largest city in the country, Stuttgart, with some remote part of the Black Forest should be expected to be served less than a line that lies almost entirely in the agglomeration.

Table 5: Explaining ex ante differences in Service quality
Dependent variable: Service quality in 1994

With competition	2.439	0.420
	(0.98)	(0.13)
Distance to nearest city (km)	-	-0.066
		(2.09)**
Population in community 1 (1994; 1000 inhabitants)	-	0.018
		(1.27)
Population in community 2 (1994; 1000 inhabitants)	-	0.038
		(1.33)
Pop. in comm. 1 * length (/100)	-	-0.023
		(1.61)
Electricity	-	5.389
		(1.79)*
Length (km)	-	0.013
		(0.50)
Constant	13.672	9.426
	(9.69)***	(4.51)***
F-test, pop. in comm. 1 and 2	-	2.93*
Observations	71	71
R-squared	0.01	0.34

Notes: Absolute z-Value in parenthese (based on robust Huber-White standard errors). * significant at 10%; ** significant at 5%; *** significant at 1%. Service quality is train kilometers per line kilometers.

Importantly, once we have controlled for all the influences just mentioned, the ex-ante difference in service quality between the two groups vanishes almost completely, with the relevant coefficient dropping from 2.439 to 0.420. This means that the ex-ante differences in service quality are due to variables that we can actually measure. This suggests that the measured line characteristics are also useful in controlling for differences in service growth that are not due to competition, provided that lines with a similar level of service also experience similar growth between 1994 and 2004.

5.2 Competition Effects

We now use the control variables just introduced to explain the differences in the changes in service quality better. Table 6 contains the results. The first column essentially restates our earlier observation suggesting the existence of a positive competition effect. The remaining columns show the effects of introducing control variables.

Consider the second column. Most importantly, lines with high initial population in the largest community experience higher growth, and this effect is more pronounced for shorter lines. The remaining coefficients are insignificant. By adding two variables relating to the population growth in the biggest and second-biggest city, the model reflected in Column 3 deals with the conjecture that changes in the service quality demanded by the agencies may reflect actual and expected population changes. Though indeed service quality seems to grow slightly more rapidly on the lines in the competition group, the effect is both insignificant and negligible in size.

As the first row of Table 6 clearly shows, both of the extended models suggest that the competition effect is remarkably robust, with the size and significance of the competition coefficent being almost unchanged in the three different models.

Table 6: The effect of competition on Service quality
Dependent variable: Change in Service quality 1994 to 2004

With competition	4.797	4.533	4.550
	(2.054)**	(2.28)**	(2.25)**
Distance to nearest city (km)	-	0.029	0.030
		(1.02)	(1.06)
Population in community 1 (1994; 1000 inhabitants)	-	0.028	0.028
		(1.93)*	(1.90)*
Population in community 2 (1994; 1000 inhabitants)	-	-0.003	-0.001
		(0.16)	(0.05)
Pop. in comm. 1 * length (/100)	-	-0.024	-0.025
		(1.75)*	(1.72)*
Electricity	-	1.689	1.769
		(0.94)	(1.03)
Length (km)	-	-0.018	-0.017
		(0.84)	(0.73)
Population growth in community 1	-	-	0.322
			(0.18)
Population growth in community 2	-	-	0.122
			(0.82)
Constant	4.275	2.151	1.396
	(4.51)***	(1.29)	(0.66)
F-test, pop. in comm. 1 and 2	-	1.99	1.95
Observations	71	71	71
R-squared	0.09	0.29	0.29

Notes: Absolute z-Value in parenthese (based on robust Huber-White standard errors). * significant at 10%; ** significant at 5%; *** significant at 1%. Service quality is train kilometers per line kilometers.

5.3 Ownership Effects

The results sketched so far suggest a positive competition effect. However, we have not yet shown whether this effect is driven by ownership or by competitive pressure. As a considerable number of the lines in the competitive group are operated by DB Regio, it is not clear whether a change of ownership from DB Regio to an NE-operator is necessary for an improvement in service quality. Interestingly, the data allow discussing this issue in detail. Out of the 24 lines subject to competitive bidding, 6 lines were won by *DB Regio*, 6 lines were won by *AVG* – the largest NE-operator in Baden-Württemberg – and the remaining 12 lines were won by smaller NE-operators.[32]

[32]Given the small size of our sample and specifically the fact that there are only 24 members of the competition group, it is impossible to draw far-reaching conclusions about the relation

Table 7 is a first step towards disentangling the effects of competition and ownership. The left-hand column is identical with the last column in Table 6, that is, there are no controls for ownership. The right-hand column controls for ownership. The reference case is a line operated by *DB Regio* in 2004. In addition, we use two dummies to distinguish between two types of NE lines, those operated by AVG, the *Albtal-Verkehrsgesellschaft* operating in the Karlsruhe area, and the remaining NE lines. The motivation for doing so is that the AVG is a particularly large operator, the expansion of which was pushed by local policy. Our results show that is important two take ownership into account. First, the positive signs of the pure ownership dummies (AVG and NE, not AVG) suggest that, in the absence of competition, both types of lines saw stronger growth than the *DB Regio* lines; note, however, that neither effect is significant. Second, the interaction terms show that competition effects are quite heterogeneous. For the baseline case of a *DB Regio* line the effect is significant at the 5%-level and quite substantial. For lines operated by *AVG*, the effect of competition is still much stronger (though the difference is not quite significant). For the remaining NE-operators, there is essentially no competition effect.[33]

between ownership and performance. However, the following observations suggest why such an analysis might be instructive at the national level.

[33]The positive overall competition effect of 5.139 and the negative effect of -6.109 captured in the interaction term "With competition*NE, excl. AVG" essentially cancel out.

Table 7: Competition vs. ownership
Dependent variable: Change in Service quality 1994 to 2004

With competition	4.550	5.139
	(2.25)**	(2.08)**
With competition * AVG	-	8.462
		(1.53)
With competition* NE, excl. AVG	-	-6.109
		(1.70)*
Distance to nearest city (km)	0.030	0.064
	(1.06)	(2.25)**
Population in community 1 (1994; 1000 inhabitants)	0.028	0.031
	(1.90)*	(1.84)*
Population in community 2 (1994; 1000 inhabitants)	-0.001	-0.001
	(0.05)	(0.06)
Pop. in comm. 1 * length (/100)	-0.025	-0.022
	(1.72)*	(1.23)
Electricity	1.769	-1.927
	(1.03)	(0.96)
Length (km)	-0.017	-0.012
	(0.73)	(0.46)
Population growth in community 1	0.322	-0.261
	(0.18)	(1.21)
Population growth in community 2	0.122	0.435
	(0.82)	(2.32)**
AVG	-	3.815
		(0.98)
NE, not AVG	-	4.283
		(1.59)
Constant	1.396	-0.473
	(0.66)	(0.23)
Observations	71	71
R-squared	0.29	0.43

Notes: Absolute z-Value in parenthese (based on robust Huber-White standard errors). * significant at 10%; ** significant at 5%; *** significant at 1%. Service quality is train kilometers per line kilometers.

6 Summary

The preceding preliminary results of our study on competition for passenger railway services suggest that there are positive effects of competition for the market on service quality. There are several reasons to criticize our approach. For instance, one might argue that the lines in the control group are also subjected to some degree of competition, because *DB Regio* might fear that uncooperative behavior induces the agency to resort to competition in the future, or that it reduces its chances to succeed on the competitive lines. However, this would suggest that our analysis underestimates the effects of competition.

We are presently extending the analysis to all other German states. Preliminary results suggest that the competition effects survive at reasonable levels of significance. However, in other ways, Baden-Württemberg is not representative. For instance, in most other states, there seems to be a negative selection effect: As argued by the competitors of DB Regio, the lines that are subjected to competition are typically lemons, with much lower frequency of service, at least in 1994.

In addition, we are thinking of several other extensions. First, we would like

to consider alternative quality measures. In particular, we shall try to supplement our analysis at least partly with data on passenger kilometers. This would not only be useful to improve the analysis of the effects of competition on service quality; it would also help to understand more about the relation between supply quality and patronage. At the present, however, we are skeptical about data limitations. Second, we would like to to use efficiency measures rather than pure output measures. From a policy perspective, it would be interesting to use data on subsidies per line-kilometer. It will be impossible to obtain data on the changes in subsidies at the required geographical level. Nevertheless, some information on the effects of competition can be obtained by exploiting the relation between required subsidies and the extent of competitive procurement at the state level.

7 Appendix

Table A1: Determinants of Competition (Probit Analysis)
Dependent variable: With competition

	Coeff. (z-Value)	M.E.
Population in community 1 (1994; 1000 inhabitants)	-0.001	-0.001
	(0.59)	
Population in community 2 (1994; 1000 inhabitants)	-0.008	-0.003
	(1.95)*	
Pop. in comm. 1 * length (/100)	-0.000	-0.000
	(0.54)	
Length (km)	0.008	0.003
	(1.41)	
Distance to nearest city (km)	-0.016	-0.005
	(1.71)*	
Electricity	1.489	0.485
	(3.19)***	
Constant	-0.618	
	(1.27)	
Lines	71	
log Likelihood	-36.19	

Notes: Absolute z-Value in parenthese (based on robust Huber-White standard errors). * significant at 10%; ** significant at 5%; *** significant at 1%

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