PROBLEMS

Financing Railways in the German States 1840-1860 A Preliminary View

Jan C. Bongaerts*
Wissenschaftszentrum Berlin

INTRODUCTION

The second half of the nineteenth century was the age of the train. All over the world railways were introduced and developed to become the most important mode of transportation of merchandise and passengers. There is no doubt that the railway industry was very successful and profitable in those days. But like every infant industry, railways once were a small and risky business with an unknown future. The railway industry, however, has been able to mobilise capital from its beginning. It also contributed to the development of capital markets, like stock exchanges, thereby lowering the transaction costs of its fund raising.

* This paper was written while the author was still affiliated with Leyden University. It is part of the Leyden Project on Regulation and Public Enterprise. The author owes special thanks to K.M. Boese and R. Fremdling, both of Free University of Berlin, V. Halberstadt and A.S. Van Schaik, both of Leyden University, for discussions and comments on an earlier version of this paper. Thanks are also due to K. Borchardt, University of Munich, who pointed out several errors and provided valuable suggestions. G. Hungerink, Leyden University, is thanked for his computational assistance.

In this paper we shall present some evidence on the capital market of the German States in the middle of the nineteenth century and on railway investment yields and draw the conclusion that investments in railways were risky, but not uncertain. In other words: given the risk involved in this investment, the expected pay-off to the investor was not uncertain. We therefore tend to consider the process of capital mobilisation by the German railway industry as successful, since it was able to finance itself without disappointing those who engaged in it. The second part of this paper will deal with government regulation of the railway industry in the German States. We will present some reasons for this regulation and conclude that it contributed to the development of a capital market through which funds were made available by investors to railway promoters. Besides this regulation governments also started to operate railways at their own risk. We will discuss some evidence with respect to the proceeds of this activity and conclude that they led to new possibilities for government finance.

The paper is arranged as follows. In section 1, we briefly present some facts on the emerging railway industry in the German States. In section 2, we discuss the capital market of these States at the time. Section 3 presents a model in which the returns to capital of railway shares and government bonds are assessed. Section 4 deals with the engagement of government in the railway industry. The last section contains some conclusions and an outlook for further research.

INNOVATIONS AND COMPETITION

The first railway on German territory opened in 1835 between Fürth and Nürnberg. By 1850 there were some 50 companies operating lines betwen the most important cities within the territories of the German States.[1]

During the first ten years after the introduction of railway transportation every company enjoyed a restricted regional monopoly, because its line or lines were not interconnected. But at the same time it was well understood that the railway industry would benefit from the existence of an entire network with passengers and merchandise easily transferring from one company to another. Hence in order to protect themselves as independent firms against one another as well as to solve common problems railway companies decided to instal an industry-wide organisation, known as the German Railway Administrations' Association (hereafter called the Association).

[1] There is an abundant literature on the history of German railways. We refer to, e.g., Ritter (1961), Steitz (1974), and Fremdling (1975).

This Association — among other things — produced excellent annual reports on the performance of its members. Under its auspices a number of innovating decisions were made. We mention the introduction of the through coach, enabling passengers and freight to be carried across companies' territorial "borders" without "disembarking", and the harmonisation of the tariff structure, which simplified inter-company refunding of tickets sold by companies on behalf of each other. In order to realise economies of scale of the haulage of merchandise the Association introduced the through train, carrying (bulk) load from destination to destination without being disconnected. The Association's members also pioneered in the field of telecommunication, becoming the first customers of the telegraph industry.

Meanwhile the railway industry grew at a considerable pace. It could be considered a fast, cheap and fairly safe mode of transportation not inhibited by any capacity restrictions. Notwithstanding the common interest policy of the Association for raising members' productivity by proposing engineering innovations and new managerial techniques, efficiency was also reached through competition. The Association did not operate as a cartel forcing members to accept administered prices. It probably did not have the power to do so, since each railway company member retained its independence with respect to most of its business decision-making. Hence companies could set their own prices within the given common tariff structure.[2] There is evidence of price competition on the East-West lines between the Ruhr area and the Hanover-Berlin area. The very successful private Köln-Minden Eisenbahn competed with the publicly owned Bergisch-Märkische Eisenbahn and in part with the also publicly-owned Westfälische Eisenbahn. Both the private and the two public companies operated parts of the important Berlin-Ruhr area lines. At the time the German network neared its completion, inter-company price competition seemed to have become more severe due to an increase in the number of parallel lines connecting the important cities.

RAILWAY PROMOTERS AND INVESTORS

Innovations and price competition, like magic engines, were claimed as the cause of economic success. Most railway companies made handsome profits irrespective of whether they were publicly or privately owned. Table 1 presents the profits to capital ratios for a large sample of privately owned

[2] In a number of States prices were also subject to the approval of the government, as, e.g., in Prussia whose government started regulating the railway industry by establishing the Railway Act on November 3, 1838. But price regulation was weak since in most cases governments were not entitled to fix prices but only to refuse their increase.

TABLE 1 - PROFITS TO CAPITAL RATIOS OF 27 PRIVATE COMPANIES DURING THE FIRST ELEVEN YEARS OF EXISTENCE

name of company	1	2	3	4	5	6	7	8	9	10	11
Aachen - Maastricht	0.3	0.4	0.2	0.2	0.0	0.5	0.9	0.0	0.0	0.1	0.0
Altona - Kiel	4.0	5.0	6.0	5.0	5.3	4.5	5.3	6.5	5.2	5.3	7.4
Berlin - Anhaltische	4.5	6.0	6.5	6.8	8.0	7.8	4.0	4.0	5.0	6.0	6.4
Berlin - Hamburg	2.5	0.0	4.5	4.5	4.0	5.2	5.4	7.0	5.9	6.4	6.6
Berlin - Potsdam - Magdeburg	1.5	3.0	5.2	5.1	5.4	5.6	5.9	6.5	8.3	6.4	6.7
Berlin - Stettin	5.0	5.5	5.3	6.0	4.0	5.3	6.5	8.4	8.3	9.0	11.1
Breslau - Schweidnitz - Freiberg	4.5	5.3	5.0	4.0	4.0	3.5	4.3	5.8	4.8	5.8	8.0
Bonn - Köln	5.0	7.0	7.5	6.5	5.0	5.0	6.0	5.0	5.0	3.8	6.3
Düsseldorf - Elberfeldt	0.0	2.5	3.0	3.0	4.0	4.5	2.0	4.5	4.5	4.4	2.3
Kf. Friedrich Wilhelms Nordbahn	0.0	0.0	2.1	2.1	2.3	3.2	2.9	2.9	3.2	3.0	na
Hamburg - Bergedorf	0.0	0.0	0.0	0.0	8.0	4.0	4.0	4.0	4.4	4.5	5.8
Köln - Minden	0.0	0.0	3.5	4.5	5.1	4.5	5.6	7.3	7.4	8.3	8.6
Leipzig - Dresden	4.0	4.0	4.0	4.4	5.0	5.0	5.0	5.0	5.5	4.0	6.0
Lübeck - Büchen	2.0	1.9	2.7	2.8	3.8	3.7	3.3	3.8	4.0	3.5	na
Magdeburg - Cöthen - Leipzig	4.0	5.0	7.0	10.0	9.0	10.0	11.5	15.0	10.0	12.5	15.0
Magdeburg - Halberstadt	3.0	3.5	5.3	7.0	7.0	8.0	8.0	8.4	9.2	11.5	12.7
Magdeburg - Wittenberge	0.0	0.0	2.4	2.7	2.4	2.3	2.7	2.8	3.3	3.0	na
Mecklenburgische	1.6	2.1	2.1	2.5	2.6	2.6	3.1	3.6	3.2	3.9	0.0
Neisse - Brieg	0.0	2.1	3.1	3.7	3.5	3.3	2.5	1.9	4.2	5.7	3.8
Niederschlesische Zweigbahn	2.0	0.0	0.0	0.0	0.0	0.0	2.0	1.7	1.6	3.0	2.7
Oberschlesische	4.0	5.4	6.0	6.3	5.6	7.0	8.0	11.2	6.9	8.1	10.8
Pfälzische Ludwigsbahn	1.0	2.1	3.5	4.6	6.8	7.0	8.5	8.2	9.3	9.5	8.6
Rendsburg - Neumünster	4.0	4.0	10.5	10.0	11.3	9.1	4.8	5.2	4.3	5.8	5.4
Rheinische	3.5	3.0	3.5	4.0	0.0	1.0	2.5	7.0	5.1	5.3	5.6
Taunus	6.4	6.0	6.0	6.0	6.0	6.0	6.8	6.0	4.4	4.8	5.0
Thüringische	0.0	0.0	1.5	2.0	3.5	4.8	5.5	5.3	5.3	6.3	6.6
Wilhelmsbahn	0.0	0.0	1.5	2.0	3.5	4.8	4.8	5.3	5.5	6.3	6.6

Sources: German Railway Administrations' Association Annual Yearbooks; Steitz [1974]

members of the Association. Profits were defined as the difference between sales receipts and business expenses. Since not all profits were paid out in the form of dividends or another remuneration to investors, the ratios overstate the annual income from investing in railway stocks or bonds.[3] Nevertheless the information on the profitability of the railway industry they contained would have been valuable to investors comparing buying railway shares with buying bonds of one or several of the many governments in the German States.

It is interesting to note that the early capital needs of railway companies were more or less met. There are reports of "railway promotion clubs", mostly set up by businessmen and engineers, sometimes with the support of local politicians or civil servants, which had to abandon their plans for lack of capital. Yet in other cases these "clubs" eventually raised enough stocks to start exploration and construction works.

Some of these "clubs" were founded by businessmen who had made their fortune in trade and who considered the opening of a railway company as a promising vehicle for expanding their markets.[4] But capital inflow into the railway industry was not limited to the funds of such capitalists for whom railways were an additional business. As early as 1842 at the Berliner Börse (Berlin Stock Exchange), both railway shares and a variety of options in railway shares were traded. These options contained the right to acquire shares in due course and sometimes to postpone payment for them. They facilitated access to the Stock Exchange for small stockholders like craftsmen, lower civil servants and other lower middle class people. Hence the railway industry stimulated innovations in the transfer of capital, lowering transaction costs and increasing capital inflow.

If the profit level of the railway industry surely motivated investors they were probably more encoranged to supply capital to new railway companies by the steadiness or even the steady increase of profits to capital ratios. A substantial number of railway companies, both privately or publicly owned, managed to yield high ratios and to keep or increase them over the years.

Table 2 summarizes these trends in the profitability of the Association's members. Column 1 of this table lists the number of companies arriving at a

[3] Business expenses did not always include interest payments on long term debt. This is explained by the fact that there seems not to have existed a precise definition of capital at the time. Capital usually referred to stockholders' equity and to long term debt owed to investors and sparsely available financial institutions. Notwithstanding the introduction of the Prussian Corporate Act in 1843, inherited from the Napoleonic Code de Commerce, there remained confusion with respect to the meaning of capital. Some companies treated it like long term debt, promising an annual interest payment; others offered to buy back their outstanding shares, in order to write them off.

[4] See, e.g., Steitz [1974] describing the legendary textile wholesaler, railway tycoon, and finally Prussian Secretary of the Treasury D. Hansemann, who founded the Köln-Minden Eisenbahn Gesellschaft.

TABLE 2 - SOME TRENDS IN THE PROFITABILITY OF RAILWAY COMPANIES

	3.5	10	total
public enterprises	13	3	29
private companies	19	10	27

3.5 : number of companies with profits to capital ratio of at least 3.5 percent after five years of business;

10 : number of companies with profits to capital ratio of at least 10 percent after ten years of business;

Sources: see Table 1.

profits to capital ratio of at least 3.5 percent within the first five years of their existence. Column 2 lists the number of companies arriving at a ratio of at least 10 percent within the first ten years of their existence.

The threshold value of 3.5 percent was chosen in this table because government bonds yielded at least an interest rate equal to it. This is seen from Table 3 which contains a sample of yields of government bonds of the important German States.

Until the beginning of the 1840s the capital market was dominated by the trade in these government bonds, together with mortgage banks' debt notes and life insurance annuities. With the introduction of railway shares, however, investors obtained a new opportunity which involved more risk when compared with the traditional investment in the safe and reliable assets just mentioned. Witness an author like Lesser [1844] who wrote:

(A decision either)

— ... to invest, quietly, free from care, one's wealth during many years in mortgage funds or in government debt titles and to earn a modest but secure yield of 4 percent... (or)

— ... to underwrite and make down payments for railway shares, expecting a future profitability of these lines...

(author's translation)

TABLE 3 - REAL INTEREST RATES NOTED IN JANUARY 1850 FOR SOME GOVERNMENT BONDS ISSUED BY SOME MAJOR GERMAN STATES

	3.5 %	4 %	4.5 %	5 %
Grand Duchy of Baden		4.354		4.994
Kingdom of Bavaria		4.255		4.975
Kingdom of Hanover	3.535	3.912		
Grand Duchy of Hesse		4.475		
Kingdom of Prussia		4.278		
Kingdom of Saxony (Dresden)*	3.485		4.672	
Kingdom of Württemberg		4.248	4.737	

* October 1850.

Sources: von Reden [1851], Vols. I,1, I,2, and II,2; Kahn [1884], pp. 209-217.

RAILWAY SHARES OR GOVERNMENT BONDS

As already mentioned in the introduction we distinguish between risk and uncertainty.[5] Uncertainty involves a situation in which only little information is available with respect to the future. Risk, however, involves a situation in which (stochastic) predictions of the future are possible because of available information which can be built into a decision model. Hence forecasting the future amounts to speculation if there is uncertainty whereas it involves a prediction on the basis of a decision model if only risk prevails. Contemporary sources point out that investors in the German States disposed of some information on railways and that this information was actually implemented. Publications on railway technology in Germany dated from as early as 1820 and railway promoters learned of auxiliary techniques such as land survey and the estimation of transport output.[6] Know-how was also available because technologically advanced capital goods could freely be imported.

Most German States did not restrict imports of rails and rolling stock at least for as long as these commodities could not be produced by German firms. The Association's annual reports contain a meticulous overview of all imports of rails and locomotives from countries like Great Britain, the United States and Belgium. Exporting firms sometimes placed technicians at the disposal of the railway companies, as in the case of the opening of the first railway company in 1836. Hence we may conclude that railway promoters disposed of adequate and up-to-date information on railway technology and its application.

Forecasting the demand for railway services turned out to be more difficult. According to Riegels [1889] passenger transportation output was severely underestimated, whereas merchandise haulage did not reach the expected levels. Table 4 illustrates this statement.

Riegels's explanation is as follows: railway promoters used statistics on the population of cities along their lines together with information on travelling habits in order to calculate possible receipts from their projected railway lines. But they did not take into account that with the coming of the railways

[5] This distinction was first made by Knight [1921] in his book *Risk, Uncertainty and Profit*. See, e.g. Whittacker [1940], p. 625 for a summary of Knight's work.

[6] As a matter of fact railway promoters travelled abroad. The famous economist and "father" of the German Railways, Friedrich List, visited the U.S.A. D. Hansemann, already mentioned, sent his collaborator Egedy to Brussels in order to learn about transportation output forecasting. Information on British railway companies was also available, witness the travels of Alfried Krupp (who changed his first name to Alfred out of admiration for British industrialists) to that country in the 1840s.

TABLE 4 - PREDICTED AND ACTUAL LEVELS OF PASSENGER AND MERCHANDISE TRANSPORTATION FOR SOME RAILWAY COMPANIES

	passengers		merchandise		
	predicted	actual	predicted	actual	year
Berlin-Potsdam		583,000			1839
Herzöglich Braunschweigerische	54,700	105,700			1838
Düsseldorf-Elberfeldt	40,000	380,000	1,350,000[a]	200,000[a]	1842
Leipzig-Dresden	44,800	411,500	190,000[b]	84,000[b]	1839
Oberschlesische	80,000	33,000[c]	1,850[d]	380[d]	1842/1843

[a] Hundredweights per day, 1 hundredweight = 47,058 kilogrammes.
[b] Taler per year.
[c] Passengers carried during the first month (June 1843) after the opening of the Breslau-Oppeln section.
[d] Hundredweights per year.
Source: Riegels [1889].

travelling habits changed and more people began travelling than ever before.[7] Merchandise haulage by rail was not as successful as expected because long-run contracts between customers and suppliers of transportation services by traditional modes (barges and horse-powered wagons) were not prematurely dissolved by the former but respected until expiration date. At that date, however, customers substituted rail transportation for traditional modes wherever they could.

But even given this under- and over-estimation of the output of some projected railway lines, there is evidence of the development of accurate estimation techniques leading to better predictions.[8] Hence, since information on technology and on demand forecasting was available promoters had the opportunity of cancelling unrewarding projects before making any decision to attract capital. In this way they secured expected positive returns to capital for projects which were actually started and carried out. For most companies these returns were lower than the yield of a government bond during an initial stage, but higher thereafter. Railway companies therefore had to overcome an «infancy» characterized by growth and low returns to capital.

[7] Riegels was probably not correct in his assessing the quality of output forecasting. The alleged "underestimation" is probably explained by the fact that railway promoters did not try to predict output but the minimal output at which business expenses would be covered.

[8] See, e.g., Steitz [1974] for a report on the meticulous efforts of Egedy in assessing the outputs of three alternative sections of the Köln-Minden Eisenbahn.

From this perspective investment in railways involved a long-run engagement not to be confused with the short-run speculation in railway shares which induced over confidence and then collapse at the time. On April 11, 1844, after a series of speculative waves on the Berlin Stock Exchange, the Secretary of the Treasury von Bodelschwingh decided to regulate all new issues of equity shares and options. As reported by Lesser ([1844], pp. 55-56) this-regulation was aimed at the restoration of the stability of share prices. But even given such short-run turbulence on the stock market and the subsequent government intervention, the long-run investor planned beyond the time span of speculators and even beyond the initial low-return stage. In this way his investment was risky but not uncertain, since almost all actually undertaken railway projects could be expected to yield a positive return.

In the rest of this section we analyse the yields on railway shares over the first eleven years of operation and show that they followed a stable pattern. For this purpose we will make use of an analytical technique known as the estimation of beta coefficients. Beta coefficients were initially defined by Sharpe [1963] and subsequently built into complex capital asset pricing models. Yet for our purpose it suffices to sketch the main concepts briefly. The beta coefficient of a (risky) asset is defined as the parameter estimate of a linear regression of the risky asset's share price on a riskless asset's share price. The riskless asset's share price is usually set equal to an index of an amalgamation of a vast number of shares like, e.g., Standard and Poor's 500. By separating the observations into (non) overlapping subsets and by repeating the estimation for each subset, one can associate as many beta coefficients to any asset as the number of subsets. Obviously the only meaningful way of partitioning consists in the construction of subsets of yields for consecutive years.[9] In this way it is possible to study the pattern of the beta coefficients associated with each asset and predict the steadiness of the return to capital over the entire period for which data are available. This steadiness is referred to as the stability of the beta coefficients.

The estimation of beta coefficients and the determination of their stability involve the choice of the «right» partitioning. Given the fact that such a choice depends partly on arbitrariness and partly on the knowledge of a "reasonable" planning horizon of the investor, it will be clear that it is exactly this choice which receives much attention in the literature.[10] Since we did not dispose of all information available to researchers of beta coefficients of current assets, we "solved" the problem in a pragmatic way by partitioning our data set three times into two subsets. The partitionings are meant to reflect the fact that only

[9] For an introduction to the estimation of beta coefficients, see Clark Francis and Archer [1979], section 4.5, pp. 60-75.

[10] See Alexander and Chervany [1980] quoting Baesel [1980].

after an initial period in which yields of most companies were low, return to capital tended to increase. Lack of data forced us to simplify our approach even more. First of all we were unable to define a compound riskless asset, since the bulk of trade on the stock market at the time was in railway shares.[11] Hence if all railway shares would be amalgamated into a compound «riskless» asset we would only have been able to assess the deviation in terms of risk incurred by an investment in shares of one particular company from the risk incurred by an investment in shares of each of these companies. We would therefore not have been able to compare the yields on a risky asset with the yields on a riskless asset. The problem was solved by taking a government bond, yielding 4.5 percent, as our riskless asset.

Secondly, we only had data on profits per unit of capital. Hence there were no data on share prices and only some on dividends. The lack of data on dividends did not constitute a problem, since many companies treated capital like long-term debt and usually paid an «interest rate» almost equal to the reported profits per unit of capital. Hence profits per unit of capital were a good proxy for dividends. Since share prices were not available we decided to consider an investment set equal to 100 at the time the company entered business. We then computed the accumulated value of the initial investment for each year as follows:

$$V_{it} = 100 \times \prod_{t=1}^{11} (1 + r_{it})$$

with V representing the accumulated value of a railway share i (i=1, ..., 27) and of the bond (i=28) respectively, set initially equal to 100; r denotes return to capital measured by the reported profits to capital ratios for i=1, ..., 27 and set equal to 0.045 for i=28; t represents time: t=1, ..., 11.

TABLE 5 MEANS OF ESTIMATES OF EACH QUINTILE

	quintiles				
	1	2	3	4	5
τ_1: 1,...,5	0.196	0.533	0.825	1.221	1.608
τ_2: 5,...,11	0.299	0.704	1.164	1.407	1.902
τ_1: 1,...,6	0.240	0.611	0.902	1.292	1.631
τ_2: 6,...,11	0.273	0.678	1.118	1.358	1.943
τ_1: 1,...,7	0.295	0.663	0.970	1.333	1.686
τ_2: 7,...,11	0.233	0.625	1.043	1.359	1.938

[11] See, again, Lesser [1844].

We then regressed the V_{it} (i=1, ..., 27) on the accumulated values of the government bond, $V_{28,t}$, for three consecutive times. In the first run the period was partitioned in the subperiods t_1=1, ..., 5 and t_2=5, ..., 11. In the second run the first time span t_1 included six years (t_1=1, ..., 6) and the second time span t_2 also included six years (t_2=6, ..., 11). In the third run t_1 was set equal to t_1=1, ..., 7 and t_2 was set equal to t_2=7, ..., 11. Hence the initial «infant» period of each railway company was set equal to 5, 6 and 7 years respectively. These regressions yielded six sets of 27 mostly significant parameter estimates. These were then placed into quintiles and the mean of the estimates of each quintile was computed. These means are reported in table 5.

The table shows relatively minor changes between the means of the first and the second periods. The difference between the highest and the lowest means for t_2 exceeds the difference between the highest and the lowest means for t_1. Obviously the estimate of a single company for t_2 did not always belong to the same quintile as the estimate of that company for t_1. Table 6 presents a summary of the number of such changes of classification.

TABLE 6 - NUMBER OF ESTIMATES FOR t_2 PLACED IN DIFFERENT QUINTILES OF ESTIMATES FOR t_1

change of quintile	5 years-7 years	6 years-6 years	7 years-5 years
from q_i to q_{i+1}	6	6	6
from q_i to q_{i+2}	.	1	1
from q_i to q_{i+3}	1	.	.
from q_i to q_{i+4}	1	1	1
from q_i to q_{i-1}	9	5	6
from q_i to q_{i-2}	2	3	3
from q_i to q_{i-3}	.	.	.
from q_i to q_{i-4}	.	.	.

Most changes only involved a move into the next higher or the next lower quintile. One company had a bad start and moved up to the fifth quintile in the second estimation period.

Arriving at the end of this section we note that the estimated beta coefficients did change over time, yet only in a minor way. Estimated beta coefficients of single companies did switch quintiles but not dramatically. Hence, even if we have not been able to demonstrate an absolute stability of the beta coefficients we have shown that returns to railway shares, measured as the profits to capital, did not behave erratically but followed a stable pattern. As a result investments in railway shares were risky, since these assets were not risk free, but not uncertain.

Hence we conclude that railway promoters who attracted capital did not disappoint investors. We may even state that they tried to operate as carefully

as possible and released detailed information in order to prevent a negative outcome for suppliers of funds. They also abandoned obviously unprofitable projects before making any decision on raising capital.[12] In this way they were sensitive to the profitability of their industry. But notwithstanding their ability to mobilise capital for profitable purposes, in most German States their activities were carefully monitored by their governments. Actually the intervention of governments in the interest of the railway industry dated from its beginning. For this reason we now briefly comment on the relationship between governments and railway companies.

GOVERNMENTS AND RAILWAYS

The financing of the railways in the German States did not take place without the support of their governments. In fact, even before any railway lines were constructed, governments became involved in their planning as railway promoters expressed the demand to obtain favourable expropriation regulations. Most German States therefore passed the necessary legislation, usually by extending existing legislation covering expropriation in the case of roads and waterways construction. This first legal arrangement then led to the development of a policy of railway regulation.

Prussia led the way by introducing a Railway Act in 1838 establishing a relationship between railway companies and the State. By the Act, the government became entitled to supervise the founding and the financing of new railway companies and their business operations. The Act covered important issues such as expropriation rules, freight rates and passenger ticket prices, common carrier competition,[13] the connection of a new line to an existing line, the obligation to "serve the market" and the question of nationalization. The government also safeguarded its ancient "regalia" (monopoly) by forcing railway companies to carry all mail without charge. Besides this regulation of railway companies governments supported railway promoters by giving them advice through expert civil servants[14] and by

[12] We already mentioned the example of Egedy assessing the returns to capital of three alternative routes, of which only one was finally built. In the case of the Prussian Ost-Bahn, connecting Berlin with the Junker farms in the eastern part of Prussia it was commonly believed that railway promoters abstained from its projection and construction because they were unable to show its profitability. Only after the government took the initiative did construction begin.

[13] I.e. competition on one and the same railway line by several companies.

[14] As in the case of the land surveyor Egedy who directed the field works and the design of the Köln-Mindener Eisenbahngesellschaft. See, again, Steitz [1974].

guaranteeing to shareholders a minimal interest payment for an initial period in case a company would not make any profits.

Obviously the application of this regulation was tedious because it forced railway promoters to engage in long and enduring negotiations with government officials before they were granted a licence to enter the industry. Yet it is possible that such a procedure helped to sort out the profitable projects since railway promoters were persuaded to rethink and rearrange their projects until they were acceptable to all parties. Since some of these negotiations became the subject of parliamentary debates information about projected railway companies was diffused through reports and newspapers. We therefore believe that by regulating private railway companies, governments may intentionally or even *malgré eux* have contributed to the profitability of the industry.

Governments in a number of states not only regulated private railway companies, they also entered the industry themselves by constructing and operating railway lines. There were at least two incentives for governments to engage in the railway industry. First of all, they expected to derive an extra revenue from it. As Rau [1855] stated in his book on public finance governments could consider themselves legitimately entitled to exclude private railway companies because they were involved in the regulation of the necessary expropriation. In his opinion governments therefore enjoyed a "railway regalia" comparable to the post office and the salt regalia and had a right to the revenues thereof. Notwithstanding strong opposition from other scholars like Bergius [1866], who considered government railway profits as hidden and superfluous taxes and who decided that governments should only engage in enterprises inaccessible to individuals, a number of government railway companies had been founded and operated very successfully. The revenue of the Royal Hanoverian Railway Company to the State was budgeted equal to 4.15 percent of the total budget for 1849-1850 and equal to 4.8 percent of the total budget for 1850-1851. Similarly the Electorate of Hesse's budget for 1849 and 1850 listed state railway revenues equal to 0.46 percent and 3.71 percent of the total budget respectively.[15] The profits to capital ratio of the Ducal Brunswick Railway Company exceeded 10 percent for many years, possibly because its lines were a vital part of the Berlin-Ruhr area connection. There are still more examples of very profitable publicly owned railway companies.

Secondly, governments were interested in economic growth. After the industrial revolution in England around the turn of the century a number of German states wanted to stimulate a quick take-off in order not to fall behind. Again Prussia, striving for an internationally acknowledged political maturity, recognized the importance of railways for the development of new industries.

[15] See von Reden [1851] who reported on other states as well.

Yet the financial engagement of the Prussian government remained modest when compared to the private investments in railway shares. Nevertheless, as Ritter [1961] stated, the coexistence of privately and publicly owned railway companies combined the advantages of purely privately or publicly owned railway networks. Whereas private companies concentrated on the construction and operation of the most profitable lines, the government could invest in those lines whose return to capital was expected to be lower, but whose construction could contribute to economic growth. Other states also decided in favour of publicly-owned railway companies because they considered such an investment in infrastructure as vital to economic growth, witness Saxony, Hanover, Brunswick, and the Free City of Hamburg. Hence both the long-run goal of economic growth and the short-run goal of the acquisition of new revenue sources seem to have motivated governments to become involved in the regulation and the ownership of railway companies.

SUMMARY AND CONCLUSIONS

In this paper we have explored some issues relating to the financing of railways in the German States between 1840 and 1860. At that time this industry could have been considered as an «infant» industry with uncertain or even unknown returns to invested capital. We discovered, however, that information on the planning, construction and operation of railway lines was available and that railway promoters, who were often supported as well as monitored by their governments, probably managed to distinguish the profitable from the improfitable projects. Hence when attracting long-run funds to their companies they could expect positive profits to capital ratios. This assumption was assessed by an analysis of railway yields. By estimating the beta coefficients for 27 privately owned railway companies for two consecutive subperiods totalling eleven years and by repeating the estimation three times with different subperiod lengths, we were able to show that the changes of the beta coefficients over time were only minor. In this way we came to the conclusion that investing in railway shares constituted a decision under risk, but not under uncertainty.

It was also suggested that the regulation of privately-owned railway companies contributed to an improvement of the profitability of the industry and that this profitability motivated some governments to become owners of railway companies themselves. In this way they combined their short-run policy of acquiring new sources of revenue with their long-run policy of stimulating economic growth. The results of the latter are well known (see Fremdling [1975]) but the short-run performance of publicly owned railway companies has not yet been explored. We leave this analysis for a forthcoming paper.

REFERENCES

ALEXANDER, G.J., AND N.L. CHERVANY, "On the Estimation and Stability of Beta", *Journal of Financial and Quantitative Analysis*, Vol. 15, No. 1, March 1980, pp. 123-136.

BAESEL, J.B., "On the Assessment of Risk: Some Further Considerations", *Journal of Finance*, Vol. 1, No. 29, December 1974, pp. 1491-1494.

BERGIUS, C.J., *Grundsätze der Finanzwissenschaft mit besonderer Beziehung auf den Preussischen Staat*, Verlag von J. Guttentag, Berlin, 1865.

CLARK FRANCIS, J. AND ARCHER S.H., *Portfolio Analysis*, 2nd edition, Prentice-Hall, Inc., New Jersey, 1979.

Deutsche Eisenbahn-Statistik für das Betriebs-Jahr (1850-1860), Zusammengestellt von der geschäftsführenden Direction des Vereins Deutscher Eisenbahn-Verwaltungen, Stettin, 1851-1854, Berlin, 1854-1860.

FREMDLING, R., "Eisenbahnen und deutsches Wirtschaftswachstum - 1840-1879. Ein Beitrag zur Entwicklungstheorie und zur Theorie der Infrastruktur", Gesellschaft für Westfälische Wirtschaftsgeschichte, Dortmund, 1975.

KAHN, J., *Geschichte des Zinsfusses in Deutschland seit 1815*, J.G. Cottasche Buchhandlung, Stuttgart, 1884.

KNIGHT, F.H., *Risk, Uncertainty and Profit*, Houghton Mifflin Co., New York, 1921.

LESSER, L., *Zur Geschichte der Berliner Börse und des Eisenbahn-actienhandels*, Carl J. Klemann Verlag, Berlin, 1844.

RAU, K.H., *Grundsätze der Finanzwissenschaft*, Dritte vermehrte und verbesserte Ausgabe, C.F. Wintersche Buchhandlung, Leipzig und Heidelberg, 1855.

REDEN, F.W. FRHR. VON, *Allgemeine vergleichende Finanz-Statistik. Vergleichende Darstellung des Haushalts, Abgabewesens und der Schulden Deutschlands und des übrigen Europa*, Vol. 1, 1851, Vol. 2 I, 1853, Vol. 2 II, 1856, Verlag der Hofbuchhandlung von G. Jonghaus, Darmstadt.

RIEGELS, G., *Die Verkehrsgeschichte der deutschen Eisenbahn mit Einschluss der heutigen Verkehrslage*, Elberfeldt, 1889.

RITTER, U.P., *Die Rolle des Staates in den Frühstadien der Industrialisierung*, Duncker & Humblot, Berlin, 1961.

SARTORIUS, A. FRHR. VON WALTERSHAUSEN, *Deutsche Wirtschaftsgeschichte 1815-1914*, Duncker & Humblot, Berlin, 1961.

SARTORIUS, A. FRHR. VON WALTERSHAUSEN, *Deutsche Wirtschaftsgeschichte 1815-1914*, 2. ergänzte Auflage, G. Auflage, G. Fischer Verlag, Jena, 1923.

SHARPE, W.F., "A Simplified Model for Portfolio Analysis", *Management Science*, Vol. 9, January 1963, pp. 277-293.

STEITZ, W., *Die Entstehung der Köln-Mindener Eisenbahn Gesellschaft*, Ein Beitrag zur Frühgeschichte der deutschen Eisenbahnen und des preussischen Aktienwesens, Schriften zur Rheinisch-westfählischen Wirtschaftsgeschichte, Band 27, Köln, 1974.

WHITTACKER, E., History of Economic Ideas, Longmans, Green and Co., New York, London, Toronto, 1940.