Regulatory Reform in Swedish Railways: Policy Review with Emphasis on Track Allocation Issues

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Abstract

This paper summarizes the Swedish organizational railway reform of 1988 and discusses some of its properties. It furthermore presents some features of the recent reports on how future regulatory reform — i.e. on-the-tracks competition — is to be implemented. Finally, one of the core aspects to successfully implement deregulation in railways, also being an essential aspect of railways in general, is discussed; this concerns means of allocating scarce track capacity among competing uses.

1 Introduction

In 1988, the Swedish railway sector was split into two separate entities; Banverket (the National Rail Administration) in charge of infrastructure investment and maintenance, and the 'new' Statens Järnvägar (State Railways, subsequently recognized by its acronym SJ). The latter still basically operates under a monopoly franchise and is state owned. In 1992 the Government appointed a Commissioner to draft proposals for how increased competition within the railway sector is to be facilitated. This followed a policy declaration saying that Swedish railways were to be deregulated by 1995; from this date more than one operator will be allowed to run traffic on state-owned tracks. The Commissioner report, submitted in January 1993, was followed by a policy document issued by Ministry of Transport in September the same year; the documents differ in important respects.

This paper has a three-fold purpose;

(a) To summarize and briefly discuss the railway sector policy of 1988 (section 2),

(b) to summarize and briefly discuss the recent policy documents (section 3) and

(c) to elaborate on one prerequisite for a regulatory change to succeed, i.e. the task of finding a mechanism for allocation of scarce track capacity (section 4).

2 The Transportation Policy of 1988

The Parliamentary decision of 1988 (Prop 1987/88:50) was (inter alia) presented as an attempt to establish a 'road model' also for the railway sector. Some aspects of this policy are summarized in section 2.1 while a non-rigorous discussion of some of its impact is provided in section 2.2.

2.1 Features of the 1988 Railway Policy

Under the new policy, the rail network is separated into a trunk system of main arteries (6200 km) and secondary lines (4800 km). Banverket, a state administration in 1992 employing 6 900 people, and basically separated out from the 'old' SJ at the split, is supported through state appropriations and is instructed to operate in order to maximize social welfare. This inter alia means that investment assessments

are made using Benefit-Cost analysis techniques. SJ (today some 20 000 employees), is, on the other hand, instructed to maximize its operating profits. In this it has succeeded, i.e. its 1988 deficit has been transformed into a (small) 1992 profit.

SJ was originally given a monopoly concession for freight operations over the whole network and monopoly rights for passenger transport on the trunk-lines. On secondary lines, County Transport Administrations - being responsible for provision of a 'satisfactory supply of regional transport', primarily meaning subsidization of regional and local bus traffic - decides whether passenger services should be continued or not; state subsidies will, for a ten year period after the 1988 reform, continue to support deficits of these operations.

On three of 24 passenger services operated at the split, operations were discontinued. For the remaining 21 secondary lines, operation was put out for tender. The process resulted in that a private operator (BK-trains) out-bid SJ on three lines, and have since operated rolling stock (railcars) owned by counties. The bidding procedure furthermore resulted in price cuts amounting to 20-30 percent of previous contract costs, i.e. SJ had to reduce bid prices in order to stay in business on these lines.

If SJ or the respective counties don't want to practice their monopoly rights, Banverket is authorized to grant other interested parties operating rights and to communicate their responsibilities; the latter includes stringent safety requirements administered through the independent Railway Inspectorate. This has resulted in some small-scale operators appearing on lines where SJ has cut down or abandoned services.

In 1992, Banverket furthermore granted LKAB - a mining company extracting iron ore in northern Sweden and accounting for some 23 out of a total of SJs 52 million net tons per year - operating rights on the line Narvik (Norway)-Kiruna-Luleå. This has resulted in a renewed contract between LKAB on the one hand and SJ/NSB (the Norwegian railways) on the other. As a part of the negotiations the mining company seems to have considered the option of running services by themselves. Rather than providing services to, and negotiating with the mining company in the capacity of a monopoly supplier of transport services, SJ/NSB under the new system operates as contractor. It is said that LKABs transport costs as a result came down with considerable amounts per year.

The Government charges train operators according to a two part tariff for using tracks. Variable charges are set in order to be equal to short run social marginal costs; the social component means that emission charges as well as charges corresponding to accident risk costs are recovered except for marginal rail wear costs etc. In addition, a fixed charge is levied per unit of rolling stock in order to raise additional revenue (cf. Hansson and Nilsson [1991] for further detail). It is the similarity between this charging structure and corresponding principles to calculate and charge for road use costs that gave reason to name the new structure a 'road model'.

In contrast to roads, the railway sector does, however, show a financial deficit. During 1992, revenue from charges added up to SEK720 million[1], while expenditure was SEK 6700 million (SEK 800 million reinvestment/track renewal etc., SEK 3700 million new investments and SEK2200 million maintenance). The investment volume - previously being close to nil - reflects a commitment made by the Government at the organizational split to increase spending in order to make up for a multi-year back-log in new construction and make railway infrastructure correspond to the needs of the 21st century. This 'hump' in spending makes a direct correspondence between expenditure and costs a bit tricky. The periodical financial deficit is therefore smaller than indicated by a crude comparison between total spending and revenue.

Except for this direct state deficit, counties subsidize local (commuter train) and regional passenger

transport. There is also a state subsidy to some inter-regional passenger lines, representing a regional--policy commitment. Swedish railways consequently have a long way to go to financial viability.

2.2 Experience

Because of a poor data-base, no exact assessment of the 1988 split is feasible. No records of unit track maintenance costs before and after the split are available. Under-way costs for rolling stock are not published. There are no statistics over track-related train-delays in a before/after setting. Should such statistics be available they must, moreover, take differences with respect to the volume of activities into account; it is reasonable to expect an increase in the number of delays under a period when more (re-)investment activities than ever are on their way. The following should therefore be considered as a preliminary and principal discussion about the re-organization only.

Benefits of the split include the isolation of objectives; previously, the 'old' SJ was instructed both to maximize profits and to take social aspects into account without further specification of the trade-off. The split also means that politicians (ex ante) can earmark tax money while tax payers under the previous regime repeatedly had to sweep up deficits without knowing what they were paying for. The new system can be compatible with how decreasing cost industries should be subsidized, would such subsidies be warranted. This is so since the split provides a basis for levying charges for infrastructure use which closely comply with marginal costs, i.e. to further an efficient use of existing track capacity.

The split has meant that the separate roles of track maintenance activities on the one hand and train operations on the other have been emphasized. Under the old structure there were tendencies that these duties became diffused because of unclear organizational responsibilities. Short- as well as medium-term track access agreements between Banverkets regions and the representatives of SJs' business concepts have, for instance, made it necessary to define which aspects of track access that are important for maintenance and operations respectively. Changes of this type might, however, have occurred also under a unified organizational structure.

A major draw-back of the split is that track maintenance activities are withdrawn from competitive pressure. No direct market repercussions because of malpractice's or ignorant handling of duties is built into the present system; in fact, quality standards to be met are not even specified. If Banverket fails to meet the most urgent needs there is no immediate way to tell that this has happened. This is the traditional problem of public administrations not being subjected to market-based checks and balances (possible remedies are discussed in section 3.2). Because of the reciprocal monopoly position, complaints from SJ on these accounts do not provide conclusive evidence of deteriorating performance; the operator can try to blame operational failures on the track authority in order to escape own responsibility.

The operator and Banverket now and again make different investment priorities. In one sense these problems can be derived from the split per se; this is so since information relevant for making appropriate priorities (costs and revenue of train operations) can be difficult to get access to for infrastructure planning. Divergent priorities can, however, also emanate from that Banverket and the operator have different objectives.

The lack of a coherent financial framework can probably come a long way to explain another debatable aspect of the system, i.e. the emergence of new lobbying groups. In the same way as in the road sector, representatives of regions, industrialists with productive activities in the sector etc. organize assessment groups to vindicate the alleged importance of spending on tracks in their parts of the country, the absolute need to avoid branch-line abandonment, and similar issues. Incentives are strong to request more money to pet projects with minor considerations only given to cost consequences.

To summarize, the Swedish way of running the organization has clearly demonstrated the feasibility of an organizational separation of tracks and operations; from a user perspective, train operations over the last years is very much 'business as usual'. Partly because of a massive investment program, railways' financial dependence of the Treasury has grown. Whether the split has contributed to cost savings in operations or other efficiency improvements remains to be vindicated.

3 Further Regulatory Reform

Except for the ideological thrust on deregulation and competitive policies of the present non-socialist government, the following factors can have affected the decision to open up for an on-the-tracks competition policy by 1995. (a) SJs policy to offer the market a comprehensive set of transportation services rather than to specialize in rail traffic only. This is contrary to the 1988 Act which advised SJ to concentrate on railway operations and withdraw from coach and trucking services. It is the Governments ambition that train transport under own control in the future is to become an alternative for outside freight forwarders and passenger firms.

(b) The observation that there is a pressure from small firms to start operations on abandoned lines etc., further emphasized by the perceived impact of the SJ/LKAB deal. (c) The interest to reap maximum benefits of the huge track investments presently under way by allowing for more extensive use of tracks. (d) The hope to improve productivity in the sector (cf. Odell [1993][2]). The forwarded policy proposal is summarized in section 3.1 and briefly discussed in section 3.2, while the Ministry's September 1993 document is briefly reviewed in 3.3.

3.1 A Policy for Further Regulatory Reform [3]

Government Directives to the 'Committee for competition in the railway sector'[4] did not give scope for discussing pro's and con's of the deregulation. The explicit directive was rather that competitive forces are to be used in order to improve sector efficiency in general terms; the Committee was to propose how this could be done. The policy reform is not accompanied by any privatization initiative.

Restrictions on proposals were that (i) safety must not loose on the deregulation and (ii) that travellers should be assured access to integrated ticketing systems. It should also be noted that the Committee subsequently never considered the option of restructuring the present SJ, i.e. to create independent firms from its component parts.

As for market organization, the Committee proposed that the basic approach should be competition on the market - companies operating parallel services on the same market segment or on different segments - rather than for the market, i.e. tendering for monopoly franchises on lines and/or origin/destination (OD) pairs. The motive goes back to the difficulty to find lines serving only one O/D pair. Operations can be thought of as an 'overlapping services' network. Running more than one type of service/franchise on each line makes it necessary for the franchising authority to trade off between demand for track access from different franchisees. Track allocation would thereby be distanced from the market.

The proposed procedure is, thus, one where various operators are allowed to run parallel operations on a branch line. This makes it necessary to take a stand on how available track capacity is to be allocated.

Railways thus consist of a network of connections or lines between stations and other terminals. Both lines and terminals have differing capacity, i.e. ability to handle a certain number of trains per time unit. This

capacity is a function of number of tracks (single/double tracks), train speed, mix of trains with different speeds etc. Demand for capacity is, moreover, different at different times of day and for different parts of the network. For some sections of the network, and during some hours of the day, demand exceeds available capacity. Moreover, for sections of the network where capacity is sufficient to admit all train operators that ask for access over a period (a day), there can be an interaction problem; requests from one operator are such that those of another cannot be satisfied at the same time. The need to mediate in these situations is the core of the railway industry's capacity allocation problem.

The committee thought of time-table 'slots' as specifying access rights. Any actor is given the right to apply for slots, i.e. this privilege is not confined to train operating firms. This makes it easier for outside agents to establish railway activities - using own or for-hire rolling stock - and to increase the competitive potential.

The ambition is to use an allocation mechanism based on pricing principles, i.e. to allocate slots between interested parties according to willingness-to-pay. To this end, a preliminary allocation process was proposed. Until the establishment of such a method, it was determined that some version of the current administrative approach has to be applied. In this, operations are classified into a number of priority classes to be applied in conflicting situations; high-speed passenger trains and priority freight trains (priority 1); freight trains on tight time-table and interregional low-frequency passenger trains on off-peak hours (prio. 2); other trains according to passenger- and freight kilometrage (prio. 3); track maintenance (prio. 4).

Extensive interest was given to the issue of how 'common functions' are to be organized. These include stations, freight terminals and marshalling yards, traffic control, depots and workshops, the ticketing systems etc. The principal conclusion of the Commissioner was that from a competitive point of view it is advantageous if these functions are provided by an outside party selling services to train operators. This was, however, seen to come with the risk of devising something new without knowing whether it would work or not. The actual proposal was, therefore, that the 'common functions' for the time being are to remain with SJ and to be made available to other operators.

So will for instance traffic control be administered by a separate SJ entity. SJ will charge for use of these services. All that is said about this charging structure is that it must be 'neutral'. This is defined to mean that the same charges must be levied on SJs own trains using the facilities, as when competitors have to pay. Workshop and depot services controlled by SJ are to be sold on a 'commercial basis'.

One exception to this principle is that responsibility for track capacity allocation - the scheduling process - is to be handled by Banverket. It was deemed impossible to make other operators confident that SJ could handle this task impartially.

Another proposal is that a separate firm for rolling stock rental is to be organized. This will in the first place include SJs redundant tractive power and cars. The firm will, however, also purchase new vehicles and to this end some financial support from the Government is proposed, albeit formulated in vague terms. The motive for forwarding the idea of a rental firm is the conceived need to lower barriers to entry and exit, i.e. to delimit risk-taking of new operators.

The proposal furthermore promotes the idea of setting up a regulatory unit, 'The National Rail Commission'. Its tasks include (i) to care for consumer interests in the sector, (ii) to promote competition and curb abuse of monopoly positions and other anti-competitive activities and (iii) to settle on appeals concerning terms for access to 'common functions' as well as track allocation decisions.

3.2 Discussion

One of the main limitations of the Committee proposals, and one which basically emanates from the Government's formulation of Committee Directives, is the absence of explicit beliefs about problems with the 'traditional' and present industrial organization of the sector and about how efficiency is to be improved under the new organizational set-up. This should be a natural point of departure for the treatment of possible problems with the process. Issues which could have been addressed include the following:

- Are there pronounced scale economies in infrastructure provision that require subsidies in order to ascertain efficient use of existing resources? A possible hypothesis worth exploring here is the following; with some exceptions (in Sweden primarily the LKAB iron ore traffic) traffic volumes are too low to make railway operations financially viable. If this could be proved to be correct, subsidization of the sector can be given an efficiency motive[5]

- Are there economies in train operations? Keeler (1983) summarize research indicating that scope as well as density economies can be present in the production in the railway industry as a whole; Caves et. al. (1985) confirm the density economies. For the present context, there are important problems with these results: First, the results do not distinguish between infrastructure and operations. Secondly, the structure of US as compared to European/Swedish railways is quite different (the huge volumes of long distance freight in the US has only one correspondence in Sweden, namely the LKAB iron ore trains). Thirdly, production principles are under constant change. This inter alia includes a shift from a common pool of locomotives which historically have been used for several purposes, over to specially designed tractive power. An important origin of scope economies is therefore getting less important.

- Given that railways should be subsidized, is the Swedish approach the appropriate way of doing it? Are there, for instance, reasons rather to consider direct support of final products, i.e. relate subsidies to how many trains etc. that are operated?

- Which beliefs prevail with respect to the contestability of the market, i.e. the importance of barriers-to-entry/exit? Will contestability be affected by that more than one operator runs trains, although this is done on different market segments? With a different formulation, what will the disciplinary impact on market behavior with respect to pricing and output quality be if more than one operator has climbed over the industry's' threshold?

- Which are the beliefs with respect to possible losses of vertical integration benefits? Sweden is, after all, one of the single examples of this industrial structure. Considering also that it has sprung not from market initiative but from government intervention, it is hardly possible to justify the split by referring to the efficiency principle.[6]

Another obvious limitation of the proposal is the non-existence of any discussion about how to deal with the remaining monopolist in the system, i.e. with Banverket. Means to introduce better checks and balances of the track authority without returning to a re-united sector should be considered.

This could include (a) separating present Banverket duties between ordering and implementation of activities and (b) merging track allocation and traffic control functions with Banverket. This 'new' Track Authority could - on the one hand - sign performance contracts with different train operators, specifying in detail what these expect and pay for (the track fees) with respect to travel/transport time, schedule reliability etc. The Authority would also control (most) activities that may affect the successful implementation

of this contract; track maintenance as well as operational traffic control and the medium term scheduling process would be under unified management. By applying incentive charges also in the operational stage, externality costs between operators because of late trains etc. could furthermore be internalized.

By separating maintenance and investment activities from the need to define what is to be done, a potential for improved cost-efficiency might also be realized. This is a forteriori so if a tendering process can be applied, where different producers bid for maintenance contracts over stretches of, or a whole branch-line; a corresponding organizational approach is presently under way in the Swedish National Road Administration.

As is obvious from the presentation of section 3.1, there will also be problems with controlling neutrality of access to the 'common resources'. The Regulator is given a difficult task to decide on which prices that are to be considered as compatible with competitive standards and which are not. Considering the substantial possibility to re-direct profits within an organization using internal-pricing principles, the proposed benchmark does not seem to be particularly reliable.

3.3 The September 1993 Document [7]

In September 1993, the Ministry of Transport published a policy document stating its views on how to handle the pending deregulation (cf. Ds 1993:63). Nothing has changed with respect to that competition on, rather than for tracks is envisaged as the basic industry structure. SJ is also recommended to be operated virtually intact for the future. The question is therefore how to promote entry and a sufficiently competitive market, given this basic structure.

On at least four important issues, the Ministry has changed its opinion as compared to the January document's proposals. First, both scheduling and operational dispatching of trains is to remain in the hands of the incumbent operator. Secondly, track capacity is to be allocated through negotiations and on the basis of administrative rules-of-thumb and with the Government as the last resort for solving conflicts; nothing is said about promoting the development of a pricing mechanism to handle this task. Third, the Regulator - which was given a comparatively strong position in the January document - is now downgraded to handle conflicts on a case-by-case basis, using even looser principles than previously discussed. Fourth, no means to lower barriers of entry are conceived of.

There is no scope to analyze these proposals in detail in this paper. It should, never the less, be obvious that the incumbent operator will have a very strong position in the sector also in the future. Rather than providing for competition on equal terms, it will be competition on SJs terms.

4 Track Capacity Allocation [8]

The issue of efficient use of existing track capacity is vital to a deregulated industry. Not only must partially competing operators agree upon the schedules that are doled out, but these must also be of a sufficiently 'good' standard; those services which have a greater net social benefit of track use, should be given priority in the allocation process.

This is, however, not only an issue for a deregulated industry. As demonstrated by Harker and Hong (1992) for instance, a monopoly operator running more than one service - i.e. supplying several markets - has exactly the same need to establish appropriate trade-offs between partially incompatible demands.

The current way to make use of available capacity can, in fact, because of imperfect allocation procedures, be of sub-standard quality; track capacity might not be allocated to its most valuable uses since its services

are improperly priced both in a temporal and a geographical sense. Inappropriate track allocation can per se provide a serious impediment to further development of service quality in the sector and can be one out of several reasons for the industry's' problem to survive in a highly competitive transport sector under constant transition.

In the following, matters related to capacity allocation will be further minuted. To this end, an introductory section presents some important concepts to bear in mind (4.1) and a pricing approach to handle track allocation is introduced (4.2).[9]

4.1 Background Features

Planning within the railway sector is directed towards three categories of issues:

- Strategic planning relates to investment decisions. Construction of tracks and terminals as well as acquisition of rolling stock and hiring/training of personnel are matters of this nature.

- Tactical planning is concerned with the use of available resources. This can be thought of as fixing which time-tables and which rostering schemes for use of equipment and staff that will be operated during the coming period/year.

- Operational planning settles priorities to be applied when unforeseen disturbances, i.e. deviations from schedules, occur.

Emphasis here is on the tactical level. As will become evident, there are, however, strong interactions between these different classes of decisions.

Tactical planning in Sweden, like in any sparsely populated country, is based on the fact that most (89 percent of total kilometrage) railroad lines consist of single tracks, meaning that no more than one train can use track between two stations if they travel in opposite directions. Low friction together with heavy loads furthermore restricts how close two trains going in the same direction can be. Signalling systems are used to partition tracks into segments - blocks - and to prohibit two trains from being on the same block simultaneously. This network of blocks can be thought of as a set of bottlenecks, the use of which must be planned in beforehand.

The practice of tactical railway planning contains elements of conservatism. As traffic becomes more dense and the planning more complicated, planners refrain from major reorganization of routines and rather try to improve by minuscule changes of existing schedules. Tactical planning therefore contains a blend of experience, rules of thumb and 'animal spirits' of the planning staff.

The appearance of new track users will put focus on the conflict of interest involved in the track allocation decision; the more allotted track access differs from an ideal time-table, the less profitable can operations be expected to be. The basic assumption in the subsequent discussion is that operators can specify their demand for track access for each single departure. In this, not only the profit maximizing allocation and its value, but also how this value is affected by allocations deviations from the preferred one, is depicted.

A clear possibility is that the (monopoly) operator today would have problems in defining the productive structure in this way. The assumption is, never the less, that it is feasible make this calculation and that it is reasonable to believe that operators in the future will take up this behavior. It could even be hypothesized that this is vital for further development in the industry; revenue and cost data directly related to single services may provide the producer with better information and could - in the long run

- improve railway's competitiveness.

Analytically, the task to allocate track capacity between users includes two different considerations. Firstly, examined allocations must be feasible; this relates to the immense combinatorial complexity of railway operation planning.

Tables specify how trains move in time and room. The basic problem is to schedule meets and/or take-overs using the (normally numerous) sidings that are available as well as blocks between sidings. In this, contingencies with respect to speeds permitted by track layout (which differ between trains of different weight), the train's speeds, which sections of the line that are equipped with double-tracking etc. have to be considered. In addition, the network dimension implies complementarities that have to be carefully nursed; passenger trains need to meet at certain places at certain times for exchange of passengers; freight-trains must meet at marshalling yards in order to be switched and to create new trains or for delivery of cars to their destination etc. This complementarity makes it impossible to schedule one (geographical) section of the network without considering also interdependencies with others. Feasibility issues are not further dealt with in this paper; cf. however Nilsson (1993).

Secondly, the process in which schedules are derived must be incentive compatible. Irrespective of whether involved parties are departments of one firm or atomistic operators, there is reason to believe that subjects may bias the description of what access they need and - in particular - the value of getting this access. If this is not taken into account, schedules which are perfectly feasible might be of bad quality since some or all operators have provided biased input into the process.

This incentive compatibility problem is a mechanism design type of problem. The general purpose of this theory is, according to Myerson [1987], to specify 'how economic decisions are determined as a function of the information that is known by the individuals in the economy'. The basic insight of mechanism theory is that incentive constraints should be considered co-equally with resource constraints in the formulation of the economic problem. In situations where individual's private information is difficult to monitor, the need to give people an incentive to share information may impose constraints on economic systems just as much as the limited availability of any physical input.

Implicit in the discussion is that complete information about operator's values of track access provides the appropriate input to handle efficiency matters. This is not so if there are important externalities related to the production or if competitors (trucks) are inappropriately priced (cf. Nilsson [1992] on the latter) or if operators fall back on monopoly rents in their bidding (cf. Borenstein [1988]).

Information about how operators benefit from a certain track allocation has implications also outside the (tactical) time-tabling problem. In strategic decisions, the revenue foregone because of current bottle-necks should affect assessments about investment priorities. With respect to operational concerns, figures related to (foregone) benefits of track access derived from the scheduling process could be used to device a charging system for violations of time-table allocations; this may help in handling the moral hazard problem related to train dispatching. An operator waiting for the last two cars of a planned freight train would, for instance, have to consider the costs of postponing its (scheduled) departure, provided that late departure is punished with a charge based on the costs of delaying other traffic.

The procedures subsequently discussed presuppose a specific institutional structure. A co-ordinator is assumed responsible for the allocation of track capacity. This function receives demand specifications from different firms/departments of one firm. This means that the task to optimize use of available rolling stock and personnel is organizationally separated from the track allocation problem. An important implication is that any way to deal with these matters presume a structure such that the co-ordinator can be assumed

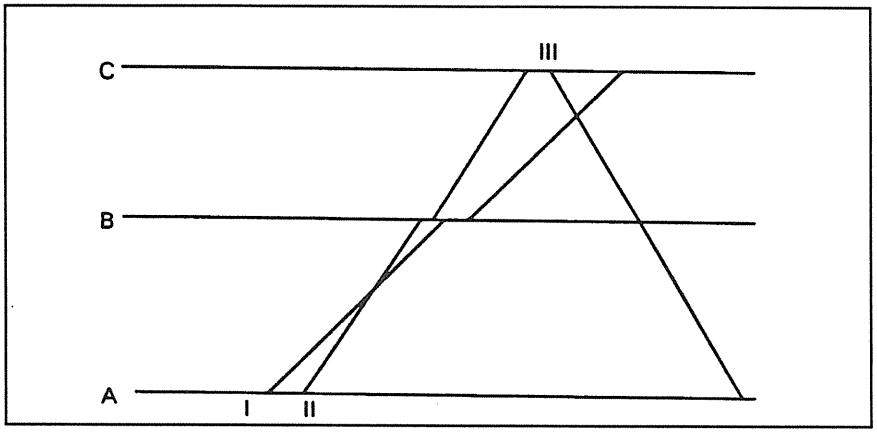
credible to handle wishes from competing agents. Agents/track users possibly include also the need to get access to tracks for maintenance purposes.

4.2 An Auction Mechanism

As an introduction to a presentation of a possible allocation mechanism, a short digression on the use of string diagrams is necessary. A string diagram depicts consecutive stations by vertical lines with horizontal movements along the line denoting time; the speed of a train between two stations is implicitly defined by the tilt of the string. Strings crossing outside stations indicate prohibitive conflicts.

The single-line situation is illustrated in Figure 1 where trains I and II leave station A, make stops at B, and finally arrive at station C. Train II is faster than train I, and will catch up the slower train between stations A and B; this is the catching-up or overtaking problem (on heavily used double tracks only overtaking constitutes a capacity problem). Train III goes from station C to A without stopping at B. It will encounter train I between stations C and B; this is the meeting problem.

Figure 1: String Diagram with Three Operators and Two Types of Conflicts



A sealed-bid auction process devised to allocate track capacity can be conceived of as including a sequence of separate steps; for short, this will subsequently be referred to as the second-price approach.

1. Operators that want to participate in the allocation process are requested to report their interest to do so to a schedule coordinator; this includes statements of the type(s) of service they intend to operate on which lines.

2. Operators submit their ideal schedules (X_i; this includes preferred departure and arrival time and possible intermediate stops) and the value of this schedule ($B_i(X_i)$) to the coordinator.

3. The Coordinator feeds an optimization program based on an approach to establish feasible schedules (not discussed here) with this information. This is done to maximize $\sum B_i(X_i)$ i.e., to assure maximum benefit from the use of available infrastructure.[10]

4. The Coordinator reports back to the operators the time-table slots they have been allocated (x_i; lower-case x is here used to distinguish final from ideal (capital X) allocations) and the price that has to be paid for this allocation. The price is related to the benefits foregone by competitors because of operator i getting his allotment (i.e., $p_i=f(B_{-i},(x_{-i}-X_{-i}))$.

5. The use of a secondary market is conceived of as a feasible option; this allows for continuous bi- or multilaterally negotiated changes of established time-tables and facilitates the need to make changes of, or additions to, a fixed table on short notice, being a particular concern for freight operations.

The initial reporting of interest in Step 1 of the process is included to circumscribe operators' uncertainty about their competitive environment. This makes it easier for each agent to assess the $B_i(X_i)$ function in step 2.

The idea of pricing track access according to 'externalities' of operator i's demand on other services has at least two motives. First, the information generated in this way might be used to handle strategic and operational problems. Secondly, this price may have interesting incentive aspects.

To further assess this incentive compatibility issue, the precise nature of p_i must be specified. To do this, let

$$B* = \sum_{i=1}^{n} B_i(x_i)$$

be the value of the preferred schedule,

$$B*_{-i} = \sum_{i=1}^{n} B_i(x_i) - B_i(x_i)$$

the value of this schedule to all operators except the i:th, while

$$B'_{-i} = \sum_{j \neq i} B_j(x_j)$$

is the value of an allocation when operator i is not in business. Since B'_{-i} includes one operator less than B^*_{-i} - i.e., it gives the optimum value for a less congested situation - we have that $B'_{-i} \geq B^*_{-i}$. The price to be paid can now be defined in the following way.

$$p_i = B'_{-i} - B^*_{-i} \quad \forall i$$

To compute this set of n prices, n+1 expressions must be optimized, i.e., one optimization where each participant of the game has been excluded plus the all-inclusive optimization. Furthermore, the n derivative values B^*_{-i} have to be calculated.

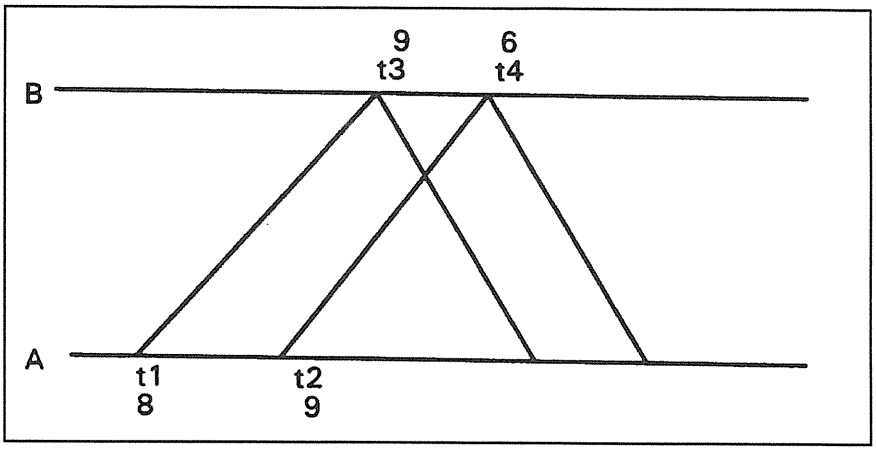
The significance of this pricing scheme can be illustrated by examples. Figure 2 describes a situation with two operators each having the discrete choice between two alternative departures. One wants to depart from station A at time t_2 but has the alternative to leave at t_1; the value of t_2 exceeds that of t_1 (9 and 8 respectively). If this operator departs at t_2, a second operator cannot depart from B at the preferred time t_3 but has to wait until t_4; values are 9 and 6 respectively. Which is the optimal allocation, and which prices does this allocation imply?

The following departure combinations with associated values are feasible: $t_1+t_3=17$, $t_1+t_4=14$, and $t_2+t_4=15$. The value-maximizing choice (t_1+t_3) means that operator B gets his preferred alternative, while A has to operate his second-best choice. Under the present mechanism, this means that B has to pay the benefits foregone by A, i.e., (9-8=) 1.

Figure 3 takes this one step further, i.e., there is a confrontation of demand from three operators each having a choice between two alternatives; t_{11} denotes an option of operator 1 and t_{12} another alternative, etc. Table 1 lists all combinations of allocations.

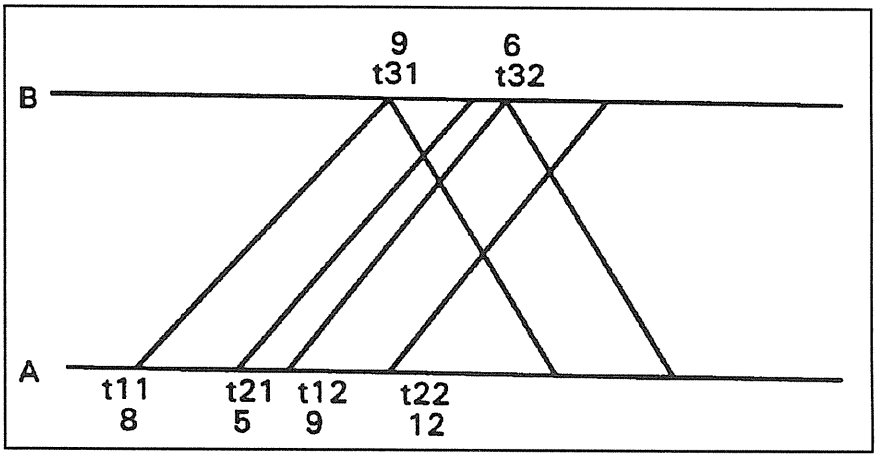
The value-maximizing solution here is to give operators 1 and 2 their preferred choices (t_{12} and t_{22} respectively), while operator 3 is excluded altogether; the total value of this allocation is 21. From the initial example, it is known that the maximum value of an allocation if operator 2 is absent is 17, while the value of the present allocation to operators 1 and 3 is 9+0; operator 2, therefore, will have to pay (17-9=) 8 to get his allocation.

Figure 2: String Diagram with Two Operators Each Having Two Options with Associated Values.



Should operator 1 be dropped, some inspection of Figure 3 indicates that the value-maximizing solution is to give priority to operator 2's first choice (t_{22}) and give no space to operator 3; this has a total value of 12 ($=B'_{-i}$). The total value of the preferred solution to operators 2 and 3 is also 12 ($=B^*_{1,2}$), i.e., $p_1=0$. The reason for operator 2 having to pay nothing is that he does not impact on the decision to let operator 1 get a first go and therefore to delete operator 3.

Figure 3: String Diagram with Three Operators Each Having Two Options with Associated Values



To prove the incentive properties of this mechanism, three approaches could be pursued. First, standard mechanism design analysis can be used. The proposed institution has qualities in common with a second--price auction. In this, the stated willingness-to-pay (WTP) decides the priority of bids, while the price to be paid is given by the bid of the second in line; in a sense, this is a measure of the impact of one agent on the ranking of competitors. If this correspondence holds, it would mean that the best for any operator is to reveal his actual preferences, that is, the procedure is incentive compatible (cf. for instance Fudenberg and Tirole 1991 on incentive compatibility of second price auctions and on the use of these techniques under games of incomplete information).

The present problem, however, does not seek to allocate one (or a set of) clearly defined capacity unit(s) among alternative users. Rather, each agent can be forced from his own first choice since other's demand is given priority. Being forced off the premium choice does not necessarily mean that the agent is dropped; in many instances, he will most probably be allocated a somewhat less good slot. No simple definition of capacity units is therefore relevant to use for the present problem.

In this context, it should acknowledged that the use of discriminative auctioning - i.e. different prices for (almost) equal units - provides an incentive for strategic underbidding of full willingness-to-pay; each bidder attempts to avoid having to pay more than the minimum necessary amount (cf. McCabe et al [1989]). It is probably this incentive that is illustrated in the second example. If operator 3 knew beforehand that he would end up paying, 8 he would prefer his second-best choice; the value-loss of going from first to second priority is less than the price that in this case will be paid. This price is, nevertheless, smaller than the total benefit of his preferred allocation.

Table 1

Values of Feasible Demand Combinations of Figure 3		
Combination	Values	Total
$t_{11}+t_{21}+t_{32}$	8+5+6	19
$t_{12}+t_{21}+t_{32}$	9+5+6	20
$t_{22}+t_{11}$	12+8	20
$t_{22}+t_{12}$	12+9	21
$t_{31}+t_{11}$	9+8	17
$t_{32}+t_{11}+t_{21}$	6+8+5	19

A second approach to deal with incentive compatibility aspects is that the mere attempt to misrepresent WTP falls on the computational difficulties of finding an 'optimal' deviation from true WTP. While allocations and payments of the present examples may be fairly easy to manipulate for whoever that would like to try to cheat the system, the combinatorial complexity of railway capacity allocation has repeatedly been emphasized. Since it is difficult for an agent to guess the details of other operator's demand - and details may be important here - it is also difficult to identify a foolproof way to misrepresent. The best strategy may simply be to tell the truth. This line of argument is used to legitimize the incentive properties of the mechanism to allocate landing slots by Rassenti et al [1982].

A third approach, also used by Rassenti et al [1982] as well as Grether et al [1989] is to test the properties of the proposed mechanism applying experimental techniques. The idea is, thus, to demonstrate whether realized allocations using the specific auction design coincides with the 'ideal', where the latter is controlled by the experimenter. This approach will be followed in a main study.

5 Summary

The Swedish separation of infrastructure from train operations of 1988 has clearly demonstrated its operational feasibility. As for economic viability, it is fully dependent on the political process; although the 'deficit' of today might be possible to force down by reduced investment volumes and possibly improved cost-efficiency in track maintenance, it could still be that only parts of today's network would be operated, should full cost recovery be required.

As for further regulatory reform, political intentions (of the present Government) are clear. The economic basis for actually expecting major benefits of a deregulated track traffic is less unambiguous. Barriers to entry and exit, possible scale economies in operations and problems with common access to terminals, yards etc. in conjunction with possible cost recovery requirements of these complementary activities, are examples of obstacles to smoothly functioning on-the-tracks competition. On the possible benefit side - not discussed here - are the possible consequences for supply quality, improved frequencies, the impact on technological development of that different productive techniques now can be tested etc. The recent policy document however makes it difficult to foresee any major gains of the forthcoming deregulation.

Of overriding importance for both the Treasury and for product quality with respect to delay frequency

etc. is an improved control of the performance of the Track Authority. An organizational option, the prime motive of which is to enforce accountability by more clear responsibilities with respect to which 'products' that are produced by the network, has been discussed.

Over the years, railways have used rules-of-thumb to allocate track capacity between different uses. This has been due to that analytical techniques to solve the complex combinatorial problems related to capacity allocation not have been available. Development of computer techniques over the last few years has probably come a long way to facilitate that this problem now can be handled under a more comprehensive analytical framework.

The paper has discussed two key features of this track allocation problem, i.e. the feasibility and the incentive compatibility issues. One basic theoretical insight when it comes to choice of organizational structure - i.e. choice between private and public, between more or less (horizontally and/or vertically) integrated firms etc. - is related to the importance of contracting. When it is costly to list all specific rights over assets in a contract it may be relevant to let one party to the contract control all residual rights, i.e. the other party [Grossman and Hart 1986]. Put differently, ownership structure does not matter if complete contracts can be written [Laffont and Tirole 1993].

In the railway sector it has been impossible to regulate the relation between a separate infrastructure and operations management using contracts; contingencies in the use of facilities have simply been too complex. This provides one reason the industry around the world can be observed to be vertically integrated. It remains to be demonstrated whether a (possibly) optimal allocation mechanism of the sort now discussed facilitates competition on terms which creates a value-enhancing organizational structure. In other words, would smooth techniques for capacity allocation make organizational shake-ups of the sort discussed here interesting for nothing but financial considerations?

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End Notes

1. The exchange rate in October 1993 takes about 8,00 floating SEK for one US$ and SEK 12.00 for one GB£.

2. Odell is the sitting Minister of Transport and Communication.

3. Published as SOU 1993:13.

4. The author was an expert member of the Committee.

5. This does not include other possible reasons to subsidize train operations such as inappropriate charging of competing modes; cf. Nilsson (1992) on this.

6. If people are able to bargain together effectively and can effectively implement and enforce their decisions, then the outcomes of economic activity will tend to be efficient; this is the efficiency principle as defined by Milgrom and Roberts (1992).

7. This section is an addendum to the original paper.

8. This section summarizes the June 1993 status of a joint project with my late friend Bo Nordin; cf. Nilsson 1993 for details.

9. A process with qualities similar to the present has been proposed by Starkie [1993]. Except for several practical differences, that proposal is not based on an explicit account of incentive compatibility aspects as these are defined in section 4.1.

10. Since trains pay a (marginal cost) fee, inter alia in order to make up for the wear and tear of additional tons on tracks, no resource use except for the congestion 'costs' has to be considered.