EJTIR

Issue 11(1)
January 2011
pp. 20-41
ISSN: 1567-7141
www.ejtir.tbm.tudelft.nl

Barriers to Entry in Rail Passenger Services: Empirical Evidence for Tendering Procedures in Germany

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As in several other European Union Member States, Germany has used tendering to an increasing degree since the mid-1990s for subsidized passenger rail services. In order to determine whether market entry barriers exist in this market, a dataset of 30 German tendering procedures with start of operations between 1997 and 2007 is analyzed. The data consists of comprehensive primary data provided directly by public transport authorities and operators.
On average 11 rail companies requested the tendering documents, but only four per tendering procedure submitted bids. The empirical analysis shows that there are two main tendering conditions that clearly influence the number of bidders. The first is the percentage of risk assumed by the public transport authority for price increases on input factors like personnel or fuel. This shows a positive correlation with the number of bidders. The second is the level of revenue risk to be assumed by the operator, which shows a negative correlation. Both correlations are highly significant. Authorities in Germany as well as in other countries using the tendering instrument should be aware of the influence of uncertainty and therefore avoid imposing untenable risks on operators. A high level of uncertainty will reduce authorities' efficiency gains by reducing competition and making it necessary for operators to calculate an increased risk premium.

Keywords: competitive tendering, market entry barriers, public transport, rail, risk

1. Introduction

European markets for passenger rail transport services were highly regulated for a number of decades. In recent years, however, efforts have intensified to make this market segment more competitive, partly in response to the precarious state of public budgets and partly to the European Commission's planned single European market for rail transport. The most intense liberalization efforts so far have been seen in Austria, Germany, Italy, and the UK.[2]

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[2] See, e.g., Beckers et al. (2009) and a report funded by the national railway operator Deutsche Bahn AG, IBM Business Consulting Services and Kirchner (2007, 76 ff.).

In those EU Member States that have decided to increase the use of competitive practices, the current tendency is towards controlled competition. According to Nash (2009, 155) competitive tendering is the main practice used in Sweden, Germany, Great Britain, the Netherlands, and Denmark. In Germany, Europe's largest competitive rail transport market in terms of the volume in train kilometers, this instrument has been used to a steadily increasing degree in regional and short-distance passenger rail services since the market reforms of the mid-1990s. Until the end of 2008, approximately 32 percent of the annual volume of 629 million train kilometers per year was put out to public tender. The previously high subsidies were thereby reduced by an average of 26 percent per train kilometer, enabling authorities to increase the amount of train kilometers offered to passengers.[3]

To reduce the need for subsidies to transport services permanently, while optimizing the situation from the budgetary perspective of authorities, economic theory recommends maintaining a high level of competition. The question here is whether PTAs in Germany have been able to achieve a high level of competition in every single new tendering procedure, or if market entry barriers have stopped newcomers from entering at least some procedures. This study focuses on this aspect in greater detail. The empirical analysis is based on 30 German tendering procedures that commenced operations between 1997 and 2007.

Section 2 starts with a literature review. In Section 3 the main characteristics of the German regional rail passenger market, including the market structure and main aspects of tendering procedures in Germany, are described. The database is presented in Section 4. The model tests and key findings of the study are discussed in Section 5. A conclusion is presented in Section 6.[4]

2. Literature review

On the international level, the British passenger rail franchise system has been analyzed by numerous authors over more than a decade, among them Preston et al. (2000), Yvrande-Billon (2004), Nash and Smith (2007), and Merkert (2009a). In recent years, further empirical examinations have been published on the results of tendering in other EU Member States, among them Alexandersson and Hulten (2007) with a study on Sweden, and van Dijk (2007) with first results from the Netherlands. A few selected articles—like those by Kain (2007) and Sharipov (2009)—have discussed the results of franchising in other parts of the world.

The economic literature on competitive tendering of regional passenger rail services in Germany is still limited. Lehmann (2000) takes a general look at micro-economic aspects of public transport services, focusing specifically on German passenger rail services. Schnell (2001) studies the competitive situation on the German regional passenger rail services market in an analysis of tendering procedures. Borrmann (2003) presents a detailed study of the economic incentive mechanisms, using a model-theoretic analysis based on contract and auction theory, complemented by a short analysis of a dataset of 39 tendering procedures.

More recent investigations, including empirical analyses, have been conducted by Brenck and Peter (2007) and Lalive and Schmutzler (2008a and 2008b). Brenck and Peter (2007, 146-160) show a great variety of awarding procedures and contract design in 2006, due to the high number of 33 different agencies responsible for awarding subsidies for regional passenger railway services in one specific area. Furthermore, their analysis, which is based on the results of a questionnaire sent out to tendering agencies, identified several entry barriers. The main barrier is the ability to

[3] See, e.g., Brenck and Peter (2007, 153 f.), Deutsche Bahn AG (2009, 15), and Holzhey et al. (2009, 16).
[4] For more details, see Beck (2009). Furthermore, the author's five years of professional consulting experience specialized in awarding public transport contracts and organizing public transport markets have played a role in this analysis.

discriminate on the part of the incumbent, the national railway operator, Deutsche Bahn AG (DB). Since DB usually provides the infrastructure, the authors argue that the company heavily influences all aspects of the infrastructure (e.g., investment decisions, infrastructure pricing, disruption of train services, etc.). Furthermore DB's existing rolling stock has been partially financed with public money. No clear entry barrier was found by the authors with respect to the volume tendered out or with respect to tendering conditions requiring new rolling stock.

The first study by Lalive and Schmutzler (2008a) is based on an analysis of 80 local passenger railway lines in the state of Baden-Württemberg. They show that lines with competitively awarded contracts experienced stronger growth in the frequency of services than lines where contracts were awarded directly.[5] The authors' second analysis (Lalive and Schmutzler, 2008b) investigates entry barriers in a database of 77 tenders for regional rail passenger services. They show that such barriers exist, and that they depend on the size of the network. A second result is that DB was more successful in the starting phase of tendering in the late nineties than in more recent years. No entry barriers were identified with respect to contract length. Due to data constraints, their database is comprised of publicly available information and additional data collected by DB. Unfortunately it does not contain any detailed data on the contractual design, which is a main aspect influencing whether or not competitors of DB decide to participate in a specific tender.

The most recent report on entry barriers was published by the Monopoly Commission. The Commission claimed that, despite the fact that open market access for commercial services is established by law and that tendering for subsidies for non-commercial services has been taking place since the mid-nineties, competition for passenger rail services is still fairly sparse (Monopolkommission 2009, pp. 28-82). With respect to tendering for non-commercial services, the Monopoly Commission report identified high entry barriers for newcomers, disadvantaging them against the incumbent DB, with respect to (i) the volume tendered out, (ii) the level of vehicle investments required (lack of used vehicles, types of new vehicles, problems with refinancing, market exit risks for investments), (iii) the discrimination potential resulting from integrating infrastructure and transport units within the national railway operator DB and (iv) the problems arising from the strong position of DB in the fare system and the sales and distribution business.

Case studies and further descriptive analyses of the German passenger rail market have been conducted by Achenbach (2006), Beck et al. (2007), Beck and Kühl (2007), Rohwer (2002), and Wewers (2004), among others. Some recent papers have focused on long-distance passenger rail services, among them Beckers et al. (2009) with an analysis on market access, and Séguret (2009) with a case study.

To date, however, there has been no empirical analysis of entry barriers in the competitive market for subsidized regional rail passenger services in Germany that uses comprehensive primary data obtained directly from public transport authorities and operators. By examining such data for 30 procedures, the present paper aims to identify barriers to entry and on this basis, to make recommendations on how to improve the level of competition for regional rail passenger services.

[5] Questions remain with respect to the representativeness of the database, since I was only able to identify five batches of lines that were tendered during the observation period in all of Baden-Württemberg.

3. Background

3.1 German Market Structure

The German market for rail passenger services is characterized by the co-existence of long-distance transport services working on a non-subsidized profit basis (long-distance services, e.g., high-speed trains) and regional and short-distance rail services subsidized by the states (*Länder*) out of funds provided by the federal government (regional services). Since the market reform in the mid-1990s, regional services have either been placed directly in the hands of the incumbent, Deutsche Bahn AG (DB), or other minor operators by means of long-term contracts, or put out to competitive tender. While market access for long-distance services is open (*competition within the market*),[6] regional services are characterized by tendering procedures (*competition for the market*) and direct awarding of contracts. Responsibility for regional services has been placed in the hands of the 16 states, while in recent years, most of them have announced plans to progressively tender out all services. The federal government does not oblige the states to put transport services out to tender.

The states have created specific agencies or authorities (*Aufgabenträger*) to function as rail task agencies or public transport authorities (PTAs). These authorities oversee negotiations over long-term contracts with DB and others, conduct tendering procedures, and carry out contract management activities throughout the term of the contracts. By the end of 2009 27 such bodies exist.[7] Every PTA has its own tendering philosophy and establishes its own contractual standards. Nevertheless, their procedures show some similarities to those observed in Sweden, Denmark, and the Netherlands.[8]

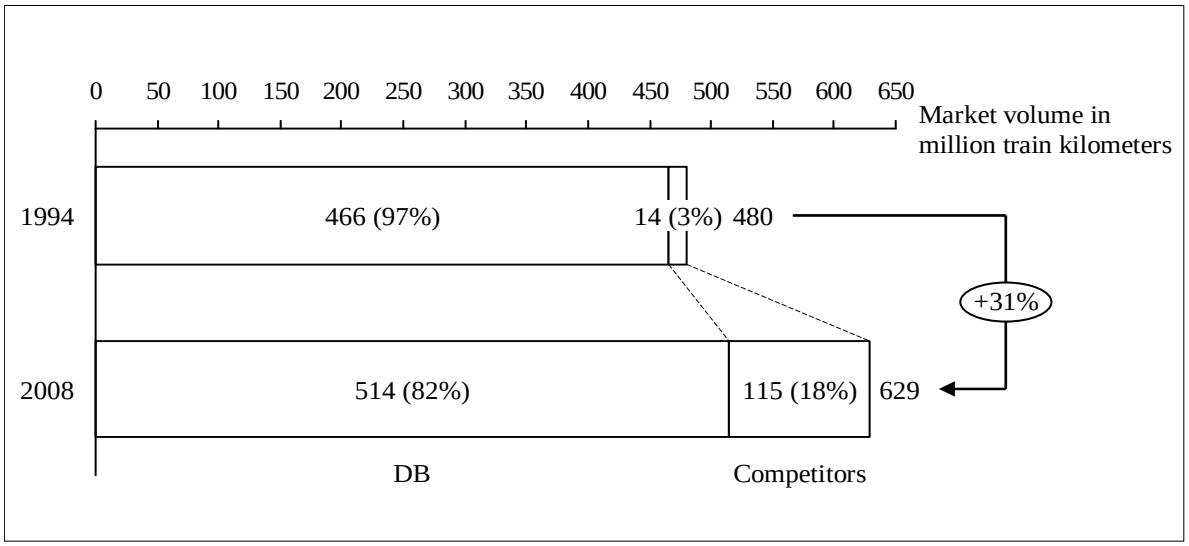

Figure 1. Market development for regional services since market reform

Since the initiation of market reforms, when there were already a number of small and mostly publicly owned train operators, the size of the total market for regional services in terms of train kilometers has increased sharply by 31 percent (see Figure 1). Numerous national and international companies have established themselves as players on the German market alongside the incumbent DB, which still is 100 percent state owned. Although DB has dominated the

[6] See Séguret (2009) and Beckers et al. (2009) for a description of this market segment.
[7] For a list of all PTAs see http://spnv.de/website/cms/front_content.php?idcat=15, accessed Dec. 19, 2009.
[8] For similarities and differences see Merkert (2009b).

market until recently, the market share of competitors in terms of train kilometers increased to 18.3 percent in 2008. Their market share in terms of passenger kilometers remains limited in comparison, with only 10.1 percent of all 46.3 billion passenger kilometers in 2008.[9]

3.2 Framework of tendering procedures in Germany

When regional services are put out to competitive tender in Germany, the procedure is generally structured in three phases as shown in Figure 2.[10] In the *preparation phase*, the PTA develops the *tendering documents*. These contain all necessary information, the tendering parameters, and the main conditions for the public service contract.

The *tendering phase* begins with the official announcement of the public tender, usually in the Official Journal of the European Union. The interested companies submit applications to tender and receive the tendering documents from the PTA for a small fee. The information in these documents forms the main basis for calculating the bids. After the deadline for submissions, the PTA evaluates the bids. The bidder with the best offer from an economic point of view is then awarded the contract on the basis of its bid. Operation commences at the beginning of the *contract term*.

Upon winning a tender, a bidder must conclude a contract with Deutsche Bahn AG for rights of use and fees for railway tracks, stations, and in case of electric traction, overhead electricity lines. Although Deutsche Bahn AG competes in tendering procedures through its subsidiary, DB Regio AG, it is also the main owner of rail infrastructure in Germany through its subsidiary DB Netz AG.

Analyzing the framework from the point of view of a newcomer trying to calculate a bid, the key factor determining how they bid and what prices they calculate are the conditions stated in the tendering documents, including those for the public service contract. These conditions regulate both the tendering design and the characteristics of the principal-agent relationship between the PTA (principal) and the operator (agent). At the same time, they describe the required services and provide other relevant information—for instance, on the potential demand—that form the basis for the company's calculations. It is assumed here that these conditions cannot be altered after the announcement of the tender as it is usual for all main conditions for the procedures observed. The tendering conditions can thus be evaluated as a take-it-or-leave-it offer in accordance with normative principal-agent theory.[11] Submission of a bid obliges the bidder to provide the contractually agreed services on award of the contract. Although final details are generally clarified in subsequent contractual negotiations, such as a slight increase in train kilometers based on an optional offer by the bidder, the main parameters of the tender do not change. The tendering documents thus form the key condition for a tender's success.

These tendering documents are also the basis for the company's calculation of their bid. Should a company consider the conditions for participating in a specific tender are not worthwhile, it can be assumed that the company will not take part in the rest of the tendering procedure, and simply not submit a bid. Should the company decide to submit a bid on the basis of the conditions laid out in the tendering documents, this signals its acceptance of the principal's take-it-or-leave-it offer.

[9] For more details see Deutsche Bahn AG (2009) and Holzhey et al. (2009).
[10] For more details, see Beck (2009).
[11] See Richter and Furobotn (1999, pp. 172-176) as well as Fees (1997, p. 585 and p. 588) for the normative principal-agent theory.

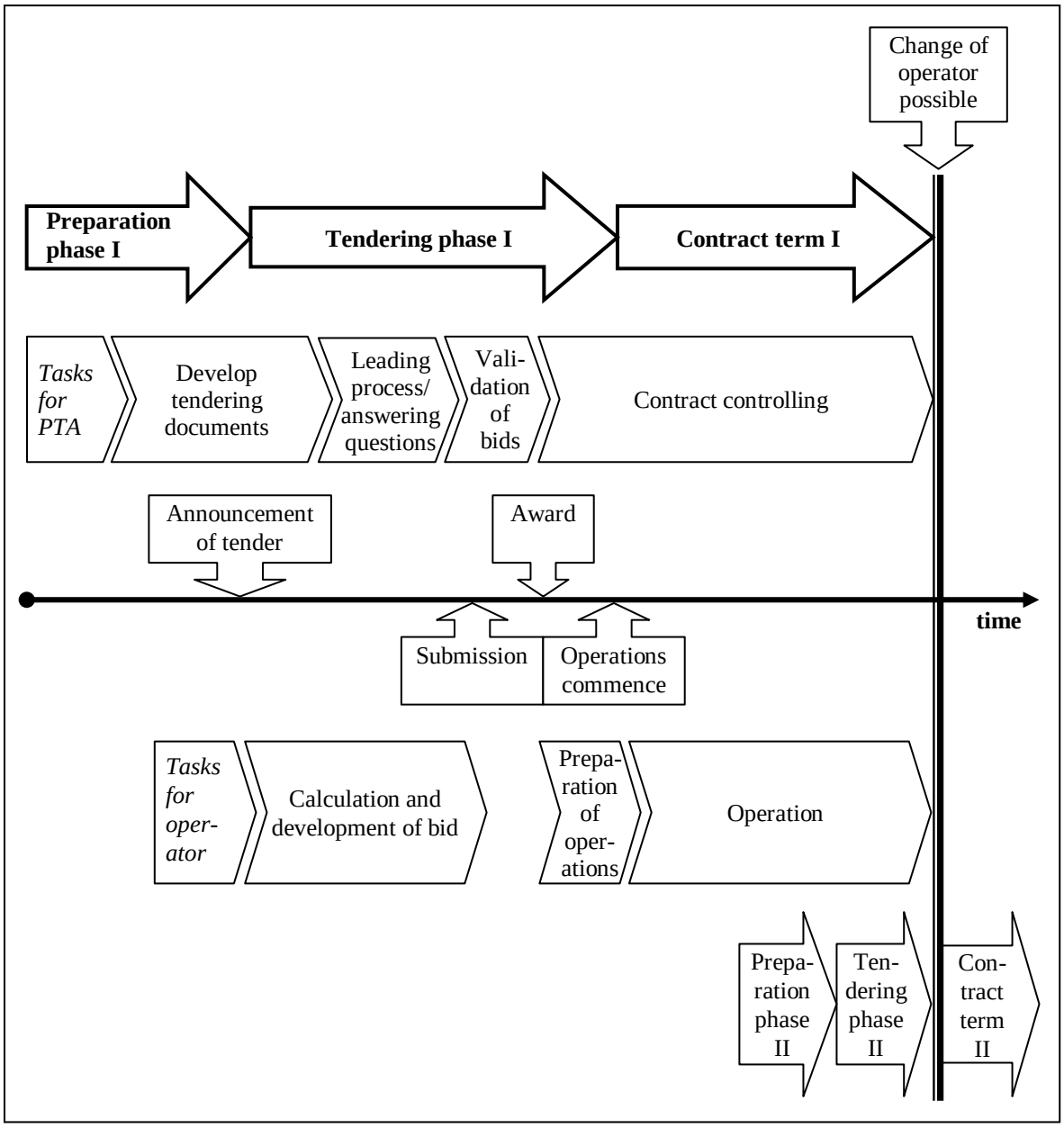

Figure 2. Schedule of tendering procedures

2.3 Objectives of the authority

During the preparation phase and the tendering phase, the primary objective of PTAs in Germany prior to receiving the bidders' submissions is usually to encourage intensive competition for the tender. As confirmed in interviews with various PTAs, during this phase of the tendering process, the authority—categorized here as an auctioneer—pursues the objectives of lowering the required subsidies and securing sufficient quality. Authorities generally select the lowest offer or bid, provided it does not fall short of the minimum quality defined in the conditions in the tendering documents. Normally, bidders must at least match the existing quality. During the tendering phase, this forms a necessary but not sufficient condition for awarding the contract. The primary objective is thus to minimize the required subsidies.

In the final tendering phase and throughout the term of the contract, the authority's focus is on reducing information asymmetries and their negative effects. Their aim is to provide operators incentives to fulfill the contract properly and to make the utmost effort to guarantee high-quality transport services. A frequently used instrument is a bonus-malus payment scheme, e.g., for punctuality. The present study focuses on the criteria of securing low subsidy levels via a high level of competition, which is the authority's primary long-term objective.

4. Description of the Data Set

4.1 Database

The study is based on a sample of 30 German tenders for regional services with operations commencing between 1997 and 2007. Awarding took place in the period 1996 to 2004. More recent data was not available. To compile the data, all public tenders announced in the Official Journal of the European Union in that period were initially selected as PTAs are obliged to publish their call for tenders there. Then the PTAs and operators involved were contacted for permission to view the tendering documents. In this document analysis, it was possible to compile data from the original tendering documents on all of the procedures in the database. In contrast to Lalive and Schmutzler (2008a and 2008b), the analysis is therefore based entirely on primary data provided directly by PTAs and operators.[12] The sample consists of approximately 70 percent of all "real" tendering procedures during this awarding period, as published in lists of German tendering procedures for regional passenger rail services.[13]

Please note that the database does not contain networks that were only "formally" tendered out. Here, only the incumbent DB was able to place a competitive bid due to the size or the technical characteristics of the network (e.g., S-Bahn Hamburg) or due to the contract design or political statements of the political decision makers responsible. Furthermore, compared to the database of Lalive and Schmutzler (2008b) with 77 observations, their database apparently also contains publicly available data on tendering procedures were awarding took place in the period 2005 to 2006. It was not possible to compile data from original tendering documents for that awarding period.

4.2 Descriptive Statistics

Altogether, data on 51 criteria were compiled. The analysis focuses on those 35 indicators where complete data were available: 1,050 individual data. The sample is almost evenly distributed over time. The results of a descriptive analysis of the sample of 30 procedures are presented in Table 1 for the most important criteria. It shows a wide variation with respect to the periods relevant for bidders, being (i) the period between the publication of the call for tenders and the deadline for submission of the bid (period to prepare the bid), (ii) the period between the deadline for submission of the bid and the final date until the bid is binding (period until the bid is binding) and (iii) the period between the final date when the bid is binding and the date when operations commence (period to launch operations).

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[12] As it is not common in Germany to publish or hand over detailed data on tendering procedures, special thanks go to all those persons and institutions that provided data for this study.

[13] See Laeger (2004, 261 f., 38 calls for tender) and Borrmann (2003, 240-243, 39 calls for tender). In comparison to the list of tenders in the Deutsche Bahn AG competition report (2004, 10), this rate is 71 percent. As the present study also includes calls for tender carried out after Borrmann and Laeger's studies, the sampling rate is presumably slightly reduced to approx. 70 percent of the population.

The volume tendered out shows average figures of 2.3 million train kilometers to be delivered per annum (p.a.) with 40.3 vehicles on a network of 175.8 kilometers. The responsible PTAs categorized the networks put out to tender as 57 percent branch or secondary lines and 43 percent main lines. In 20 of the 30 tendering procedures studied, the networks in question exceeded the boundaries of a single PTA area of jurisdiction, thus involving more than one PTA in the tendering procedure. In most cases, however, one PTA took command of the tendering procedure. In total, 23 of the 27 German PTAs were involved in the tenders studied. However, all PTAs that actively promote competition in their area and issued calls for tenders in Germany during the period analyzed are represented in the sample.

Table 1. Descriptive statistics for selected criteria

	Mean	Maximum	Minimum	Standard deviation
Public call for tenders dated…		28/09/2004	15/12/1996	
Period to prepare the bid (in days)	122.40	250	5	54.58
Period until the bid is binding (in days)	214,83	775	20	144.47
Period to launch operations (in days) *	578.90	1,078	-17	282.71
Volume in train kilometers p.a.	2,277,033	6,000,000	90,000	1,585,654
Volume in number of vehicles	40.30	160	2	36.09
Length of network in kilometers	175.80	379	13	106.29
Permitted age of vehicles (in years)	3.43	18	0	4.24
Contract duration (in years)	9.15	12	2.75	2.31
Share of revenue risk to be borne by operator in percent	57.17	100.00	0.00	48.40
Share of total costs where price risk for input factors is borne by PTA in percent	57.47	64.00	0.00	13.25
Security deposit in percent	11.43	50.00	0.00	16.27
Number of participants	10.90	24	4	5.16
Number of bidders	3.97	8	0	1.87

*Please note that in two cases, the official awarding took place several days after start of operations due to emergencies.

The maximum age of vehicles permitted at start of operations is 18 years, while 47 percent of the procedures required brand-new vehicles. The mean contract duration is 9.15 years. Two contracts show a regular contract term of only 2.75 years (see Figure 3), while contracts with a high volume of train kilometers per annum show a contract period of 10 years and more. An optional extension of the contract period is stipulated by just 20 percent of the 30 procedures (optional contract extensions by 2, 2, 4, 8, 15, and 20 years).

The share of the revenue risk to be borne by the operator ranges between 100 percent ("net cost contracts") and zero percent ("gross cost contracts"). In several contracts, this risk is shared between operator and PTA.

The risk of increasing (or the chance of decreasing) prices for input factors is often shared between operator and PTA. Here, most of the contracts stipulate that the PTA bears this risk for infrastructure costs (e.g., fees for track access and stations) as well as for costs for personnel and energy. In these cases, 64 percent of the total costs are costs where no risk of price increases has to be borne by the train operator. Only one procedure does not have a risk-minimizing contract clause for any input factor. In this case, the full risk of price increases on input factors lies with the operator.

Nineteen tendering procedures (63 percent) required a security deposit paid by the operator in favor of the PTA, measured as a percentage share of the subsidies to be paid by the PTA for the

first year of operations. Here the average deposit is 11 percent (average figure for the 19 procedures with such a clause: 18 percent).

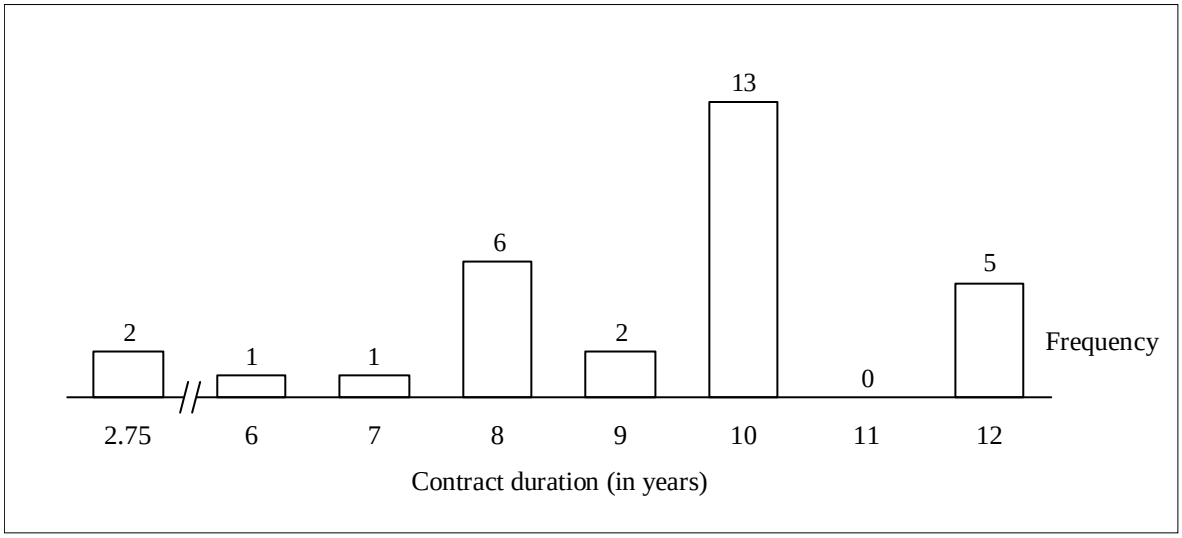

Figure 3. Frequency distribution of regular contract duration

3.3 Level of competition

Competitive potential

To reduce the need for subsidies for transport services—permanently, if possible—and optimize the situation from the PTAs perspective, economic theory recommends maintaining a high level of competition. The initial issue is whether a sufficient number of potential bidders are active in the specific market in question to enable actual competition. Have enough companies decided to enter the German market for regional services? Examining the tendering procedures shows that an average of 10.90 train operating companies requested the tendering documents per tendering procedure. The minimum was four; the maximum was 24 requests. These results suggest that the number of operators active in this market and interested in placing a bid is sufficient for a high level of competition.

Comparing the number of inquirers to the number of actual bidders, however, reduces the sum of potential competitors by differing percentages. On average, seven of the eleven operators (64 percent) who applied to participate decided not to submit a bid after analyzing the tendering documents. However, it is not possible to assess the success of tendering based solely on the reduction in the number of bidders during the tendering process: bidders are part of networks that share such information in publicly available media. It is therefore possible that they inform themselves on tendering conditions before paying the fee to request the tendering documents from the PTA. This information forms the basis for an initial decision for or against participating in the tender in question. It is therefore impossible to establish how many potential bidders are actually discouraged from bidding by the conditions. For this reason, the following observations focus on the number of companies actually submitting bids.

Number of bidders

On average, 3.97 bidders submitted bids in the tendering procedures analyzed. The standard deviation is 1.87. The analysis of the dataset, however, reveals considerable differences in the

number of bidders per tendering procedure. In one procedure, no bids were submitted on the basis of the tendering documents developed by the PTA. The most successful procedure, in contrast, attracted eight bidders. Figure 4 shows the frequency distribution of the number of bidders. In comparison to the British franchising procedures studied by Preston et al. (2000, 104), with four to eight bidders per tender, the dataset shows a greater variation.

The findings regarding the number of inquirers suggest that there are a sufficient number of potential bidders on the German market to enable a higher level of competitive tenders than currently observed. Thus, from the PTA's point of view, the prerequisite for a result closer to the optimum tender outcome—a lower level of subsidies thanks to increased competitive pressure within the tendering process—is fulfilled. In view of the wide distribution in the number of bidders per tender, it would appear, however, that there are tendering conditions that prevent individual inquirers from submitting bids. This raises the question as to whether barriers to market entry exist that prevent potential bidders from submitting a bid and competing for this segment of the market.

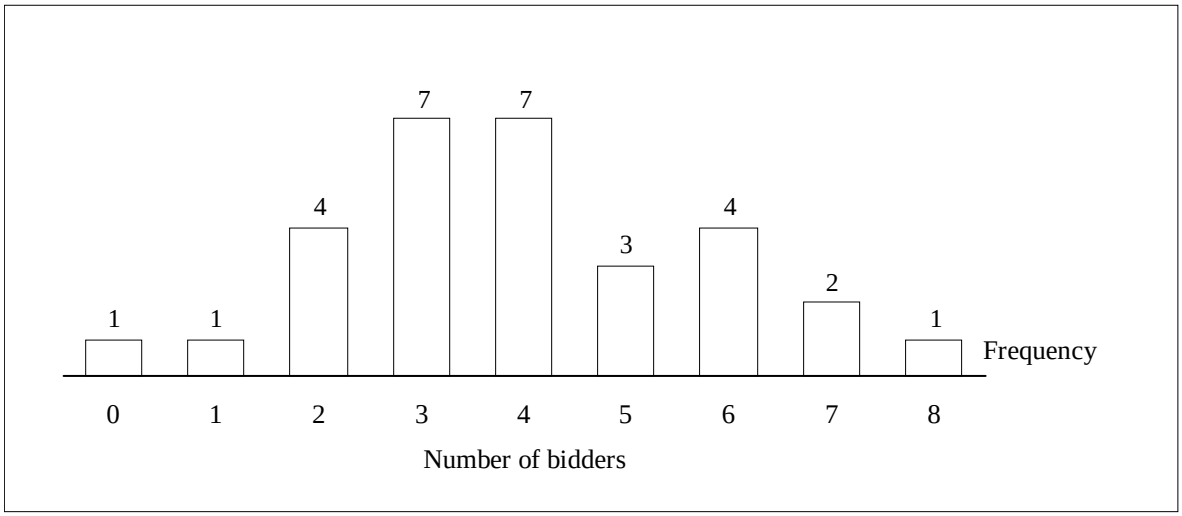

Figure 4. Frequency distribution of number of bidders

During the analysis period, no change was observed in the legal and regulatory parameters in Germany that might impact the bidder's decision to submit. This is confirmed by the lack of correlation between the dependent variable *number of bidders per case* and the independent variable *time*, an assessment confirmed by a simple OLS-regression for these two variables.[14] Furthermore, no collusion or syndicate of bidders was observed. In view of the complex structure of the 27 German PTAs for regional services and their varying tendering philosophies, it can be assumed that tendering conditions exist that prevent interested parties from submitting a bid. The following analysis investigates these barriers to market entry in greater detail.

[14] OLS-results for variable *time*: Coefficient and standard error being -0.0005 and 0.0004, t-value being -1.38, ergo insignificant correlation with P>|t| 0.178.

5. Results and discussion

5.1 Hypotheses

General remarks

The ultimate aim of increasing competition within tendering procedures is to reduce the need for subsidies. As an auctioneer determining the tendering conditions, the PTA can influence the intensity of the competition by creating participation conditions that ensure as many bidders as possible. If the tendering conditions prevent potential bidders from submitting a tender, these must be seen as barriers to market entry.

McAffee et al. (2004, 465) define newcomers' disadvantages compared to the incumbent as market entry barriers. They emphasize that if there are sunk costs in the market, these barriers include "uncertainty about market conditions." Even a group of smaller barriers together "may constitute a significant entry barrier." If the level of uncertainty is (significantly) lower for the incumbent than for the newcomer, this might also be classified as a "disadvantage." Here, newcomers have to reckon with higher risk costs than incumbents. They can reduce the level of uncertainty by analyzing the market, but this will also represent an entry barrier, as these research costs will have to be classified as sunk costs.

When looking at the tendering documents, a key concern with respect to risk is that the contract duration is usually long. The transport contracts in question have a term of 9.15 years on average, with the shortest being 2.75 years and the longest 12 years.

Beck (2009, pp. 39-48 and 53-56) shows that in long-term contracts, economic theory generally assumes a higher risk aversion for the agent than for a public principal. This is why by assuming risks, a PTA (the principal)—a public entity that is generally assumed to be risk-neutral—may prevent bidders (the agents) from calculating high risk premiums. This holds especially for aspects affected by external factors that are outside the operator's sphere of influence.

Sometimes it is argued that a higher level of risk would not per se reduce the number of operators handing in a bid if an adequate risk premium were calculated by the operators and paid by the PTA. However, it has to be noted that this argument is applicable only if the same level of risk aversion is assumed for all operators. In Germany, the risk attitude of bidders is probably different, especially since private operators like Veolia or Arriva have to compete with public operators like DB. Economic theory usually assumes a risk-averse attitude for private companies like Veolia and Arriva and a risk-neutral attitude for public entities like DB. In this analysis, we will assume all (potential) bidders to be risk-averse since all public bidders are subject to the laws regulating private companies and, when participating in a tendering procedure, act like private operators (especially DB with its aim of becoming a real private company by going public). Nevertheless the degree of risk aversion among (potential) bidders will differ and necessarily remains unknown ex ante, with public operators assumed to be characterized by a lower level of risk-aversion than private operators.

Preston et al. (2000, 111) confirm the assessment of bidders as risk-averse in their empirical study of the British rail franchise market. Based on interviews with operators active in the German regional passenger rail services market, I conclude the same. Hence, if the conditions in the tendering documents entail a high overall risk for potential bidders and if these bidders are risk-averse, this may prevent at least some of them from submitting a bid and entering into competition for the market. Fulfilling the participation constraint of a higher number of bidders then leads to a higher level of competition.

Preston et al. (2000, 111) emphasize that the risk aversion of bidders in British rail franchising procedures increases the need for subsidies by increasing the risk premium to be calculated by the remaining bidders. An optimal auction or tender accordingly reduces the bidder's insecurity in order to reduce the risk premium. With respect to tendering procedures for regional services in Germany, and based on the assumption of risk-averse bidders, the following hypothesis can be derived from this consideration:

H: *The higher the risk inherent in a potential contract, the lower the number of bidders participating in the tendering procedure will be.*

Influence of the price escalation clause

Based on the explanations above, one can say that with respect to the risk of increased costs arising from the higher prices of exogenous input factors, economic theory suggests that the risk-neutral contracting party (the PTA) should assume at least part of the risk in order to reduce the risk premium of the risk-averse contracting party (the operator) in the case of long-term contracts. If the PTA decides to assume at least part of the risk of increased costs, it should assume the risk of price increases of the cost-intensive input factors in particular, since these increases can hardly be influenced by the operator. The PTA also should bear the risk of price increases for (i) infrastructure (e.g., fees for use of railway tracks and stations, usually provided by DB), for (ii) personnel (wages, usually dependent on collective labor agreements) and for (iii) energy (overhead line electricity, usually provided by DB, or diesel fuel). In most of the contracts analyzed, a cost index is used. This instrument envisions an increase (or decrease) in the subsidy payments during the term of the contract in proportion to the increase (or decrease) in costs of the selected input factors.

Within the framework of this study, I investigated whether and to what extent the tendering documents stipulate that the risk of price increases for infrastructure, personnel, and energy costs is assumed by the PTA. A regulation of this type is known as a price escalation clause, and generally refers to the input factors of infrastructure, personnel, and energy. These constitute by far the bulk of the costs from the bidders' perspective. The analysis is based on the variable *price risk* (share of total costs where price risk is borne by the PTA in percent).

If the general hypothesis H is refined in view of the price escalation clause of a regional services tender, we have the hypothesis:

H^P: *The lower the price increase risk taken over by the PTA, the lower the number of bidders.*

In other words, in the event of the PTA assuming the price increase risk for all three types of costs, there would be a high number of bidders (and hence more competitive bidding). In the event of the PTA assuming none of the price increase risks, the level of competition in the tender procedure would tend to be lower than in a scenario where the PTA assumes full risk.

Influence of the revenue risk

From the bidders' perspective, the revenue potential of a particular route is determined by the demand potential and the fare. Since the fare structure, including the type of ticket, is directly or indirectly stipulated or at least influenced to a large extent by the PTAs in all cases examined, it is assumed that the fare structure cannot be influenced by the operator. Consequently, fare revenue potential is affected to a large extent by external factors that the operator is unable to change. These include demand potential, which is mainly influenced by factors such as population density and quality of alternative means of transport, and the profitability of fares. The latter is determined by multiplying the types of ticket selected by passengers by the number of users of each type of ticket. In addition, the established procedures of revenue-sharing in transport

associations and/or tariff networks (*Verkehrsverbünde*) in Germany are often confusing and opaque for new companies (as are the conditions for entering the Verkehrsverbünde). Usually only the incumbent obtains detailed information, which represents an information-based competitive edge (see Schmidt et al. 2004, as well as Stammler and Pulkkinen 2008). By limiting the extent and quality of information it provides to the PTA, the incumbent is able to discriminate against competitors, because the PTA usually provides this information to newcomers with the tendering documents. Further potential for discrimination arises with the distribution of tickets, as discussed above, which is a common practice of DB and which also affects fare revenues (see Eisenkopf and Grotemeier 2009).

The fare revenue potential can thus be compared approximately to the common value approach in auction theory (see Krishna 2002). The bidder is faced with what is known as the winner's curse: the news of winning the call for tenders is bad news because it is highly likely that the winner miscalculated the expected fare revenue. The ex-post revenue potential is the same for all potential operators. The winner's curse was explained in more detail by Kagel and Levin (2002).

Expectations of newcomers concerning fare revenue potential are formed primarily on the basis of the information made available by the PTA in the tendering documents. This is assuming that the level of risk aversion of the individual companies is a normally distributed random variable of otherwise symmetrical companies. Then the risk attitude of the individual company gives a private signal used in assessing the risk premium to calculate the fare revenue potential. Here, the more demand information is made available, the lower the uncertainty about the (expected) fare revenue potential and hence the lower the necessary risk premium in the event of a tender assigning the revenue risk to the operator.

The incumbent operator's information advantage concerning the demand potential and the profitability of fares should be viewed critically, since it can lead to a bias of the bidders' initial conditions. From the other bidders' points of view, information from the PTA is more reliable, and ideally a comprehensive report on the demand potential is submitted by the rail authority.

In order to check the effects of the distribution of revenue risk, I treated the operator's percentage share of fare revenue as revenue risk. The criterion shows a ratio scale and is analyzed using the variable *revenue risk* (share of revenue risk to be borne by the operator in percent). If the hypothesis H is refined to apply to a call for tenders for regional services, we have the hypothesis:

H^R: *The higher the operator's revenue risk, the lower the number of bidders.*

In other words: if a low share of the revenue risk is transferred to the operator, there would be a high number of bidders (and thus a high level of competition in the tender). In the event of the entire revenue risk being assumed by the operator (e.g., within a net cost contract), the level of competition in the tender procedure would tend to be lower compared to when the full revenue risk is assumed by the PTA in a gross cost contract.

Formulation of the model

If hypotheses H^P and H^R are combined in a stochastic model, the following relationship can be assumed:

$$\textit{number of bidders per case} = a + \beta_1 \times (\textit{price risk}) + \beta_2 \times (\textit{revenue risk}) + \upsilon \qquad (1)$$

On the basis of the objectively logical correlation, the variable *number of bidders per case* is to be classified as a dependent variable and the variables *price risk* and *revenue risk* as independent variables. Also, a positive coefficient β_1 can be assumed for *price risk* and a negative coefficient β_2 for *revenue risk*. a represents the constant (the axis intercept of the dependent variable) and υ is a stochastic random variable (disturbance variable).

5.2 Results

Estimation of the model

In order to be able to confirm or reject the above-mentioned hypotheses, a multiple regression analysis was conducted on the basis of the model *(1)* presented above using the data set of the tenders in question. The analysis gives us the following estimation equation *(2)*:[15]

$$number\ of\ bidders\ per\ case = 2.0027 + 5.4028 \times (price\ risk) - 1.9957 \times (revenue\ risk) \quad (2)$$

Table 2 provides a full overview of the results of the multiple regression. It should be noted that both the dependent variable and the independent variables show a metric measurement scale. Since the signs correspond to the theoretical observations, the model is also to be categorized as plausible. Thus, it is possible to confirm the assumptions above according to which the bidders must be classified as risk-averse.

Table 2. Results of multiple regressions with number of bidders as dependent variable

	Coefficient	Standard Error	t-value	P>|t|
price risk	5.4028	1.9454	2.78	0.010
revenue risk	-1.9957	0.5325	-3.75	0.001
a	2.0027	1.2595	1.59	0.123

Number of observations	30
F-Value (2, 27)	14.783
Prob > F	0.0000
R^2	0.5227
Adjusted R^2	0.4873

With a coefficient of determination of $R^2 = 0.523$, the share of the declared dispersion in the overall dispersion as a performance measurement of the adjustment of the regression function to the data in question is 52.3 percent. If the coefficient of determination is corrected with the aid of the degrees of freedom forming the basis of the regression, this results in a mean standardized coefficient of determination of 0.4873.

The validity of the causal link assumed in hypothesis H between the dependent variable *number of bidders per case* and the independent variables *price risk* and *revenue risk* for the population is checked by means of an F-test. The F-value empirically determined for this hypothesis test is 14.783. On the basis of a significance level of 95 percent, this gives a theoretical F-value of 3.354 in accordance with the F-distribution. As the estimation results show, a high confidence coefficient of over 99.9 percent can be assumed for the estimation. Further examination of the premises reveals, moreover, that the premises of the regression model are fulfilled. The BLUE characteristic of the model (best linear unbiased estimators) is guaranteed.

Analysis of the regression coefficients β_1 and β_2

Analyzing the results for the independent variables *price risk* and *revenue risk* shows interesting results for the coefficients β_1 and β_2. The coefficient β_1 for *price risk* shows a positive value of 5.4028 and a standard error of 1.9454. The t-value is 2.78. With a probability of 99.0 percent, there is a positive linear correlation in the population between the share of the PTA in the price

[15] The empirical analysis in this study was conducted by using SPSS and confirmed by using Stata for Windows 9.1.

increase risk for the above-mentioned pools of costs and the number of bidders. The lower the percentage share of total costs for which the PTA assumes the risk of price increases, the lower the number of bidders will be. Hypothesis H^P was therefore confirmed by the estimation results.

The examination of coefficient β_2 for *revenue risk* shows a negative value of 1.9957 and a standard error of 0.5325. The t-value is -3.75. With a probability of 99.9 percent, there is a negative linear correlation in the population between the share of the operator on the *revenue risk* and the number of bidders. The lower the percentage share of revenue risk to be borne by the operator, the higher the number of bidders will be. Hypothesis H^R was therefore confirmed by the estimation results. A higher number of bidders then has to be expected for a tendering procedure using a gross cost contract compared to a tendering procedure using a net cost contract.

Summing up, the analysis shows highly significant results for the coefficients of the independent variables *price risk* and *revenue risk* and confirms the assumption of risk aversion among bidders. Nevertheless, due to the low number of only 30 observations, the validity of the significance is limited and needs to be confirmed by further research based on a higher number of observations when these become available.[16] Conversely, the number of independent variables with a t-value confirming a significant influence on the number of bidders might also be higher in reality, but is currently suppressed by the low number of observations. However, compared to other empirical studies on this market segment, such as Preston et al. (2000, 106) with 33 interviewees and Yvrande-Billon (2004, 183) with 25 observations, and with respect to the low number of cases in reality, the sample is presumably of an acceptable size for an up-to-date empirical analysis of tendering procedures for regional rail services in Germany.

Further Results

It was checked whether further aspects were able to improve the model tested above. Among others it was examined whether aspects relevant for fixed costs (especially investments in vehicles and depots) and the underlying risk have a significant influence. Here the number of vehicles, the contract term (relevant for depreciation), contract clauses where the PTA takes over the vehicle risk by the end of the contract term and other such aspects were analyzed.

Forty percent of the procedures stipulate a vehicle transfer by the end of the contract term, minimizing the vehicle risk for operators. Furthermore, 43 percent of the procedures support operators through lump-sum subsidies for investments in vehicles and 10 percent through lump-sum subsidies for investments in vehicles and depots. A vehicle pool, where ownership of vehicles lies at the PTA, was used for 10 percent of the procedures. Furthermore it has to be noted that PTAs tend to offer longer contract terms in cases where higher volumes were tendered out.

None of these instruments aimed at minimizing the risks associated with fixed costs showed any influence on the number of bidders in the database. Nevertheless, it has to be stressed that the database only consists of procedures with operations beginning before 2007, meaning that bidders' reactions to the financial crisis of 2008/2009 are not included in our analysis. According to numerous experts, access to capital (for rolling stock, depots, etc.) has been the key entry barrier in Germany in recent years. Here, further research is urgently needed to determine whether instruments to minimize operators' risks associated with fixed costs (or the lack thereof) have had an effect since the financial crisis.

Other factors that could potentially exercise an influence also did not show any significant correlation: the size of the network in terms of kilometers, the volume in terms of train kilometers, and the number of vehicles. With respect to the period between publication of the tender and start of operations, the data also did not show any significant correlation with the

[16] As the model consist of only two variables an error might already be narrowed.

number of bidders. Here, PTAs were obviously already using time frames considered by operators to be sufficient. This applies in particular to the period set by PTAs to launch operations, which increased with the volume of the network tendered out (see trend plot presented in Figure 5 with a coefficient of determination of $R^2 = 0.5300$).

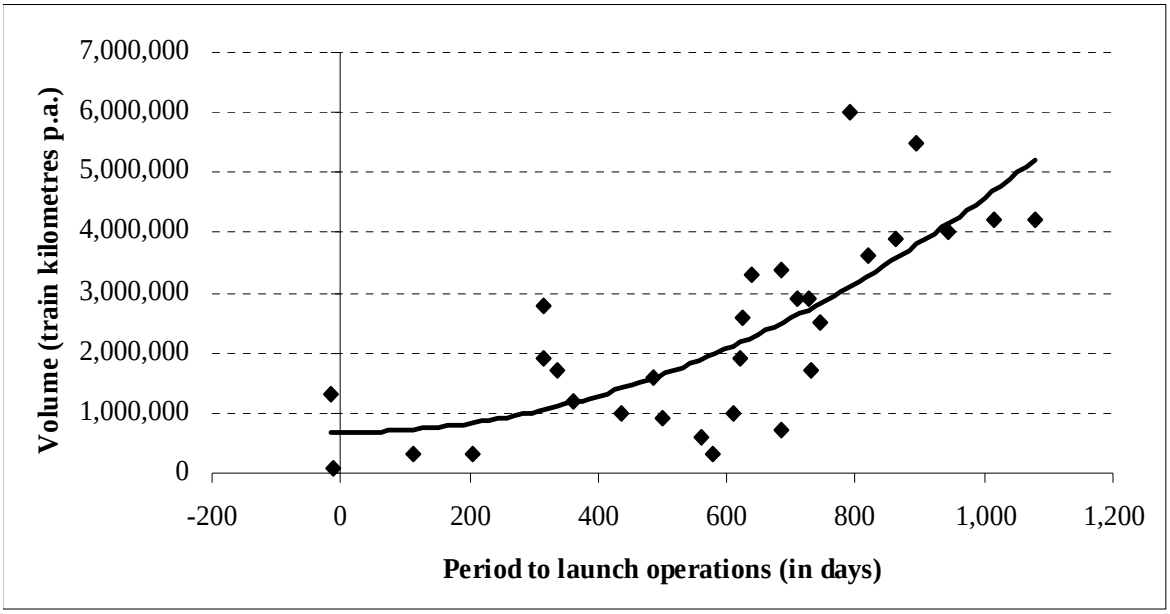

Figure 5. Best matched trend plot for volume and period to launch operations

5.3 Discussion

Summing up, the result confirms the assumption of risk-averse bidders in rail tendering procedures on a significant level: the higher the level of risk to be borne by the operator, the lower the number of bidders per case. PTAs should therefore avoid a high level of uncertainty in areas that operators are unable to influence. These aspects will be summarized in the following.

Price risk and impact of the price escalation clause

It has become common for the tendering documents for regional services in Germany to include a clause in which the PTA assumes the *price risk* for specific input factors where the risk of price increases cannot be influenced by the operator. Only a few tendering procedures did not include such a price escalation clause. One of these was the failed tendering procedure for the "Nordharz" network in Saxony-Anhalt, where not a single bid was submitted (not even by DB). Here the tendering documents stipulated that the full risk of price increases for input factors was to be borne by the operator. In view of the term of 15 years (term between date of bid submission and termination of the contract) and the possibility for increases in infrastructure costs by the incumbent, DB, this risk is, according to Quandt (2003), unacceptable for operators. Discussing this case, he argues that it is impossible to imagine a risk premium that would be able to limit such a risk. Furthermore, he explains that newcomers experienced several complete changes in the price system for track access charged by DB every three to four years in recent times, making this system unpredictable.

The potential for discrimination by the incumbent DB was also confirmed by a decision of the Frankfurt district court in 2004 (Az. 3-08 O 72/04), claiming that the price system for overhead line electricity penalizes newcomers. For personnel costs and diesel fuel, a clear potential for discrimination by DB could not be identified. However, price developments for these input

factors are usually out of the sphere of influence of a single operator (including DB) and unpredictable for a term of up to 15 years.

Revenue risk and the impact of the winner's curse

An investigation of the dataset with respect to the types of contract used showed that in a total of 60 percent of the public service contracts awarded, these have to be classified more or less as net cost contracts (revenue risk borne [usually entirely] by the operator). Forty percent of the public service contracts have to be classified more or less as gross cost contracts (revenue risk borne [usually entirely] by the PTA).[17]

The quality of information on demand contained in the tendering documents provided by PTAs to operators for net cost contracts varies greatly. In six percent of cases, no information on demand was provided by PTAs. In 44 percent of cases, data provided by the incumbent to the PTA was used only (information which has presumably limited reliability). 33 percent of the tenders of net cost contracts included data provided by the incumbent and additional demand information from the PTA. Only in 17 percent of all cases was it possible for the operator to make a calculation on the basis of a comprehensive and reliable report provided by the PTA.

It is not yet possible to make a qualified statement on the correlation between the quality of the demand information and the number of bidders with net cost contracts due to the low number of net cost contract cases. Nevertheless, it should be noted that comprehensive reports have only been used since 2003 for some procedures, while the tender lacking demand information was from 1999 and thus from the initial stage of market development. Thus, owing to the low quality of the demand information, there is usually no valid database on the actual demand potential for tenders with net cost contracts, which involve greater insecurity from the bidders' perspective than would be desirable. The transfer of revenue risk therefore entails the danger of the winner's curse. Assuming a stochastic revenue function and a risk-averse bidder, the latter will reckon with a risk premium commensurate with the revenue risk. Waiving this risk premium may result in insolvency, as was the case with the company FLEX AG, which operated the Hamburg-Flensburg(-Padborg) network in 2002/2003 after winning the respective tendering procedure (see Wewers 2004).

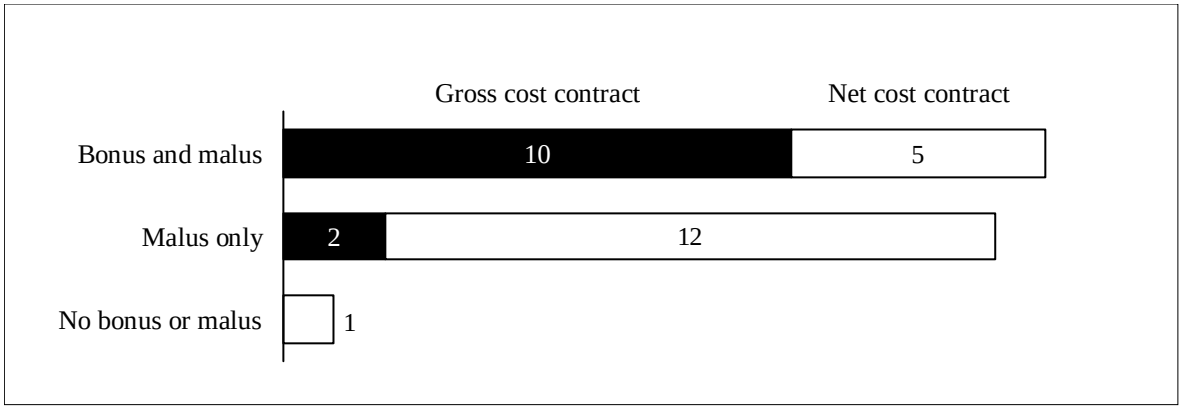

Figure 6. Frequency distribution of bonus-malus schemes compared to type of contract

Nevertheless, net cost contracts generally provide better incentives than gross cost contracts, since the operator's revenue is at least partly connected to the quality of its performance on the

[17] Contracts classified as net cost contracts include mixed contracts, where the PTA assumes part of the revenue risk (e.g., a 5 or 20 percent share).

passenger market. In view of this fact, new forms of tendering and other means of awarding public transport services are currently being discussed by several European Member States and by the research community, in order to improve the quality of operators' performance and thereby establish a stronger relationship to the passenger satisfaction (see e.g. van de Velde and Beck 2010). To secure a sufficient level of competition, efforts should be undertaken to avoid a high level of risk in these new awarding procedures.

When gross cost contracts have been used in Germany, the tendering agencies have tried to promote high quality by providing operators with alternative incentive schemes. Such mechanisms include bonus payments for good performance (see Figure 6) in order to compensate the missing fare revenue incentives. As the maximum volume of bonus and malus payments in the cases observed is usually limited to five percent of all payments in a gross cost contract, this impact has to be limited.

6. Conclusions

In the last decade, tendering of passenger rail services in Europe has increased. In Germany, Europe's largest market of this type, this instrument has been used more and more since the mid-1990s for subsidized regional and short-distance passenger rail services. To reduce the need for subsidies to a given transport service—permanently, if possible—a high level of competition is necessary. Based on a dataset of 30 German tendering procedures with start of operations between 1997 and 2007, the empirical study analyzed whether market entry barriers can be identified for newcomers.

The investigation shows that on average 11 interested rail companies requested the tendering documents, representing a sufficiently high level of potential bidders. Yet on average only four operators submitted bids per tendering procedure: a reduction of 64 percent. The empirical analysis shows that there are two main tendering conditions that have the potential to increase the overall level of uncertainty for newcomers and are obviously preventing inquirers from submitting a bid. These are: the share of risk of price increases for input factors assumed by the public transport authority, and the revenue risk to be borne by the operator. Both variables show a significant correlation with the variable number of bidders per case.

When the authority assumes a higher share of the risk of price increases for input factors, this leads to a higher number of bidders, especially with respect to infrastructure costs, personnel costs, and energy costs. Here, changes in prices are out of the operator's sphere of influence. On the other hand, obliging the operator to bear a higher (or the full) revenue risk leads to a reduction in the number of bidders per case. The analysis shows that currently comprehensive reports on the demand potential in the tendering documents are rare, and that several important factors influencing revenue potential are out of the operator's sphere of influence.

Summing up, the analysis shows that authorities using competitive tendering processes should be aware of the influence of uncertainty and therefore avoid imposing excessive risks on operators that will reduce their efficiency gains. The negative impacts include a lower level of competition but also a higher risk premium to be calculated by operators under higher levels of inherent uncertainty in tender conditions. These results are also relevant for tendering agencies in other states, since German tendering procedures show similarities to those procedures in other EU countries such as Sweden, Denmark, and the Netherlands, and since the economic pitfalls in the tendering of rail services discussed here may also arise in other parts of the world. Interestingly, the analysis was not able to identify any further entry barriers in the tendering procedures, also not in terms of fixed costs, e.g., resulting from utilization of vehicles after termination of the contract. As the dataset does not include the years 2008 and 2009 during which the financial crisis probably reduced train operators' capabilities to refinance their purchases of

new vehicles, further research on this matter is urgently needed. This applies especially to operators' access to capital (for rolling stock, depots, etc.), which has probably been the key entry barrier in Germany (and other states) in recent years. Another research question might be how the structure of the market, in terms of the market shares of global players and small- and medium-sized operators, influences the level of competition, and how an oligopoly of only a few operators can be avoided.

Acknowledgments

This paper is a product of research conducted at the Christian-Albrechts-Universität Kiel (Institute of Economics), supplemented by research conducted as an external doctoral candidate at KIT - Karlsruhe Institute of Technology (Institute für Economic Policy Research, Department for Network Economics). I would like to thank all discussion partners throughout the research phase, in particular Florian Niebur, Sabine Sontopski, Sven Paasch, Joachim Laeger, Sascha Frohwerk and Johann von Aweyden as well as Stefanie Sittig, Olaf Zeike, Marc-Oliver Wille and Rico Merkert. Special thanks go to the consultancy KCW and Christoph Schaaffkamp and to all the individuals and institutions who provided the relevant data as well as to BSL Management Consultants (Lloyd's Register Group) and civity Management Consultants for supporting my research. Without their advice and support, this paper would not exist.

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