How good is first best? Marginal Cost and other Pricing Principles for User Charging in Transport

Werner Rothengatter

University of Karlsruhe

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1 A Brief History of the Marginal Cost Debate

The discussion about marginal costs and their central role for pricing in the transport sector has undergone several scientific cycles. The average length of the periods is about 30 years if we start with the welfare theory of Marshall and Pigou at the beginning of this century, continue with the work of Hotelling in the late thirties, its refoundation in the late sixties and its rediscovery in the nineties. In particular the 1960 – 1970 phase included heavy attempts to bring the concept closer to reality and to make it a uniform principle of pricing in transportation. The episodes of the cycle are depicted in Figure 1 and Table 1.

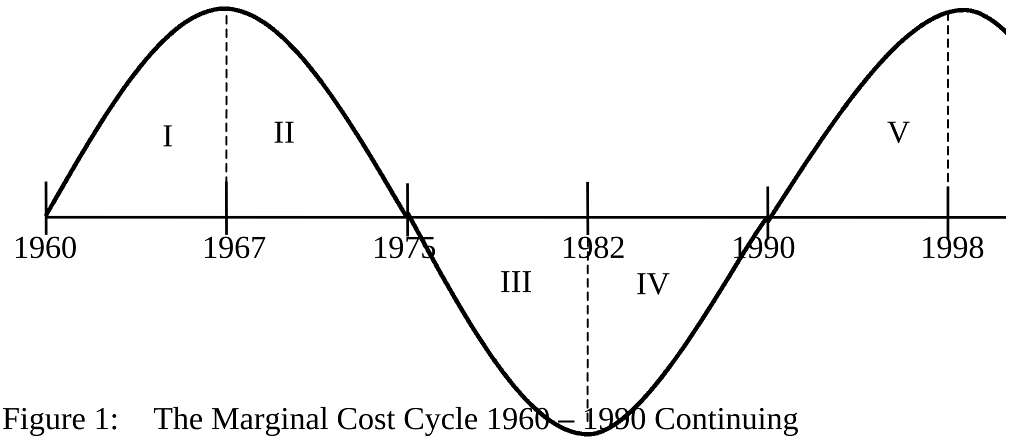

Figure 1: The Marginal Cost Cycle 1960 – 1990 Continuing

Phase I:	Oort (1961):	Short-run marginal cost pricing (SRMC)
	Allais (1965):	Marginal cost pricing plus mark-ups (péage system)
	EC (1965):	Pilot study Paris-Le Havre
Phase II:	EC (1971):	Final recommendation: Marginal costs and budget constraint
	Member Countries (1969):	FDC-Schemes in the UK and Germany
Phase III:	Willig (1978):	Multi-part tariffing; Pareto-inferiority of SRMC with mark-ups
	Littlechild et al. (1977):	Club principle: Structured full cost allocation (game theoretical foundation of FDC)
Phase IV:	Rees (1986):	Pricing and investment under indivisibility constraints
	Williamson (1966/89):	Institutional settings, specificity of investments
Phase V:	Jansson, Proost (1990)	SRMC Schemes in transport revived
	EC (1998)	White Paper of the EC: SRMC as a uniform scheme

In Phases I/ V the schemes developed are very close to the textbook literature on neo-classical micro- and welfare economics. Therefore acceptance is broad in academia and with professionals who had a basic course in welfare theory. Phase II is characterised by an upcoming insight that marginal costing neglects important cost blocks which do not vary with traffic. Various recommendations have been developed for appropriate departures from marginal costs. In extreme cases they included the advice to go back to the safer grounds of average cost pricing because this at least guarantees for full cost recovery. Phase III is a period to explore alternatives. In the schemes mentioned here, the multi-part tariffing or the club principle, the marginal costs are still an element of optimal pricing, but their importance is decreasing with the share of marginal costs of the total cost to be recovered. Phase IV, finally, brings wide departures from neo-classical welfare theory, putting emphasis on sustainable dynamic schemes of pricing and investment under institutional constraints.

Typically, Phases III and IV provide theorists with a number of nasty problems, non-convexity, dynamic interactions or disequilibrium situations prevailing. It is a field for some specialists, working on partial aspects, which can hardly be generalised on one theoretical platform. As this is so it is also a field for some generalists who try to bring together the complex patterns of theoretical approaches by a more qualitative and pragmatic reasoning or simulation techniques. The latter is not well received in theoretical transport economics. Therefore it is not a surprise that Phase IV leads to frustrations of theorists and creates the feeling that a general, unified and theoretically proven approach is urgently needed for the transport pricing problem. This has been the start for Phase V which has an academic foundation by neo-classical welfare theory ("first-best theory") and was followed by national and EU sponsored research activity on applications to the transport sector.

Following this logic it was quite natural that the Commission, in their Green and White Papers 1995, 1998, revived the marginal cost concept, again, suggested to introduce it in the transport sector as a general principle from which departures are only admitted in exceptional cases. After some years of discussions on the practicability of this scheme the recent recommendations of the Commission, in particular for the railways, allow for mark-ups on the marginal costs to improve the level of cost recovery. To put it in the context of the historical cycle, the Commission is thereby approaching the state of 1971, again, when the importance of fixed cost recovery within a marginal cost based scheme was underlined in form of a final recommendation to the member countries.

2 Some Characteristics of SRMC

„Marginal costs are those variable costs that reflect the cost of an additional vehicle or transport unit using the infrastructure. Strictly speaking, they can vary every minute, with different transport users, at different times, in different conditions and in different places” (EC White Paper, 1998, p. 10). With this definition, the Commission has determinedly committed itself to the *short run* marginal costs (SRMC), which means that all cost components that do not react to minor changes in use are excluded. This relates to all costs that are fixed in the short run, such as costs of the administration, operational readiness or depreciation and interest on capital. In the definition of the White Paper, social marginal costs comprise

- operating costs,
- costs of the wear and tear of infrastructure,
- congestion and scarcity costs,
- ecological costs and
- accident costs,

caused by an additional transport unit using the infrastructure.

If the transport technology were convex then marginal costs would increase with traffic and an equilibrium would be achieved with full cost recovery. *If* transport investments were perfectly divisible then a clear rule for the network extension could be developed: The savings of marginal user costs should exceed or at least be equal to the increase of marginal infrastructure costs. *If* there were perfect markets outside the transport market then the pricing/ investment strategy based on the marginal costs were also optimal for the whole market system. And *if* there were perfect information and foresight then the transport system could be optimally controlled by one authority.

In reality, not one of there four “ifs” is given. Transport infrastructure technology is not convex such that marginal costs are below average costs and a deficit occurs. Transport investments are also not perfectly divisible. Applying the marginal cost rule for pricing and investment, then would lead to a fluctuation of prices and investment activities (Rees, 1978).

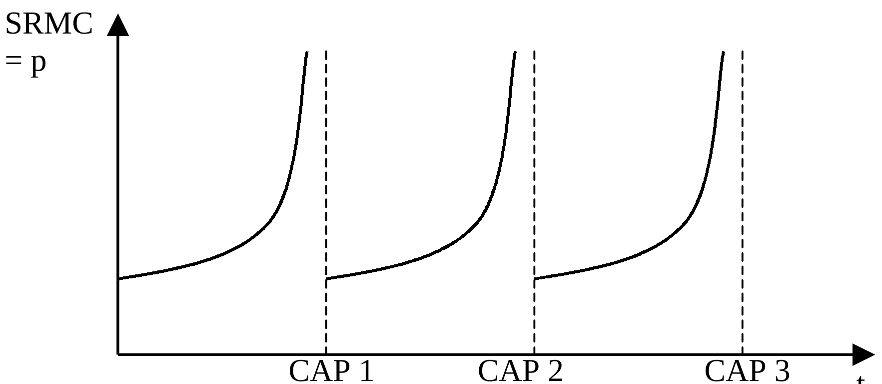

Figure 2: Lumpy Investments and Price Fluctuations
CAP i: Infrastructure Capacity in Phase i

Price fluctuations would disturb all private decisions on investments which are dependent on transport prices, i.e.: transport logistics, choice of locations. Furthermore, suboptimal investment decisions of the past would immediately reflect in the wrong transport prices in the present. The development of the transport infrastructure is closely interrelated with imperfect markets on land-use and spatial development. Therefore it is an illusion to believe that "optimal pricing" in the transport sector would improve the situation in the whole market system. Examples for this have been given by Verhoef et al (1998).

Finally, "optimal pricing" according to SRMC completely abstracts from institutional aspects. According to neo-classical theory the revenues are given to the general public budget and budget spending is decided on the base of optimal public choice, which yields under perfect conditions the golden benefit-cost rule for transport investments. In practice this leads to four fundamental problems: imperfect information, missing acceptability, missing incentives to announce correct infrastructure needs and missing procurement for the right institutions considering all transaction costs.

In a world of *imperfect information* the optimal control of a system is hardly possible by one central authority. Introducing a neo-classical scheme of optimal transport infrastructure pricing and investment would presuppose that the state would centrally manage the system. But the state is known as a most incompetent manager and therefore in most state-regulated sectors economists are calling for reducing the state's influence and to strengthen decentral, eventually private management. *Missing acceptability* is caused by the fact that people who have to pay do not trust in the normative power of the state, on the contrary, they are afraid that money given to the state will vanish through uncontrollable channels. Therefore the users of the infrastructure would prefer that their payments would be used for the development of the infrastructure, again (decentral self-financing systems). Only under such decentral self-financing rules *incentives* would arise to adjust the infrastructure optimally to the needs of the users. This is because every announcement for infrastructure needs would have to be accompanied by the willingness-to-pay for its provision. In the "first-best" welfare world this incentive would not exist as users in congested network parts, though suffering from bad infrastructure quality, would pay for users enjoying good quality in less congested areas. Finally the neo-classical approaches completely abstract from finding the appropriate *decentral institutions* outside the state's budget to implement incentive compatible decision units at reasonable transaction costs. The real political problem, in this context, is not to control the transport sector optimally through first-best pricing rather than to establish an institutional system with enough compatible incentives on one hand and low transaction costs on the other.

Looking at the air transport market, there are big achievements on this line. The railway sector is presently an object of (unfortunately inconsequent) institutional reforms, while for the road sector – except for some motorways – no institutional reforms are at sight. Therefore it is not surprising that SRMC is suggested by the EC in the first instance to the road sector in terms of unrestricted road pricing. For the railway sector some departures from SRMC are admitted to give the companies more chances for budget control, while for the air transport sector there are only marginal changes proposed for the presently used pricing systems, in particular to take into account congestion and environmental aspects.

3 Consequences for a Dynamic Pricing/ Investment/ Finance Scheme

Typically, an SRMC-pricing scheme is orientated to optimise the use of an existing facility of which the fixed costs are bygones. In a dynamic context this leads to a number of consequences which are more or less undesired.

a) Budget deficit

Once the technology of the transport infrastructure system is concave it follows that marginal cost is decreasing with traffic activity and below average costs. This implies that a deficit occurs. The EC suggests three ways to close the gap between infrastructure costs and revenues:

1 Adding external congestion costs and external costs of accidents and the environment;
2 Cross subsidisation from road to rail or from urban to non-urban areas; and
3 Finance by the general budget.

Ad (1)
The first remedy dates back to Pigou and his famous paradigm. If users behave completely egoistic they follow their average user cost curve and produce a Nash-type equilibrium. Including the external cost elements which are not considered by the single user the social marginal cost curve is the relevant decision base, and if it were followed, the Pareto-equilibrium would occur. To stimulate the user decisions to follow the social marginal cost curve the difference between average and marginal costs has to be charged. Figure 3 shows this well-known theoretical insight.

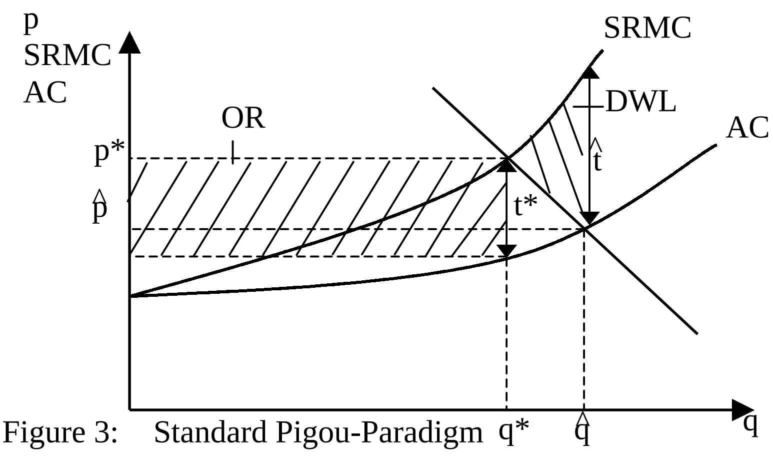

Figure 3: Standard Pigou-Paradigm

Some theoretical and practical problems are associated with optimal Pigou-taxation to internalise externalities:

- It is assumed that individual users are perfect egoists and follow AC. This assumption, by the way, can not be confirmed by experimental studies, which show that people tend to anticipate interaction effects in a social environment (see Harsanyi and Selten, 1988;

Berninghaus and Ehrhardt, 1998). This implies that the relevant perceived AC-curve shifts towards SRMC, reducing the welfare loss DWL.

- The external congestion costs are DWL (dead-weight-loss) while the tax revenues in the optimal situation are OR = t* • q*. In the Figure 3, OR > DWL. Taking practical experiments OR exceeds DWL by 4 to 9 times (INFRAS and IWW, 2000). This means that to remove a small welfare loss a huge flow of tax revenues is generated including transaction costs for correct price setting and the administrative costs to manage the budget. It easily can happen that transaction costs are higher than the achieved welfare gain.
- The optimal tax t* is not only dependent on costs but also on the demand elasticity. From this two properties follow: The pricing system becomes very complex, because in a real network this elasticity is composed of many elements: route choice, mode choice, destination choice time choice, trip choice, etc. Secondly optimal pricing will become discriminatory, i.e. dependent on user characteristics. This means that the concept involves all problems of equity and fairness, which are known for demand driven pricing schemes, at least implicitly, i.e. involved in the assumptions on elasticities.

  Coming back to the external costs of accidents and of the environment one can not discover the logic why this type of costs should contribute to infrastructure cost recovery. It would be more understandable that environmental charges would be used to internalise the costs of these externalities and not spent on covering budget deficits.

Ad (2)
Congestion externalities in the first instance occur in urban areas. Therefore only in urban regions there is a chance to generate enough income to finance the overall investment cost through SRMC-based prices. Furthermore, if the investment level is kept low (eventually using the argument that urban area is limited) then a source of finance is generated for investment outside urban areas. This type of a regional cross subsidisation raises cause a “double rebound effect”:

- People living in urban areas would enjoy less transport capacity than optimal, as funds are withdrawn;
- Urban areas would become less attractive because of high transport prices such that urban sprawl would be fostered.

These disadvantages of regional cross subsidisation have motivated several authors to promote a modal cross subsidisation from private road to public transport. Surpluses from urban car traffic could be spent for urban public transit; surpluses from motorway heavy duty vehicle could be given to developing rail freight transport. On the first view this idea seems fantastic as it corresponds to a system’s approach to optimising the overall transportation activities. In particular, the PT-companies and the railways love the concept and the UIC has spent a lot of effort in studies to show that imposing high congestion fees on road traffic and transferring the revenues to the railway sector were a welfare maximising strategy. However, some caveats have to be considered:

- The fact that road is congested while rail is not can not be used as a rational argument for a money transfer. One has to notice that the service qualities can differ substantially such that enforcing the use of an inefficient alternative is not a convincing economic advice. Only the argument of externality would give rise to support a modal shift, but, unfortunately, the marginal external costs of accidents and of the environment are low

compared with congestion costs in urban areas (see the results of marginal cost estimations in the appendix).
- Once an ear-market cross subsidisation scheme from road to rail is established the main interest of the railways will not be to create an economically optimal network rather than to preserve the automatism of cross subsidisation and spend the money on prestige projects (incentive problem). There would be no incentive to improve on the service quality of railways.
- At least in the long-run there is a missing acceptability by the population. Therefore probability is high that such a money transfer system from road to rail can not sustain. In particular, in the case of public/private partnership, i.e., if parts of the road system would be managed by private companies it would become difficult to let their management collect money for the competing railway mode.

Ad (3)
Finance of the deficit by the general budget is the most comfortable solution. This would presuppose that the welfare loss imposed on the tax payers is lower than that of the users of the transport system. Indeed, there are some theorists who argue that lump-sum taxes are existing which do not influence decisions, thus do not disturb optimal allocation of resources and therefore can be used for financing deficits of the transport infrastructure. After the debacle of Mrs. Thatcher with introducing capita taxes the number of scientists is decreasing who still believe in the existence of lump-sum taxes. The only rational for preferring tax finance to user finance in a transport system with concave technology is that the burden per tax payer would be so low such that be won't realise. But this is a very weak argument.

Summing up the only rational arguments for cross subsidisation and state finance are

- production of benefits which can not be captured through direct pricing, or
- production of externalities by the cross taxed mode which is not internalised directly.

An SRMC based pricing scheme would need subsidisation not because of the above reasons rather than because of technological reasons (marginal costs lower than average cost). Thus, it would automatically socialise responsibility for the provision of infrastructure. This would not allow to extend private and public/private provision of the transport infrastructure with a substantial private risk taking.

4 Extensions and Alternatives to SRMC

As the level of cost recovery is an important figure for infrastructure management and policy, it is felt one of the most serious deficiencies of SRMC that does not provide information on overall cost control. Therefore extensions of SRMC such as

- SRMC with mark-ups, or
- Ramsey-pricing

and alternatives like

- multi-part tariffs, or
- structured FDC pricing according to the club principle

are discussed (see the marginal cost discussion cycle in the introduction).

Before introducing the concepts of multi-part and club tariffing it is useful to briefly present the structure of an infrastructure cost function in its simplest form:

(4.1) $C = C(z,v,q)$
z: infrastructure characteristics
v: user (vehicle) technology
q: traffic activity level.

An important property is that different decision makers may decide on the variables z, v and q. Nevertheless all variables are highly interdependent, what for instance means that decisions on the infrastructure depend on the technology used and the traffic activities expected. While q can be regarded continuous without misrepresenting reality, v and z are discrete variables. One can immediately notice the difference to the classical way of defining the cost function as $C = C(z,q)$ and assuming that C is separable in a part which is only dependent on z (fixed cost) and a part which is only dependent on q (variable cost).

Technology of users and infrastructure can eventually be grouped, categorised and linked together. Therefore cost elements which are fixed with respect to q can be variable with respect to v. We can call such cost blockwise variable and notice the property that these costs can be influenced with every decision on technology with respect to vehicles, infrastructure investment or replacement. Such decisions are much more frequent and fluid in practice than assumed in neo-classical theory. The costs of the infrastructure now can be subdivided into

(4.2) $C(z,v,q) = c(z,v,q) + F_1(z,v,q) + F_2(z,v,q)$
c: variable costs, $c(z,v,0) = 0$
F_1: blockwise variable costs ; $F_1(z,v,0)>0$, $F_1(z,0,0)=0$
F_2: common fixed costs; $F_2(z,v,0)>0$, $F_2(z,0,0)>0$.

The longer the time horizon of planning is the more common fixed costs F_2 become blockwise variable costs F_1. In this context the technological interdependence between vehicle technology and infrastructure technology is a crucial point in decision making. Particular user groups (e.g.: HDV or cars on roads) have specific infrastructure requirements. This means that characteristics of the vehicle technology can be matched with characteristics of the infrastructure. Suppose that every user group is characterised by a particular technology which requires specific infrastructure design. Then a function which maps all combinations of user groups into the associated infrastructure costs is called a “characteristic function”:

(4.3) $C: \Omega(N) \rightarrow \mathbb{R}$
$N = \{1,...,n\}$: set of users
$\Omega(N)$: power set of N
$\mathbb{R}$: set of real numbers
C : costs of infrastructure

If a costing scheme is aiming at generating incentives not only with respect to q but also with respect to v and z then the characteristic function gives the basic information on the lever points of influencing decisions on v and z. These lever points are the more important the longer the time horizon and the higher the proportion F/c are. Structuring a pricing system on the base of C will create incentives of the user groups to adjust their requirements of specific infrastructure design to the real needs.

SRMC with mark-ups and Ramsey-pricing are extensions of pure SRMC to achieve budget recovery. In the case of mark-ups the SRMC values are increased proportionally or additively such that finally the sum of revenues equals the sum of costs. Ramsey pricing is modifying the SRMC values according to the budget scarcity and the (reciprocal) demand elasticities. Both pricing schemes would guarantee for sufficient income to cover the costs. But as they are linear and uniform they cannot give any incentives with respect to technology decisions v and z. Furthermore they presuppose central decision making.

a) Multi-part tariffing

Multi-part tariffs consist of fixed, blockwise variable and variable parts. They can be flexibly adjusted to the cost and the demand characteristics. There are three main points, which make multi-part tariffs so attractive for transport pricing, are:

(1) Multi-part tariffs can be constructed in a way that the result is Pareto-superior to linear tariffs (SRMC with mark-ups, Ramsey-pricing), once a defined level of cost recovery is desired. The proof has been given by Willig (1978).
(2) Multi-part tariffs can include the information of the characteristic function and therefore generate the right incentives with respect to infrastructure requirements and technology choices of user groups.
(3) A self-selection principle can be applied. This means that a set of tariffs can be offered to the user groups who then can decide in favour of a tariff which fits best to their situation. In a world of uncertainty self-selection reduces the information requirements on user demand characteristics dramatically.

In the case of private companies providing infrastructure (e.g. for electricity, communication networks) a further feature is important: The risk of capital investment can be optimally allocated away the supplier and the customers through the fixed charge element. Therefore such pricing schemes are widely applied in practice when high fixed costs have to be managed.

We develop a small example to show the superiority of a two part tariff over an SRMC scheme with proportional mark-ups. Suppose there are two consumer groups A and B with demand functions D_A and D_B. Under a linear tariff p_1 which combines the marginal costs m with a mark-up the demand is q_A and q_B and total demand is q‘. Fixed costs are recovered through payments a+b+c. After introduction of a two-part tariff $\frac{a+b+c}{q_A}+m$, B will still prefer the linear tariff p_1. A, however, will choose the two-part tariff which encourages him to increase the demand to q_A*. By this consumer’s surplus increases by d. If the technology is concave, a further scale effect occurs: marginal cost will decrease instead of remaining constant as shown in Figure 4. This will increase the welfare gain d.

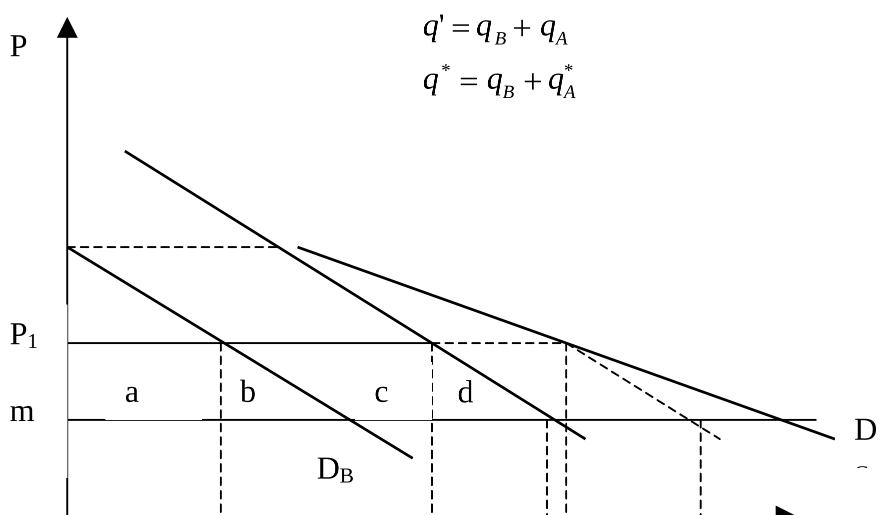

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Figure 4: Superiority of a Two-part Tariff

b) Club principle

Transport infrastructure is not a public good rather than a club good which provides benefits to particular user groups which can be regarded to form a club (Coase, 1946; Buchanan, 1960). Littlechild and Thompson (1977) have formulated efficiency and fairness criteria which have to be met by a cost allocation or pricing scheme such that a club can sustain over time:

Efficiency:

E1. The pricing regime should give the infrastructure authority the incentive to build the optimal size of the network and to accept the optimal pattern of users. It should just break even.

E2. There should be no cross subsidisation among user groups such that a disadvantaged group were motivated to build an infrastructure for its own.

E3. The pricing regime should give all user groups the incentive to use the facilities according to their willingness and ability to pay.

Fairness:

F1. User groups which need more or more expensive capacity pay a higher charge.

F2. The amount by which the charge of a user with high quantity/quality requirements exceeds that of a user with low quantity/quality requirements should not exceed the difference in costs of providing for the two types.

The efficiency conditions E1 – E3 are also called competitive conditions, because they would follow from a free bargaining process between potential users and providers of the infrastructure under private property rights. Furthermore the club principle includes the strong fairness issues F1 and F2, which are perfectly observable by the user groups (which does not necessarily hold for efficiency criteria).

In practice the acceptability of a pricing scheme is very much dependent on the fairness properties. Insofar the club principle can help at least to generate important benchmarks for fair pricing. The theory of club pricing strongly relates to co-operative game theory. Two solutions concepts which are often referred to are

(1) Shapley value: The benefits of a club compared with a stand-alone situation are allocated on the base of contributions of club members to the overall benefit and the probability of a member to appear in benefit generating coalitions.
(2) Nucleolus concept: The optimal allocation is found through lexicographically minimizing the complaints of disadvantaged groups such reducing their threats to leave the club.

The game theoretical concepts have the properties that they allocate the total costs on the base of the characteristic cost function (4.3) and that the allocation principles have a clear axiomatic foundation. However, it might be tedious to generate the characteristic cost function in its complete and extensive form (it requires a number of cost calculations which equals the power set of possible coalitions). Therefore simplifications will be preferred, firstly through approximation, and secondly through using the key functions for common cost allocation, as used in FDC costing schemes. As soon as such key functions become arbitrary the club pricing will loose its scientific foundation.

5 Price Setting of a Firm Owning Essential Network Facilities

We now examine the optimal pricing strategy of a company which owns the network rights and operates on its own network. This holds for most of the railway companies. From the general consideration on the pricing concepts above follows that an integrated will prefer to set multi-part tariffs. In this case the tariff system can flexibly be adjusted to cost blocks and demand features and a part of company risk can be allocated to the customer. Subject to the socially right choice of fixed and variable components of the tariff such a pricing regime can prove Pareto-superior to all other schemes.

However, the price discrimination of multi-part tariffs can not only be used for social but also for private monopolistic optimization. In an environment without a balanced intramodal competition a monopolistic pricing regime can be implemented which maximizes revenues or profits for the supplier rather than social benefits. The fixed charge amount can be used to set barriers to entry for potential competitors. An example is the pricing scheme of the German Deutsche Bahn AG introduced in summer 1998. The fixed charge has been set so high that only very large companies, in particular the DB AG itself, enjoyed a benefit from the two-part scheme while smaller companies had to pay the variable (but in the end more expensive) tariff. After an intervention of the Federal Competition Authority the two-part tariff has been replaced by a linear tariff, again. But now the big regional transit companies are complaining that the new system brings a disadvantage and discourages the companies to lease large capacity blocks from DB AG.

As a result of theoretical reasoning and practical experience one can conclude that multi-part tariffing can provide advantages as well for the supplier as for the customers. A main problem is that the pricing system can also be used to establish barriers to entry for third parties to a network which is managed by a monopolistic company. Therefore it is necessary in a monopolistic transport market to establish a strong regulator which sets price caps to exclude unfair pricing. These price caps could be derived in principle from the fairness issues F_1 and F_2 of the club pricing rules introduced in section 5.

6 Price Setting in a Co-operative Regime of Partnership

Suppose that there are different companies or user groups operating on one network. Then the parties could form an alliance and establish an agency which provides the network for all of the members of the alliance. If the finance of the network would be performed by user charging then the parties would be interested in a pricing system which is fair and efficient. Clearly a full cost allocation principle will be applied in the absense of state subsidies as no party will volunteer for covering the fixed costs alone.

In such an environment the club principle can provide the adequate pricing form. It constructs the fiction of a decision situation in which all user groups have to decide co-operatively on the common facility and allocation of associated costs at the same time. In a railway system with commercially operating transport service companies one can expect that the fairness axioms of the Shapely value are acceptable by the parties. Companies which contribute most to the common benefits (costs) would be allocated the highest pay-offs (cost shares).

For the road system also social equity considerations are important such that the axioms of the Nucleolus concept apply. The allocation system would balance the burdens in such a way that complaints of groups which feel relatively disadvantaged are minimised. In its extreme version the scheme would approximate the Rawlsian principle of justice which says that the position of disadvantaged groups should be improved as much as possible.[1] The balancing of burdens would include the different vehicle categories on one hand and the different origins of users (domestic, foreign) on the other.

In the airline sector this principle is partly applied for allocating the common costs of air traffic control to the aircraft. Actually, a scheme for distributing the full costs has been developed by EUROCONTROL under consultation of the ICAO, which is the association of users (airline companies). Airlines pay a charge per movement based on the average costs of control for the particular aircraft category. Overpayments are reimbursed such that costs are exactly recovered.

The example from the airline sector gives rise to mention the potential disadvantage of an average cost based allocation scheme: It does not provide enough incentives for an efficient use of capacity and eventually the incentives for using better technology are too weak. Therefore, the EC has recommended in their Directive 1999/62 for charging the motorway use by HDV to differentiate the average cost charge by characteristics of congestion and environment. First experiences with a differentiation of prices on the base of EURO emission standards in Switzerland and a study on environmental differential of charges for HDV in Germany show that a charging system based on a club principle and differentiated according to lever points of decision making on technology and capacity use has higher chances of being accepted than a marginal cost based pricing scheme.

6 Conclusion

As soon as one relaxes the strict assumptions of neo-classical welfare theory the “first-best” – rules like marginal cost pricing collapse. In the real world it is the major issue of economic advice to consider the dynamic incentive patterns, the acceptability and the institutional consequences of a pricing scheme. Once these aspects are introduced step by step into the analysis the pricing of transport infrastructure on the base of marginal costs is no longer optimal, on the contrary, it can lead to serious disturbances of long term incentives. It can easily be shown that the introduction of a budget constraint leads already to the result that nonlinear, non-uniform pricing such as multi-part tariffs is Pareto-superior. When trying to develop better schemes than SRMC pricing one should remember the lessons of F. A. Hayek and J. A. Schumpeter:
“Much more serious than the fact that prices may not correspond to marginal cost is the fact that, in an intrenched monopoly, cost are higher than necessary” (Hayek, 1948).

[1] This does not necessarily imply that benefits (costs) are distributed equally.

“A system which is efficient in the static sense at every point of time can be inferior to a system which is never efficient in this sense, because the reason for its static inefficiency can be the driver for its long-term performance” (Schumpeter, 1950).

Putting the emphasis on the long-term adaptive efficiency (see North, 1990) rather than the static efficiency of the transport system the following principles are proposed:

- Separate charging from taxation and put the charging regime in a clear institutional environment. Main issue of charging should be the optimal development of the infrastructure. An appropriate differentiation of the charges can set incentives for better capacity use. The institutional setting should provide clear rules for where the money goes and what it will be spent for.
- As soon as institutional regimes include private participation and risk taking there should be private responsibility for price setting. Private firms will automatically prefer nonlinear pricing schemes to apply price discrimination. The state then has to define price caps to avoid monopolistic price discrimination and barriers to entry.
- Fairness is an important issue for long-term incentives to provide the right capacities and acceptability.of a pricing scheme. This can be fostered by the club principle, either institutionalised (e.g.: railway or airline companies could own shares of the infrastructure company) or fictitious (cost allocations are computed on the assumption that a club were existing).
- A pricing scheme for the transport sector is not necessarily uniform. There can be different schemes for different modes (road, rail, airline, waterway shipping), network parts (motorway, secondary, urban) or regions (sensitive areas).
- A pricing scheme is not the only way to influence behaviour. Therefore it has to be adjusted to the regulatory environment and the taxation system.
- There should be flexibility in the pricing system to include learning effects over time. The main issue from the European perspective is not that prices are equal in all countries or the same theoretical principles are applied. The main issue is that fair competition is guaranteed and unfair discrimination beyond countries and beyond modes is excluded. This does not presuppose that pricing in the transport sector is perfectly homogenous.

Appendix: Some Results from Cost Estimations

A1: Comparison of Marginal and Average Costs for the Railways

Source: TRL et al. 2001

	Sweden [1]	Finland [1]	Germany [2]	Switzerland[3]	France [4]
average track maintenance	0,35 cent/tkm 1,8 Euro/km	0,22 cent/tkm 1,1 Euro/km	-	2 Euro/km 0,4 cent/tkm	-
marginal maintenance	0,001-0,09 cent/tkm (3)	0,002-0,003 cent/tkm (3)	-	-	-
average operation + maintenance	-	-	1,6 cent / tkm	3,4 Euro/train km (2), (5) 0,68 cent/tkm	-
marginal operation + maintenance	-	-	-	-	0,23 cent / tkm (4) 1,15 Euro/km

tkm referring to gross ton-kilometres, km to a 500 gross ton train.

(1) including: Maintenance, administration, operational services, railway-police

(2) including: Maintenance, stations

(3) marginal long term

(4) marginal long term, referring to virtual tkm (cf. part 4).

[1] Johannson (2001)
[2] Link, DIW (2000)
[3] Ecoplan (1997)
[4] EUNET D12 (1998)

A2: Marginal Cost of Road Traffic

Source: Infras and IWW, 2000

MSEC: Marginal Social External Costs

Detailed marginal congestion values (Euro / 1000 km)	Marginal values per vkm			Marginal values per pkm / tkm		
	MSEC	Charge	Av. DWL	MSEC	Charge	Av. DWL
Passenger car on motorway						
- relaxed traffic	11	11	0.0	5.6	5.6	0.0
- dense traffic	1’977	1’004	77.6	1'040.7	528.5	40.8
- congestion	2’032	1’478	194.6	1'069.5	777.8	102.4
Passenger car on rural road						
- relaxed traffic	37	37	0.0	19.6	19.6	0.0
- dense traffic	1’254	803	2.1	659.8	422.6	1.1
- congestion	1’951	1’687	28.3	1'026.8	888.0	14.9
Passenger car on urban road						
- relaxed traffic	26	26	0.0	18.5	18.5	0.0
- dense traffic	2’708	1’595	60.1	1'934.3	1'139.2	42.9
- congestion	3’096	2’205	178.5	2'211.5	1'575.2	127.5
Motorcycle on motorway						
- relaxed traffic	5	5	0.0	4.9	4.9	0.0
- dense traffic	989	502	38.8	898.8	456.5	35.3
- congestion	1’016	739	97.3	923.7	671.7	88.4
Motorcycle on rural road						
- relaxed traffic	19	19	0.0	17.0	17.0	0.0
- dense traffic	627	402	1.0	569.8	365.0	0.9
- congestion	975	844	14.1	886.8	766.9	12.9
Motorcycle on urban road						
- relaxed traffic	13	13	0.0	11.8	11.8	0.0
- dense traffic	1’354	798	30.0	1'230.9	725.0	27.3
- congestion	1’548	1’103	89.2	1'407.3	1'002.4	81.1
Bus on motorway						
- relaxed traffic	21	21	0.0	1.1	1.1	0.0
- dense traffic	3’955	2’009	155.1	197.7	100.4	7.8
- congestion	4’064	2’956	389.2	203.2	147.8	19.5
Bus on rural road						
- relaxed traffic	75	75	0.0	3.7	3.7	0.0
- dense traffic	2’507	1’606	4.2	125.4	80.3	0.2
- congestion	3’902	3’375	5.6	195.1	168.7	2.8
Bus on urban road						
- relaxed traffic	52	52	0.0	3.4	3.4	0.0
- dense traffic	5’416	3’190	120.2	361.1	212.7	8.0
- congestion	6’192	4’411	356.9	412.8	294.0	23.8
LDV on motorway						
- relaxed traffic	16	16	0.0	53.5	53.5	0.0
- dense traffic	2’966	1’506	116.4	9'887.1	5'021.2	387.8
- congestion	3’048	2’217	291.9	10'160.2	7'389.2	972.9
LDV on rural road						
- relaxed traffic	56	56	0.0	186.6	186.6	0.0
- dense traffic	1’880	1’204	3.1	6'268.1	4'014.6	10.4
- congestion	2’926	2’531	42.4	9'754.3	8'436.4	141.4
LDV on urban road						
- relaxed traffic	39	39	0.0	129.3	129.3	0.0
- dense traffic	4’062	3’292	90.1	13'539.9	7'974.5	300.4
- congestion	4’644	3’308	267.7	15'480.5	11'026.5	892.3
HDV on motorway						
- relaxed traffic	27	27	0.0	4.8	4.8	0.0
- dense traffic	4’944	2’511	193.9	882.8	448.3	34.6
- congestion	5’080	3’695	486.5	907.2	659.7	86.9
HDV on rural road						
- relaxed traffic	93	93	0.0	16.7	16.7	0.0
- dense traffic	3’134	2’007	5.2	559.7	358.4	0.9
- congestion	4’877	4’218	70.7	870.9	753.3	12.6
HDV on urban road						
- relaxed traffic	65	65	0.0	11.5	11.5	0.0
- dense traffic	6’770	3’987	150.2	1'208.9	712.0	26.8
- congestion	7’740	5’513	446.1	1'382.2	984.5	79.7

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