

Pricing and Financing of the Railway in a Competitive Environment

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1 Introduction

An interesting fact to consider is that in all European and most non-European countries, there are subsidies directed at rail passenger services irrespective of organisational form. This fact may lead to the question whether this has a rationale from welfare point of view.

One part of this paper is general in character, discussing the possible arguments for rail subsidies. The other part uses Sweden as a case study for simulations of the possible effects of one type of subsidy scheme, without and with supposed response from coach and airline operators.

During the last five years a number of new policy measures affected the Swedish rail industry. In 1989 the Swedish national state-owned railway, SJ, was separated into a national state-owned, socially oriented, rail track authority (Banverket, BV) and a state-owned, commercially oriented operator, also called SJ. The Swedish air industry was fully deregulated on January 1st 1992. On 1st of January 1993 the Swedish coach industry was partially deregulated and from 1999 it was fully deregulated. These policy changes led to increased competition between long-distance public transport modes. However, the Swedish Railways, SJ, still has a monopoly for long-distance passenger transport. The consequence of the Swedish partial deregulation of the coach industry has been a small increase in coach service supply which mainly has favoured the less affluent travellers, without affecting the railway significantly, neither the operator, SJ, nor the passengers.

Section 2 includes a brief principal discussion of possible market failure arguments for political intervention in terms of railway subsidies. Section 3 analyses the consequences for price and frequency of one possible subsidy scheme. Section 4 includes the nation wide simulation analyses of price reductions assuming no response and response respectively from air and the assumed coach operations after deregulation in the year 1999. Conclusions are presented in section 5.

The analysis and results presented here lean on unpublished research by the author in 1998 plus the first results of a new project financed by the Swedish Rail track Authority, BV, which commenced in May 1999 and which is due to be finished in mid 2001.

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The simulation work has been done in co-operation with Mats Hansson, SL Konsult, a subsidiary to the Stockholm Public Transport Authority, SL.

2 Theoretical discussion

Most economic activities in market economies have relatively few regulations, apart from health control, anti-trust laws etc. With respect to rail passenger services we believe there may be three main rationales for political interventions, the second-best motive, economies of density in production and economies of density in production.

2.1 The second-best argument

There seems to be a wide consent among transport planners and economists (see e.g., The EC Green paper "Towards Fair and Efficient Pricing in the Transport Sector") that heavy road vehicles, including coaches, and aircrafts pay less than the social marginal cost which depends on air contamination and climate gases.

In such cases the common argument for public intervention, and probably the most commonly understood argument among politicians, is the "second-best argument". The first-best solution, to price coach/air according to marginal social cost may not be politically accepted. In this case efficient pricing stipulates that the price of rail services should also be below marginal social cost, where the magnitude of the price marginal cost differential is dependent on market shares, rail own price elasticity and cross-price elasticities. (See for example Glaister (1974) and Jansson (1991) for more details).

2.2 Economies of density in consumption

Mohring (1974) observed economies of density in consumption of public transport, which gives rise to a positive external effect. Each additional passenger will benefit the already existing passengers through a higher optimal service frequency or a denser network.

The consequence is that the optimal price equals the average operating cost minus the passenger benefit in terms of less frequency delay due to a one unit increase in frequency. This is thus an argument for public intervention through part government financing.

The optimal deficit may be estimated according to the following type of calculation according to Jansson (1991). Empirical studies show that the value of frequency delay, expressed in half the headway, is around SEK 40/h for private journeys. Assuming an average trip length of 400 km and headway of 1 hour this means that the deduction to arrive at social marginal cost is SEK 0.05/pass.km. ($= 40/(2 \times 1)/400$). If the headway were 2 hours the deduction would be SEK 0.10/pass.km. These

values constitute between 8% and 16% of the average variable cost of 2nd class operation. Interestingly the fare structure employed by the Swedish rail operator SJ for various rail passengers segments means that the prices are more or less proportionate to each respective segments value of time. For this reason this magnitude of optimal deficit is approximately valid for all passenger groups, as long as no budget constraint is taken into account, that is as long as no price discrimination based on elasticities is considered.

2.3 Economies of density in production

Where a passenger transport operator enjoys an increase in demand there are three ways to react. One is not to increase the supply, but let the passengers perceive a higher degree of in-vehicle crowding. The other two ways mean to expand the capacity, by increasing either the number of departures or the size of the unit. For coaches the latter possibility is not very large, since road regulations set the limit of the vehicle. For air- and rail industries a size increase is possible.

For both rail- and airline operations we have used available, but unfortunately vague, information on the cost structure of various aircrafts, trains and train carriages (during the course of the project we will try to obtain more information and all contributions are welcome). The outcome is the following.

Assuming a 50% average load on the Swedish high speed trains X2000, the average variable cost per departure is calculated to be around SEK 0.80/km. For ordinary Intercity trains, assuming a 25% average load, the average variable cost per departure is calculated to be around SEK 0.60/km. These costs thus refer to the marginal cost per passenger if the frequency is changed.

The corresponding marginal cost per passenger of one more carriage is calculated to be around 0.50 for X2000 and 0.30 for InterCity trains.

For airline operation corresponding calculations demonstrate a similar relationship between average variable cost and social marginal cost. The difference between air and rail services is, however, that airlines already apply tourist class prices that are close to social marginal cost. The reason is that the cost per passenger kilometre of airline operation is higher than the cost of rail operation. The consequence is that the percentage of full fare (business or 1st class) passengers compared to "ordinary" travellers is much higher for airlines than for rail operators. Where both operators have a budget constraint, it is thus much easier for the airline to apply price discrimination in order to meet the budget constraint and fill the aircraft than it is for the rail operator to meet the constraint and fill the train.

With respect to coaches the marginal cost is very close to average cost since there is little scope too increase the size of the vehicle.

3 One way to subsidise the railway

3.1 Assumptions

Irrespective of how the marginal cost is calculated we may conclude from section 2 that the marginal social cost is well below the average variable cost for the Swedish railways, mainly due to economies of density in production and less so due to economies of density in consumption. In this section we will employ a simple model in order to analyse whether one form of subsidy, a grant related to the price charged, is welfare improving

The cost is expressed as follows

$$(1) C = C(X, F) - FC_F$$

where X is demand per hour, F is frequency and C_F is cost per departure.

Revenue, R, is:

$$(2) R = PX(G)$$

where X is a function of the generalised cost.

Generalised cost is:

$$(3) G = P + T + T_v \equiv P + T + \frac{\theta}{2F}$$

where P is price, T is riding time cost, T_v is wait time cost. The latter can also be expressed as $\theta/2F$, where θ is the value of wait time, assuming that the wait time is half the interval, $1/2F$.

The cost for riding time in detail is:

$$(4) T = \gamma(X/2\sigma F)$$

where γ is the value of ride time as a function of in-vehicle crowding, where σ is the number of seats in the vehicle.

3.2 Optimisation without subsidies

The objective function of the profit maximising operator:

$$(5) \pi = PX(G) - C(X, F) - FC_F$$

The objective function of the welfare maximising authority:

$$(6) W = \int_G^{G^m} X dG + PX(G) - C(X, F) - FC_F$$

3.2.1 Price optimisation

The profit maximising operator determines the price according to:

$$(7) \frac{\partial \pi}{\partial P} = X + P \frac{\partial X}{\partial G} \frac{\partial G}{\partial P} - \frac{\partial C}{\partial X} \frac{\partial X}{\partial G} \frac{\partial G}{\partial P} = 0$$

Since $\partial G / \partial P = 1$, we achieve:

$$(8) P = \frac{\partial C}{\partial X} - \frac{X}{\frac{\partial X}{\partial P}}$$

or, by use of the price elasticity, ε_P :

$$(9) P = \frac{\frac{\partial C}{\partial X}}{\left(1 + \frac{1}{\varepsilon_P}\right)}$$

The price chosen for each passenger group thus depends on its price elasticity and the cost recovery constraint, which typically means price at least equal to average cost.

3.2.2 Welfare maximisation

The welfare maximising authority determines price according to:

$$(10) \frac{\partial W}{\partial P} = -X \left(1 + \frac{\partial T}{\partial X} \frac{\partial X}{\partial P} \right) + X \frac{\partial X}{\partial G} \frac{\partial G}{\partial P} - \frac{\partial C}{\partial X} \frac{\partial X}{\partial G} \frac{\partial G}{\partial P} = 0$$

which yields:

$$(11) P = \frac{\partial C}{\partial X} + X \frac{\partial T}{\partial X}$$

The socially optimal price equals the marginal cost of the operator plus the negative external effects borne by other passengers through more in-vehicle crowding.

The expressions for optimal price do not tell whether profit or welfare maximisation yields the highest price. For this question we have to turn to the first-order conditions for optimal frequency.

3.2.3 Frequency optimisation

The profit maximising operator determines optimal frequency according to:

$$(12) \frac{\partial \pi}{\partial F} = X + P \frac{\partial X}{\partial G} \frac{\partial G}{\partial F} - \frac{\partial C}{\partial X} \frac{\partial X}{\partial F} - C_F = 0$$

(12) yields:

$$(13) P = \frac{\frac{\partial C}{\partial X} \frac{\partial X}{\partial F} + C_F}{\frac{\partial X}{\partial G} \frac{\partial G}{\partial F}}$$

The welfare maximising authority determines optimal frequency according to:

$$(14) \frac{\partial W}{\partial F} = -X \frac{\partial G}{\partial F} + P \frac{\partial X}{\partial G} \frac{\partial G}{\partial F} - \frac{\partial C}{\partial X} \frac{\partial X}{\partial F} - C_F = 0$$

A welfare maximising authority thus does not only take into account the effects on marginal costs and marginal demand with respect to frequency (second and third terms), but also the direct marginal effect on generalised cost with respect to a frequency change (first term). The optimal price is then:

$$(15) P = \frac{\frac{\partial C}{\partial X} \frac{\partial X}{\partial F} + C_F}{\frac{\partial X}{\partial G} \frac{\partial G}{\partial F}} + \frac{X}{\frac{\partial X}{\partial G}}$$

Expression (15) can be rewritten in several ways, for example as:

$$(16) P = \frac{FC_F}{X} - \frac{\theta}{2F}$$

This means that the optimal price equals the average cost minus the value of wait time (see for example Jansson (1991) for further analysis).

3.2.4 Optimal pricing according to optimal frequency

From expressions (12) and (14) we get:

$$(17) \frac{\partial G}{\partial F} = \frac{\frac{\partial \gamma}{\partial R} (\sigma F X \frac{\partial X}{\partial F} - \sigma X)}{\sigma^2 F^2} - \frac{\theta}{4F^2} \equiv \frac{\frac{\partial \gamma}{\partial R} (\frac{\partial X}{\partial F} - \frac{X}{F})}{\sigma F} - \frac{\theta}{4F^2}$$

The first term is negative since the average number of passengers is reasonably higher than the marginal demand increase of the frequency increase. The first term, which reflects the marginal in-vehicle crowding effect, also has a higher absolute value that is smaller than that of the second term, which reflects the marginal value of reduction of frequency delay. All in all, we can conclude that the expression can be approximated with one which is inversely proportional to the squared value of frequency, an expression we can denote α/F^2 .

Profit maximisation

Expression (12) can be rewritten as:

$$(18) \frac{\partial \pi}{\partial F} = -P \frac{\partial X}{\partial G} \frac{\alpha}{F^2} \equiv \frac{\partial C}{\partial X} \frac{\partial X}{\partial F} - C_F = 0$$

This yields:

$$(19) F^2 = \frac{-P \frac{\partial X}{\partial G} \alpha}{\frac{\partial C}{\partial X} \frac{\partial X}{\partial F} + C_F}$$

Welfare maximisation

Correspondingly we achieve:

$$(20) F^2 = \frac{\alpha X - P \frac{\partial X}{\partial G} \alpha}{\frac{\partial C}{\partial X} \frac{\partial X}{\partial F} + C_F}$$

From (19) and (20) we can conclude that the optimal frequency is higher for welfare than for profit maximisation. The reason is that the first term in the nominator reflects the value to the existing passengers of increased frequency.

3.3 Introduction of a subsidy

We assume a subsidy as part, s , in addition to the price, P . The objective function of the operator is then:

$$(21) \pi = (1+s)PX(G) - C(X,F) - FC_F - \lambda(sPX - K)$$

where the last term reflects the governments restriction with respect to the maximum amount of subsidy, K .

Price optimisation

The profit maximising operator determine the price according to:

$$(22) \frac{\partial \pi}{\partial P} = (1+s)X + (1+s)P \frac{\partial X}{\partial G} \frac{\partial G}{\partial P} - \frac{\partial C}{\partial X} \frac{\partial X}{\partial G} \frac{\partial G}{\partial P} - \lambda s X - \lambda s P \frac{\partial X}{\partial G} \frac{\partial G}{\partial P} = 0$$

This yields:

$$(23) P = \frac{\frac{\partial C}{\partial X}}{(1+s - \lambda s + \frac{1}{\epsilon_p})}$$

Since the shadow price of public funds normally is around 0.2-0.4, the subsidy s will imply a price reduction compared to the situation without the subsidy. Where there are several passenger groups, the profit maximising firm will put a higher price for groups with low price elasticity compared to the price for groups with high price elasticity.

Frequency optimisation

The next question is how the subsidy will affect the optimal frequency. Expression (12) now becomes:

$$(24) \frac{\partial \pi}{\partial F} = (1+s)P \frac{\partial X}{\partial G} \frac{\partial G}{\partial F} - \frac{\partial C}{\partial X} \frac{\partial X}{\partial F} - C_F - \lambda s P \frac{\partial X}{\partial G} \frac{\partial G}{\partial F} = 0$$

(24) can be rewritten as:

$$(25) \frac{\partial \pi}{\partial F} = (1+s)P \frac{\partial X}{\partial G} \frac{\alpha}{F^2} - \frac{\partial C}{\partial X} \frac{\partial X}{\partial F} - C_F - \lambda s P \frac{\partial X}{\partial G} \frac{\alpha}{F^2} = 0$$

This yields:

$$(26) F^2 = \frac{-P(1+s-\lambda s) \frac{\partial X}{\partial G} \alpha}{\frac{\partial C}{\partial X} \frac{\partial X}{\partial F} + C_F}$$

Since $1+s-\lambda s > 0$, the frequency will be higher with than without the subsidy.

We have thus found that a subsidy as part of the price imply a price cut and a frequency increase, that is, the move is in the direction towards the welfare optimum. We can, however, say nothing about the magnitude from this theoretical analysis. One effort to quantify is done in the case study for the Swedish railway in the next section.

4 Simulations of rail subsidies in Sweden

4.1 Introduction

Nash and Preston (1990) have made an empirical study of costs revenues and productivity of railways in 13 European countries. The study shows that SJ and Banverket (the Rail Track Authority) had the next highest productivity, after the Netherlands, measured in train kilometres per employee (NS: 4 484, SJ: 3 501), and the second highest cost coverage, after British Rail, BR (BR: 0,82, SJ: 0,59). Nevertheless, the Swedish railway operator SJ has financial problems. Would subsidies be welfare improving? We investigate the issue by use of simulations.

We assume here that the state subsidises only 2nd class rail fares so that the price is reduced by 20%, i.e., for budget reasons the state encourages price discrimination, since 1st class passengers (assumed to be business trips) are less price sensitive.

The arguments for lower rail prices may be further enhanced by coach deregulation. The reason is that one may then avoid certain rail supply reductions which otherwise could be socially undesirable. We will thus take into account that the Swedish deregulation of coach services may affect the situation. For this reason we will base our analysis on a future base situation for which it is assumed that the coach supply has increased and that SJ has responded by selective price cuts on lines that will lose patronage. This base situation has been analysed and defined in K Jansson (1998a).

The price reduction analysis will be done in two steps. First we assume that SJ reduces all 2nd class fares, on the basis that they have already made the selective price cuts, but given that the air and coach operators do not respond. In the second step we analyse the outcome given that the air and coach operators reduce their supply in proportion to their demand loss on each specific route. For the second step we describe the outcome in terms of change in: the various traveller groups' surplus, the various operators surplus, external effects, State revenue, excess burden, and welfare.

It must be observed that the results presented are based on calculations that are influenced by a number of sources of uncertainty, even if this for convenience is not everywhere explicitly underlined.

4.2 Basic prerequisites and assumptions for simulations

In the analysis we regard the passenger transports as a system, where passengers can choose among lines and operators and where a single journey may involve several lines and operators.

We assume that: a) Operators compete independently, without regarding modes as being complementary, b) Passengers regard the modes as alternatives, but also as being complementary, c) Passengers are not homogenous, but have different preferences and face different prices.

Both for the simulation of choice of route and mode and for the calculations of consumer benefits we assume that passengers minimise their generalised cost per journey, that is price plus weighted travel time converted into monetary units.

The network we have used for the simulations is comprised of the Swedish air-, rail-, regional bus-, ferry and coach lines, plus the national road network.

We categorise the passengers in different approximately homogenous groups, each with a separate monetary value of time per mode and each meeting a specific price per mode, taking into account an assumed discount per group and that that business travellers deduct VAT and corporate tax. We also take into account that each group may have different values of time for each specific mode due to comfort etc. See the table below.

Table 4.1 Assumed time values and weights for the national network

	Share Trips	Ride time value (train) SEK/hour	Weight for		Ride time weight				
			Wait time	Transfer and walk time	IC-train	X2000 (fast train)	Coach	Air	Car
>100 km journeys									
Private									
Private, 90	0.20	90	0.6	2.0	1.0	0.9	1.50	1.2-2.0	1.6
Private, 70	0.50	70	0.6	2.0	1.0	0.9	1.50	1.2-2.0	1.6
Students	0.15	25	0.5	2.0	1.0	0.9	1.20	1.2-2.0	1.6
Senior citizens	0.15	25	0.5	2.0	1.0	0.9	1.50	1.2-2.0	1.8
Business	1.00	220	1.2	2.0	1.0	0.9	1.50	1.2-2.0	1.6
≤100 km journeys									
		20	0.5	2.0	1.0	0.9	1.50	-	1.7

Note that the car time weight reflects the combination that car drivers and passengers usually take breaks during the journey and the fact that car driving may be perceived as less comfortable compared to train. The time values and the weights are derived from a Swedish stated preference study and from the calibration work.

The assignment program used is the VIPS-system. The share of each mode (car, coach, rail, air), P_u , and the composite waiting time, W , are calculated according to:

$$P_u = \prod_{i \neq u}^N \int_0^{t_u} (1 - \min \left\{ 1, \max \left\{ \frac{x + t_u - t_i}{t_i}, 0 \right\} \right\}) dx$$

$$W_T = \sum_{i=1}^N \int_0^{t_u} \frac{1}{t_u} x \prod_{i \neq u}^N (1 - \min \left\{ 1, \max \left\{ \frac{x + t_u - t_i}{t_i}, 0 \right\} \right\}) dx$$

where

- N is the number of services
- t_u is the interval of service u
- t_i is the interval of service i
- r_u is the remaining travel time of service u
- r_i is the remaining travel time of service i
- x is the time till departure of service u

For external effects we have used the official Swedish values according to the Swedish Institute for Transport and Communications analysis

4.3 Reduced rail prices - with no response from air and coach

Due to the limited space of this paper the results of this situation are presented in short form under the headings: Passengers and Operators.

Passengers

Since fare cuts are assumed to refer to 2nd class only and business travellers are assumed to use 1st class, business travellers are not affected at all. The two working groups benefit most in total, but students and senior citizens benefit more per trip. The benefit of short trip travellers is negligible per trip but quite substantial in total. Some groups benefit not only in terms of money but they also gain travel time, due to that train, which has become cheaper, is sometimes faster than the mode they used before.

Operators

Given that yet no concern has been taken to possible responses from air and coach operators, the railway is estimated to increase its demand by 31%, while airlines would lose 12% and coach operators 28%.

4.4 Reduced rail prices - with responses from air and coach

Here we assume that air and coach operators respond by reducing the service frequency on each line in proportion to the demand lost and that the SJ responds by increasing the service frequency on each route in proportion to the demand gained. The results are presented under the headings: Passengers, Operators, External effects and fuel taxes, State finances and excess burden, Welfare.

We make the calculations under two assumptions: "max" and "min". "Min" means minimum shift to rail transport, for which case we have assumed that reduced rail fares attract coach and air passengers only, according to the simulation model, but no car travellers. "Max" means maximum shift to rail transport, for which case we have assumed that reduced rail fares attract coach and air passengers but also car travellers, according to the simulation model.

Passengers

The increased frequency on some rail lines implies that most passenger groups gain both in terms of time and money, and this effect is thus stronger than the effect of reduced frequencies on some coach-

and airlines. See table 4.2 below. For the sum of consumer surpluses we also add a column for this sum assuming that all groups have the same value of time, something which may be regarded as the equality value of aggregate consumer surplus. If all passenger groups were given the same (average) value of time the total benefit is again much larger, since the groups who gain most have a relatively low value of time.

Table 4.2 Calculated change in average generalised cost and total consumer surplus (MSEK per year) distributed on travel categories.

Consumer surplus, MSEK/year										
	Business	Working	Working	Senior	Students	Short	Sum		Sum	
	220 SEK/h	90 SEK/h	70 SEK/h	25 SEK/h	25 SEK/h	20 SEK/h	different	equal	max	min
	max	max	max	max	max	max	max	max	min	max
Consumer surplus	44	127	354	51	63	204	842	741	1458	1283
of which time	6	22	-158	38	8	123	39	380		
of which fare	38	105	512	13	55	81	803	361		
Generalised cost, SEK/trip										
	Business	Working	Working	Senior	Students	Short	Sum			
	220 SEK/h	90 SEK/h	70 SEK/h	25 SEK/h	25 SEK/h	20 SEK/h				
Generalised cost	1,2	2,9	4,0	3,6	7,0	0,1	18,8			
of which time	0,2	0,5	-1,8	2,7	0,9	0,1	2,5			
of which fare	1,1	2,4	5,8	0,9	6,0	0,0	16,2			

Operators

The railway is estimated to gain 19% and 43% new passengers respectively according to the "min" and "max" assumptions, while airlines would lose 21%, coaches 42% and regional buses 3%.

For table 4.3 below we shall be aware that we have not included the state subsidy to the railway. The railway would thus be in a better situation than that shown in the table, and the state would lose the corresponding subsidy amount. For the cost-benefit analysis result inclusion of these transfers would make a very little change. Note also that for the max case no subsidies would be needed, something which indicates that the max assumption may not be realistic. The losses of airlines and coaches may be exaggerated since they may have means to reduce costs, which we are not aware of.

Table 4.3 Calculated change in passenger kilometres and producer surplus per vehicle categories and operators (in million SEK per year)

	Change in passenger km, million		Change in passenger km, %		Change in revenues MSEK/year		Change in costs MSEK/year		Change in producer surplus MSEK/year	
	max	min	max	min	max	min	max	min	max	min
SJ	3131	1368	43	19	1806	117	1288	560	168	-313
Air	-526	-526	-21	-21	-903	-903	-585	-585	-318	-318
Long-distance coaches	-522	-522	-42	-42	-198	-198	-168	-168	-30	-30

Regional buses	-1175	-1175	-3	-3	-7	-7	0	0	-7	-7
Total public transport	1965	-855	13	-6	698	-991	885	-193	-187	-668
Car	-1761	0	-3	0						

External effects and fuel taxes

The increase in coach service supply and the reduction of car use mean that the external effects in total are reduced to some extent. However, the current low level of taxation of heavy vehicles also means that the total tax revenues would be reduced. This is thus an illustration of that external costs of heavy vehicles and coaches are not internalised.

Table 4.4 Calculated change in vehicle km, external costs and tax revenues

	Change in vehicle km/year		External costs MSEK/year		Tax vehicle km MSEK/yea r	
	max	min	max	min	max	min
	Rail	6.8	3.0	38	17	26
Air	-6	-6	-66	-66	-25	-25
Coaches	-17	-17	-33	-33	-13	-13
Regional buses	0	0	0	0	0	0
Total public transport	-16	-20	-61	-82	-12	--26
Car	-1174	0	-364	0	-411	0

State finances and excess burden

The change of the excess burden is assumed to be 30% of the net state financial outcome. The net effect on the state revenues would then be -556 MSEK for the max case and -261 MSEK for the min case. The corresponding values for excess burden are - 167 MSEK for max and - 78 MSEK for min.

Welfare

Here we sum consumer surplus, producer surplus, government surplus, excess burden and external effects. The net social benefit seems to be positive, even if very small for the "min" case where different values of time are used. We shall though bear in mind that the cost savings of the airlines may be much larger than what we have assumed. The net benefit is therefore probably higher. We can however be quite certain that the net social benefit is much larger than the financial loss of the railway. This depends on economies of density in rail operation, i.e., that more passengers can be accommodated at a low marginal cost.

Table 4.5 Welfare effects (MSEK/year).

	Different values MSEK/year		Equal value MSEK/year	
	max	min	max	min
Consumer surplus	842	741	1458	1283
<i>of which travel time</i>	39	380	-	-
<i>of which fare</i>	803	361	-	-
Producer surplus	-131	-468	-131	-468

Government surplus	-556	-261	-556	-261
Excess burden	-167	-78	-167	-78
External effects	453	131	453	131
Net social benefit	441	65	1057	607

5 Conclusions

This tentative study indicates, both through theoretical analysis and by use of simulations, that subsidisation of the railway is worth to consider. We must be aware, however, that this result is based on the present organisation and subsidy scheme of the railway. We cannot know, for example, whether the current subsidies of rail access charges and the subsidies assumed in this paper is an optimal combination.

It is concluded to be worthwhile to analyse rail pricing in more detail than what has been possible in this small study. Important research issues during the course of the new project financed by the Swedish Rail Track Authority, BV are:

- The joint concern for and the optimal combination of rail access charges and passenger fares,
- How optimal access charges and fares may be affected by organisational form, that is vertical vs. horizontal integration and private vs. public ownership.
- Estimation of total costs, average variable costs and social marginal costs, in order to find the optimal level of subsidy,
- Compare various forms of subsidy: lump sum, reduced access charges, contributions linked to passengers etc.

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Work has comprised for example: Cost-benefit analyses, Optimal prices and quality of public transport, method for computer simulation of public transport networks, organisation of public transport, assessments of combined road pricing/public transport pricing in Stockholm, European Community Research work for DG VII, Feasibility studies for public transport projects in Tallinn, Estonia, Lima, Peru, Bangalore, India, Comprehensive Bus Study in Singapore.

Publications

Examples:

Article in Dagens Nyheter (Leading Swedish Daily) on distribution effects of an area licence scheme for private car traffic, 1978.

Public Transport in Trujillo, initial study (co-author), VTS Systems, 1979.

Public Transport in Lima, initial study (co-author), VTS Systems, 1979.

Computerised methods for evaluating public transport networks presented at PTRC Summer Annual Meeting 1980.

Weights on travel time components in public transport planning in Stockholm, presented at PTRC Summer Annual Meeting 1981.

Article in DN (Leading Swedish Daily) concerning costs and benefits of expanding train operation vs expanding bus operations in the Stockholm region.

Invited by the Organisation of Economic Co-operation and Development (OECD),
Division European Conference of Ministries of Transport, to a conference in Paris entitled "Aims and Effects of Public Financial Support for Passenger Transport", May 1984.

Paper in Lyon, France, at a Seminar 'Financing Urban Transportation'. The seminar is organised by Laboratory of Transport Economy (Associated with the French National Centre for Scientific Research). Paper presented September 1984.

Marginal costs in Local and Regional Public Transport. Swedish Governmental Transport Research Commission 1984.

Productividad y costos (Productivity and Costs), VTS Lima 1985.

Pasajes y cobros (Fares and Ticketing), VTS Lima 1985.

"VIPS II - A New Computer System for Public Transport Planning", presented at PTRC Summer Annual Meeting 1987.

"Deregulation of Public Transport in Sweden" (co-author Bosse Wallin, Stockholm Public Transport Authority), Journal of Transport Economics and Policy, London, 1991.

"Efficient Prices and Quality in Public Transport" (PhD. thesis), Department of Economics, Stockholm University, April 1991.

"Deregulation of Public Transport in Sweden". Presented at the "2nd International Conference on Privatisation and Deregulation in Passenger Transportation", Tampere, Finland, 1991.

"Optimal Public Transport Price and Service Frequency", Journal of Transport Economics and Policy, London, 1991.

Invited by the Organisation of Economic Co-operation and Development (OECD),
Division European Conference of Ministries of Transport, to the Round Table in Paris entitled "Marketing and Quality in Public Transport", Dec. 1991.

"Optimal Public Transport Prices, Frequency and Transport Unit Size", presented at the 6th World Conference on Transport Research, Lyon, France, July 1992.

"A Method for the Route-Choice Problem in Public Transport Systems" (co-author with Bosse Ridderstolpe), Transportation Science, vol. 26, no. 3, August 1992.

Invited by the Organisation of Economic Co-operation and Development (OECD),
Division European Conference of Ministries of Transport, to the Round Table in Paris
entitled "Short-Distance Passenger Transport", Feb. 1993.

"Transport Economic Analysis - Tallinn, Estonia" , 1993.

"Organisation of Public Transport in Tallinn" (co-author Robert Tamm), 1993.

"Swedish Competitive Tendering in Local and Regional Public Transport - Overview and
Comparative Case Studies". Presented at the Third International Conference on Competition
and Ownership in Surface Passenger Transport", Toronto, Canada, Nov. 1993.

"Social Welfare and Competition in Public Transport". Presented at the Nordic Committee for
Transport Research (NKTF) , Helsinki, Finland, Dec. 1993.

"Welfare Aspects on Organisation of Passenger Transport", presented at PTRC Summer
Annual Meeting 1994.

"Valuation of travel time and information - with and without use of timetable" (co-author
Kerstin Blomquist), presented at PTRC Summer Annual Meeting 1994.

Report on issues related to the Latvian Inter-regional Transport system. A brief pre-study,
requested by the Latvian Ministry of Transport, financed by the Swedish Agency
for International Technical and Economic Co-operation (BITS). The aim of the report is
to formulate the economic and organisational problems of the Latvian transport system, 1995.

"Welfare Aspects on Organisation of Passenger Transport" (revised version), presented at 7th
World Conference on Transport Research, Sydney, July 1995.

"Valuation of travel time and information - with and without use of timetable" (revised
version) (co-author Kerstin Blomquist), presented at 7th World Conference on Transport
Research, Sydney, July 1995.

Reports for the European Unions DGVII research project "ISOTOPE", concerning
organisation of local and regional public transport, 1996.

Reports for the European Unions DGVII research project "SORT-IT", concerning strategic
organisation and regulation in transport - inter urban travel, 1997.

"Welfare Aspects of the Organisation of Passenger Transport", International Journal of
Transport Economics., Vol. XXIV- No 1, February 1997.

"Public transport versus car in urban areas - Simulation of price and service changes in
Stockholm", Presented at the Fifth International Conference on Competition and Ownership
in Surface Passenger Transport", Leeds, England, April 1997.

"Analysis of Deregulation of Coach Services in Sweden", for the European Conference of
Ministries of Transport, CEMT, March 1999.

Reports for the European Unions DGVII research project "FISCUS", concerning pricing and
financing of urban travel, 1998-99.

Reports for the European Unions DGVII research project "PATS", concerning pricing acceptability in the transport sector, 1999-.

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