

BUDAPEST UNIVERSITY OF TECHNOLOGY AND ECONOMICS
DEPARTMENT OF TRANSPORT ECONOMICS
TRANSPORT SCIENCE PH.D. PROGRAM

MARGINAL COST BASED PRICING MODELL IN THE RAILWAY TRANSPORT

overview of Ph.D. thesis

By:

Péter Rónai

*M.Sc. in Transportation Engineering,
engineer - economist*

Scientific Supervisor:

Katalin Tánczos, D. Sc.

2003 Budapest

ACKNOWLEDGEMENTS

Accomplishing my Ph.D. thesis wouldn't have been possible, in case I can't live in such an environment that was provided me by my family, and if my research work is not bolstered by high educated, furthersome professionals. The following lines are dedicated to them.

Many thanks to my **family**, above all to my **parents** that they widely provided me the balanced, peaceful environment, which was needed for the successful work.

I thank to **Katalin Tánczos, D. Sc.** as to the leader of my department and to my scientific supervisor, that she assumed the treatment of my research topic, and that in the course of the work she afforded indispensable help to me. Furthermore, I thank to her that - as the leader of the Dpt. of Transport Economics – she continuously provided the necessary equipment and financial background which was needed to my research and publication activities.

Additionally, I thank to my colleagues at the department, to **Zoltán Bokor, Ph.D., Dr. Istvánnak Magyar, Gyula Farkas, Ph.D.** and, without mentioning their name, all other workmates who contributed to my successful research work.

I have to say special thanks to **Prof. Werner Rothengatter** and his colleagues at the University of Karlsruhe, Institute of Economic Policy and Research because they accommodated me for a visit, and made possible to get acquainted with the earlier results of the literature and some new research outcomes.

I want to say emphatic thanks to the associate, **Erzsébet Domokos** at the Hungarian State Railways who offered professional answers to my technical questions while having a hard daily work to perform. I thank to the leader of the Rail Traffic Department at the Ministry for Economy and Transport, **László Polgár**, that he provided essential help to me in an early stage of preparation of my thesis.

1. THE TASK AND PRECEDENTS OF THE RESEARCH WORK

1.1 *The theme of the research*

In the competition for technological, economical and social efficiency the professionals and researchers of each scientific fields are working on the escalation of new results, in order to improve welfare in the society. The transport economist – having an interdisciplinary research field – are no exception of this: they have the simultaneous task of providing economical and social welfare, of providing efficiency and equity and of providing technological optimum for transport processes.

A characteristic topic of this theme is to configure the cost calculation system and pricing method of the transportation companies, including railway companies: in this case the researcher can not avoid the basic technical processes that are described by financial ones, and have special attributes, constraints and barriers. At the same time, attention has to be paid to the instructions of the economic theory, in order to help the railway company to contribute to the increase of social welfare. One of the currently consorting optimisation theories in economics is the neo-classical doctrine with its marginal costs and marginal revenues.

The neo-classical school was founded by Walras, and by his mathematical model that describes the usage of marginal costs and marginal revenues [Wal87]. First application of this was evolved at the beginning of the 20th century with the welfare theories of Marshal [Mar16] and Pigou [Pig24], later with the overwork of this by Hotelling [Hot38]. As a result of their work, a new, prospective challenge was revealed before theorists and practitioners of the economics: the mathematical equations that were resulted from the research don't only provide the profit-maximum of the company, but, at the same time they show the way to the optimal capital-allocation and efficiency among companies for the society.

The advocacy of application of the neo-classical equilibrium welfare theory and its marginal cost approach showed a cyclic alternating process during the 20th century. More scientists queried its equity issues and applicability. But its advantages did not let scientists to come by the theory without consideration when having the task of economic optimisation. This is well reflected by the fact that in the recommendations of the Commission of the European Union the theory of marginal cost based pricing become more and more stressed. One of the most broadly discussed topics of the announced research framework programmes is the examination and valuation of the marginal cost theory. In the work and recommendations of the DG TREN the Commission's opinion seems to be reflected: more examination of methods are needed that can help to utilise better the society's scarce resources, let it be about tolls for using transport infrastructure, about analysis and monetarisation of external effects of transport activities, profitability of transport companies, utilisation of transport assets from social point of view, or about optimal capital, made available for transport companies.

As a result of all this, the Commission reframed the possibilities of marginal cost pricing in the 1995 Green Paper [Ecm95] and in the 1998 White Paper [Ecm98], and recommended its usage for the transport sector, allowing exceptions only in special cases. Since in the following years the applicability of the scheme was widely discussed, the attitude of the Commission changed: under some circumstances, only the limited usage of the rule is desired. Now, as a result of earlier research, the better cost coverage solutions make the marginal cost equation more accurate.

My research work – after disclosing the theoretical background of the marginal cost pricing rules – searched for solutions of applicability using the example of European railway companies, and in particular the Hungarian State Railways. During the negotiation, usually the economical viewpoint was the first, while the practical applicability was continuously paid attention to. This latter was a strong aim, since the developed model need to be beneficial for the railway company, a non-usable theoretical innovation is without any value.

1.2 Overview of the literature

The marginal cost theory passed more “scientific cycles” since its appearance at the beginning of the 20th century [Rot01a]. Its history was not a linear development, the “periodical” adjective is more appropriate, since, in certain time intervals the theory started to decline. After its appearance the theory was very popular thank to the mathematical optimum, regarding company and asset efficiency. The neo-classical economists (like Walras, Marshal and Hotelling) dedicated special attention to the elaboration of the mathematical equations and their application.

The marginal cost theory was born on the basis of production industry (machinery, textile, toys, etc.), its adaptation in the service sector started later, and in the transportation even later. Application within the transport industry is delayed with one time period compared to the one in the production industry. The following literature overview starts with the appearance of the marginal cost theory within the transport sector (early 1960's), when the industrial application was already over the first disappointment. After completing the theory, scientists started to elaborate on the constraints and barriers, and as a result of the numerous disadvantages, the theory started to get over. When it appeared in the transport sector, its popularity within the production industry was again appreciating. This might has been the real reason for the trials within the transport industry. Next phases show, which turning-points the marginal cost theory has gone over within the transport sector.

1st phase (1960-1967). The marginal cost theory – elaborated for industrial applications – was “transplanted” to the transport sector [Oor61]. Already at this stage the bad cost coverage appeared in the communications of the Commission [Ecm65]. However, the theory has been accepted by transport economists, especially by those, who had strong neo-classical background (“the marginalists”).

2nd phase (1967-1975). It is recognised that within the transport sector the proportion of the fixed costs is relatively high and these are independent from the change of output. Together with the problem of the fact, that average costs are over the marginal costs, this causes a certain disappointment (because of the bad cost coverage). The Commission is intensely engaged with the problem of the bad cost coverage and of the budget deficit [Ecm71]. More other ideas appeared to reach a better cost coverage, even if “leaving” the original marginal cost rule. In some cases authors have suggested to return to the average cost based prices instead of having problems with the “new” marginal costs.

3rd phase (1975-1982). A very strong draw-off from the standard marginal costs is observable that practically means the abandon of the marginal equations. Other methods are elaborated, that use the term “marginal costs” but in fact the price basis is far from that. One of them is the theory of multiple tariffs [Wil78] and the club principle [Lit77].

4th phase (1982-1990). In this period the marginal cost rule is still not as popular as before (in the 1st and 2nd phases), but researchers tend to consider it again as a price-basis. First of all, those methods are gathering ahead that help to support the traffic policy serving the priorities of sustainable development. Institutional constraints and barriers [Ree86] and the effects of these to the investments [Wil89] are treated with especial attention.

In the third and fourth phases theorists pay attention to particular constraints as first, e.g.: convexity of functions, cost-dependencies on time, and the continuously occurring unbalanced equity. Solving the problems on these particular fields – or at least the determination of the disposal of them – does not mean to organise all sub-optimums along an overall theory. Those who want to have more general outcomes try the simulation-tools. This generates a further discussion between theorists and practitioners of the transport economics. The “conflict” leads to the frustration of the theorists, and gives a boost to ongoing research work in the 5th phase.

5th phase (1990-1998). The Commission wanted to arrange the more decade long discussion in the topic of the marginal cost based prices within the transport sector, and announced the research framework programmes within this field. This came up with the renaissance of the neo-classical theory that was introduced also in the white paper of the Commission [Ecm98].

6th phase (1998-). With the reviving of the neo-classical theory the drawbacks of the bad cost coverage appeared as well, when it was about elaborating on solutions for the practical applications. In case of the railways some multipliers became allowed in order to achieve better cost coverage [Ecm01]. In case of the roads practically the average cost based prices are accepted [Rot02a]. If we try to arrange these attempts within the above described cycles, it can be experienced that the Commission wants give a new form for the efforts carried out in the 1970’s.

Aim of the dissertation was in this development process to provide a clear picture regarding the theoretical and practical relations, and, furthermore, to give a new form for railway business cost functions, to suggest an applicable system for using marginal costs as price basis.

2. THE METHOD OF THE RESEARCH

2.1 Aims of the research work

The domestic and the international business research work has recovered those battle-criteria that are needed for companies that want to keep alive on the market in a long term. Besides the customer satisfaction, quality assurance, and other expectations one of these criteria is the efficiency of the business planning processes. One element of this is the proper configuration of the cost calculation methods, and the suitable setting of the pricing policy to the costs.

The current cost calculation method of the Hungarian State Railways (MÁV Rt.) meets some important requirements, and keeps the calculation on a stable way within the company. Still, it seemed to be necessary to provide some further suggestions that can help the company to fit its business processes better to the needs of the market. These suggestions can be elaborated within a new cost calculation model, as the best. When planning the new model, the following requirements seemed to be the most important:

- to make possible to represent the economical methodology within the company;
- to utilise and to practice the domestic and international research results, that can help the company to achieve better efficiency;
- to eliminate the drawbacks of the current cost calculation system, and to give solutions for the difficulties without giving up the available features;
- to be usable in the everyday-life of the company, not only to give theoretical assumptions;
- to eliminate all serious drawbacks that could inhibit its practical usage.

It was evident already at the beginning of the research work that the marginal cost theory (and social optimum) can solve many of the current problems. At the same time, it has some serious drawbacks that its “pure” – i.e. definition-like – usage is not possible for a railway company.

According to preliminary efforts, if we can adopt some elements from the marginal cost theory, but do not insist on the classic definition, a special business model could be elaborated that considerably improves the efficiency of the business processes and serves the better utilisation of the current assets.

2.2 The used approach

The elaboration of the applied model of the marginal cost theory was started with the experience of the meaning of the “pure” marginal cost rule: according to the guide of differential algebra, function-analysis was carried out. I’ve determined the maximum of the profit function, examined the intersection points of cost curves and – in compliance with the market structures – elaborated the control directives for an economic company.

In order to make the directives of the marginal cost theory applicable for the railway company, I’ve carried out the structural analysis of the railway market. Using the market concentration indicators and exploring the behaviour of competitors I’ve determined the conformity between micro-economical categories and the real railway market. This conformity can be described by the compliance of constraints and how they work in practice. Therefore, I’ve dedicated a separate chapter for examining how the real market can fit into the theoretical constraints.

To achieve the desired stability of the prepared model, the dynamic interactions between the company and its environment need to be known. The legal- and (as a result of this) the competitive environment of the railway company is audited by the coming changes in the legal constraints. In this aspect, the specialities of the EU-accession is underlined.

The preliminary examination of the marginal cost theory resulted that there are a lot of arguments against its usage in practice. This is why I paid particular attention both to the theoretical and to the practical difficulties regarding its application. Exploration of these was mainly carried out by the study and critical overview of the available literature.

In order to achieve better embedding of the new model within the company, I’ve managed to look through and to aggravate the current cost calculation system, with special regards to its opportunities and threats.

The conception of the new model was build up with the tool-system of strategic modelling. During this I’ve used the general requirements composed to cost calculation processes, and the elements of this requirements were coupled with ones of the used elements of the marginal cost theory. When considering the cost-functions within the model, the company was examined in the previously explored market environment.

By constructing the applied price function, the general pricing method of the railway companies were examined as first, and the state’s decision-influence role was taken into consideration. Later on, these effects were structured by configuring the price-function and its mathematical expression.

Information that influence the decisions of the management were structured in order to be able to elaborate on the decision-support system of the model. Working up the decision support system was started with the definition of the essential sys

tem elements. Using connection-evaluation methods the contact of these with each other and with basic data elements were formed.

When scheduling the implementation of the model, network- and logical scheduling methods were used. I took the time constraints, and the logical order subalternation of the elements into consideration, with special regards the possible parallel steps for the acceleration of the process.

The proving of the new model was carried out by test calculations with real and as much as possible detailed data. The calculation process was embedded into a demonstration of the decision-support system of the model.

3. NEW SCIENTIFIC ACHIEVEMENTS, THESIS

As a result of my research activities, I've elaborated a new cost calculation method that supports the company's decision making system with enforcing the advantages of the marginal cost theory, while eliminating most of its drawbacks. The process got the name: "*account based marginal cost model*".

In the dissertation as an "account based marginal cost model" is referred the business management structure that ensures the collection, analysis and usage of data for the decision support system according to the marginal cost theory. But, the production of the company is valued and priced along a different pattern, using the price function.

My scientific achievements can be summarised in the following seven thesis:

1. **I've elaborated a cost-calculation method for the railway company, based on the business cost allocation and decision-making. This keeps the advantages of the marginal cost theory while eliminates the most serious drawbacks.** I've defined the contents and structure of the cost record used for data acquisition. I've processed the cost-collection procedure that provides the necessary basic data for the account based marginal cost model. I've scheduled the time-dependent aggregation of the cost record. I've formalised the functions between the cost components and the performance of the railway company (5.1 sub-chapter of the dissertation). Function groups that refer to the cost records are shown as follows:

$$\begin{aligned}
 PDC_1 &= fp_1(q_1) + fp_2(q_1) + \dots + fp_n(q_1); \\
 PDC_2 &= fp_1(q_2) + fp_2(q_2) + \dots + fp_n(q_2); \\
 &: \\
 PDC_m &= fp_1(q_m) + fp_2(q_m) + \dots + fp_n(q_m); \\
 &: \\
 ADC_1 &= fa_1(q_1) + fa_2(q_1) + \dots + fa_q(q_1); \\
 ADC_2 &= fa_1(q_2) + fa_2(q_2) + \dots + fa_q(q_2); \\
 &: \\
 ADC_m &= fa_1(q_m) + fa_2(q_m) + \dots + fa_q(q_m); \\
 &:
 \end{aligned}$$

$$\begin{aligned}
IDC_1 &= f_{i_1}(q_1) + f_{i_2}(q_1) + \dots + f_{i_r}(q_1); \\
IDC_2 &= f_{i_1}(q_2) + f_{i_2}(q_2) + \dots + f_{i_r}(q_2); \\
&\vdots \\
IDC_m &= f_{i_1}(q_m) + f_{i_2}(q_m) + \dots + f_{i_r}(q_m); \\
&\vdots \\
NDC_1 &= f_{n_1}(q_1) + f_{n_2}(q_1) + \dots + f_{n_s}(q_1); \\
NDC_2 &= f_{n_1}(q_2) + f_{n_2}(q_2) + \dots + f_{n_s}(q_2); \\
&\vdots \\
NDC_m &= f_{n_1}(q_m) + f_{n_2}(q_m) + \dots + f_{n_s}(q_m); \text{ where}
\end{aligned}$$

- 1...m: number of railway activities,
1...n: number of perfectly direct cost (PDC) components,
1...q: number of adherent direct cost (ADC) components,
1...r: number of imposable direct cost (IDC) components,
1...s: number of non-direct cost (NDC) components,
 f_{p_i} : function of PDC elements;
 f_{a_i} : function of ADC elements;
 f_{i_i} : function of IDC elements;
 f_{n_i} : function of NDC elements;

The most important results of the model compared to the marginal cost theory is indicated in table 1.

<i>Comparison parameter</i>	<i>Marginal cost theory</i>	<i>Account based marginal cost model</i>
optimal utilisation of assets	feasible	can be reached
microeconomic constraints	fulfilment of them is basic need	fulfilment makes comprehensive work, but it is no need
price fluctuations	can be very strong	the price function eliminates them
free pricing policy	not feasible	feasible
equity of prices	not assured because of the pure economic optimisation	can be reached (through the parameters of the price function)
implementation phase	big transient fluctuations within the transport sector	moderated fluctuations

Table 1: Comparison of the account based marginal cost model and the marginal cost theory

2. **I've determined the cost curves of the railway company for monopolistic and competitive market environment, and interpreted the characteristic form of this with respect to the output.** I've proceed the examination of the classical mico-economic cost curves. I've exploited the process that leads to the equilibrium by considering the specialities of the competitive market. I've stretched the difference to the optimal equilibrium, and analysed the possible solutions for this problem (price corrections, administrative fill-up of the capacity, state finance, 5.2 sub-chapter).

3. **I've defined the applied price function within the account based marginal cost model, and provided a mathematical formula for it, that values the production of the railway company in the market.** In order to construct the function, I've grouped the factors that influence the pricing process of the state-owned railway company. I've provided a matrix for these factors, and established the price function (5.3 sub-chapter). The mathematical formula for the price function is:

$$P = [p_1, \dots, p_m] = [s_1^T \cdot t_1, \dots, s_m^T \cdot t_m]$$

scalar multiplication of vectors, where:

1...m: number of railway activities;

p_i : price function of each service segments;

s_i^T : linear vector, the i. row of the $S_{m \times (n_1+n_2+n_3+n_4)}$ -es weight-matrix, i.e. the weight of the function elements of the i. railway activity (service), while:

$$\sum_{j=1}^{n_1+n_2+n_3+n_4} s_{ij} = 1, \text{ and;}$$

t_i vertical vector, the i. column of the $T_{(n_1+n_2+n_3+n_4) \times m}$ function matrix, n_i : number of variables in each function-groups.

4. **I've structured the information responding to the inputs of the decision-making of the company, and elaborated the connection of these with the basic data set.** I've limited the events that can be modelled with the new system. I've configured the basic-data matrix for arranging financial- and real statistical data and indexes (6.1 sub-chapter). The structure-matrix of ground data is shown in table 2.

		groups of financial statistics			
		PDC elements	ADC elements	IDC elements	NDC elements
groups of real statistical data	passenger km	fc ₁₁ vs. rc ₁₁	fc ₁₂ vs. rc ₁₂	fc ₁₃ vs. rc ₁₃	fc ₁₄ vs. rc ₁₄
	tonne-km	fc ₂₁ vs. rc ₂₁	fc ₂₂ vs. rc ₂₂	fc ₂₃ vs. rc ₂₃	fc ₂₄ vs. rc ₂₄
	gross tonne-km	fc ₃₁ vs. rc ₃₁	fc ₃₂ vs. rc ₃₂	fc ₃₃ vs. rc ₃₃	fc ₃₄ vs. rc ₃₄
	axle-km	fc ₄₁ vs. rc ₄₁	fc ₄₂ vs. rc ₄₂	fc ₄₃ vs. rc ₄₃	fc ₄₄ vs. rc ₄₄

Table 2.: Basic data structure matrix

5. **I've elaborated a new decision-making system for the company, that interposes the market reactions for the company and makes possible to utilise the benefits of the account based marginal cost model.** During the process I've defined the essential steps, and analysed their connection. The decision support system was constructed with respect to self-correction methods. As a result, an integrated answer is provided for the appearing problems (6.2 sub-chapter).
6. **I've scheduled the implementation process of the model by logical and time scales.** The scheduling devotes special attention to the possible – but not unreal – acceleration of the initiation process. The conversion steps from the current system to the new one consider the continuous work of the calculation method (6.3 sub-chapter).

4. EXPEDIENCE OF THE NEW SCIENTIFIC ACHIEVEMENTS

The utilisation of the result of the research work is of a manifold nature. It provides advantages for the railway company that decides about the implementation as first, but it can be incorporated into the education activities within cost calculation systems and microeconomic applications.

For the railway company the utilisation of the results of the research can assure the following advantages:

- It ensures to access arbitrary the optimal usage of assets available for the railway company. Taking into consideration the fact, that the railway's assets are in public ownership, and mean a big proportion of the national assets, the optimal usage can have essential benefit. The "grade of optimality" can be measured and planned (1. thesis: model structure and 2. thesis market equilibrium).
- Eliminates the big price-variations of the "pure" marginal cost theory, and stabilises the market (3. thesis: price function).
- An arbitrary price policy is possible through the desired usage of the price function. Both the market signals and state priorities can be reflected in the prices (3. thesis: price function).
- It improves significantly the transparency of business processes. The activity-based-costing like calculation method makes clear for both the management and for the state the cost of each particular activities/products. Information is provided about the costs of the extension of certain activities. This can be embedded into the decision-making system of the company (4. thesis: data structure and 6. thesis decision making system).
- Its implementation results in a significant improvement of the controlling system of the company. The developments offset the company towards market-conformity (1. thesis: model structure and 6. thesis: implementation process).
- Contributes to the awareness of the activity-cost-income-benefit chain within the company (2. thesis: forms of cost curves).
- Helps the analysis of the inefficient activities, to discover the especially high cost components (1. thesis: data acquisition).
- Its work can be realised under not absolutely "clear" microeconomic conditions as well. The profit maximisation of the company is not needed, it works within semi-rational market environment, incorporates the out-of-the-market instructions, no homogenous competitive market is assumed, and follows well the real market's conditions (1. thesis: model structure).
- Cost coverage can be – within certain limits – adjusted arbitrary by the desired construction of the price function, demand and price elasticity, and the output-compensation (2. thesis: market equilibrium and 3. thesis: price function).

- The model is much more stable than the marginal cost rule itself. It is less sensitive to the change of input basic data, because the market behaviour is only in an indirect contact with the market equilibrium (2. thesis: market equilibrium).

5. LITERATURE

5.1 The author's technical literature coupled to the dissertation

Rónai, P.: Cost Estimation Methods of Transport Infrastructure Projects, *Periodica Polytechnica, Ser. Transportation Engineering*; vol. 29. No. 1-2. 2001 p. 107-116.

Rónai, P.: Marginal Cost Calculations and Price Discrimination in the Railway Freight Sector, *Periodica Polytechnica, Ser. Transportation Engineering*; vol. 30. No. 1-2. 2002 p. 79-88.

Rónai, P.: Marginális költség alapú árak alkalmazási lehetősége a vasúti fuvarozásban (Usage Possibilities of Marginal Cost Based Prices in the Railway Freight Sector), *Vezetéstudomány (Budapest Management Review)*, 2003/3, p. 53-60.

Rónai, P.: Marginal Cost Based Pricing Policy in the European Transport Sector, *In: MicroCAD 2001 International Scientific Conference, University of Miskolc, Section R: „European Union and Regional Economics” 1-2. March, 2001. p. 61-66.*

Tánczos, K., Rónai, P.: Közlekedésgazdaságtan előadásjegyzet (*Transport Economics Presentations*) electronically published at <http://www.tar.hu/kozlekedesgazdasagtan> , 2001.

5.2 Other technical literature of the author

Tánczos, K., Rónai, P.: BUDAPEST – On the Way to Join the IDIOMA Project, *Periodica Polytechnica, Ser. Transportation Engineering*; vol. 28. No. 1-2. 2000 p. 91-102.

Rónai, P.: A Logisztikai stratégiaalkotás térségi és időhorizontjai (Geographical and Time Horizon of Logistic Strategy-Making), *Vezetéstudomány (Budapest Management Review)*, 2001/09. p. 25-30.

Tánczos, K., Duma, L., Rónai, P.: External Costs and Benefits of Waterborne Freight Transport in Europe, *In: European Inland Waterway Navigation Conference (EIWN), Budapest, 13-15. June, 2001*

Tánczos, K., Rónai, P.: Major Improvements and Challenges in the Transport Logistics along the 5th Corridor in Hungary, *In: International Conference on Cost Effective Infrastructure and Systems to Improve Cargo and Passenger Transport in s. Eastern Europe, Budapest, Hungary, 16-19. October, 2001*

Rónai, P.: A city-logisztika megvalósítási lehetőségei a budapesti agglomerációban, különös tekintettel a technológiafejlődés irányaira (Application Possibilities of the City Logistics Within the Gross Area of Budapest, with special attention to the technological development), *XV. Szállításszervezési Szakkonferencia (15th International Freight Forwarding Conference)*, KTE, Balatonvilágos, 29. nov. 2000.

Rónai, P.: A közlekedéépítés externális gazdasági hatásai, különös tekintettel ezek tükröződésére a megvalósíthatósági vizsgálatokban, (External Effects of Transport Asset Construction with special regards to the Feasibility Studies) *BME Ipari Nyílt Napok (Industrial Open Days)*, section: „Közlekedés és környezet (Transport and Environment)” presentation, 28. feb. 2001.

Rónai, P.: A vasúti közlekedési externális hatások számszerűsítési lehetőségei (Enumeration Possibilities of Railway Externalities), *MÁV üzemmérnöki tanfolyam (Hungarian State Railways courses)*, 23.-25. apr. 2002.

5.3 The processed literature in the dissertation

- [Arn63] Arnim, C.: Die Preisdifferenzierung im Eisenbahngüterverkehr, ihre theoretische und wirtschaftspolitische Begründung; *J. C. B Mohr, Tübingen, 1963.* p. 38-88.
- [Bau70] Baumol, W. J. – Bradford, D. F.: Optimal Departures from Marginal Cost Pricing; *American Economic Review, 07/1970.*
- [Ber58] Berkenkopf, P.: Die gemeinwirtschaftliche Verkehrsbedienung der Deutschen Bundesbahn; *Die Bundesbahn, Darmstadt, 1958.*
- [Bok02] Bokor, Z.: A tevékenység alapú költségszámítás alkalmazása a vasúti közlekedésben; *Közlekedéstudományi Szemle, 2002/12.* p. 449-456.
- [Böt77] Böttger, W.: Kosten und Kostenrechnung bei Güterverkehrsbetrieben; *Verkehrs-Verlag J. Fischer, Düsseldorf, 1977.* p. 50-75.
- [Bri63] Bringewald, W. R.: Wirtschaftlichkeitsrechnungen für den Einsatz von Mitteln des kombinierten Verkehrs auf der Grundlage der Standard-Grenzpreis-Rechnung; *Rationeller Transport, 1963.*
- [Bro83] Brown, D. J. – Heal, G. M. – Khan, M. A. – Vohra, R.: On a General Existence Theorem for Marginal Cost Pricing Equilibria; *Journal of Economic Theory, New York Academic Press, 1983-1986.* p. 371-379.
- [But93] Button, K. J.: Transport Economics – 2nd ed.; *Cambridge University Press, 1993.* p. 123-147.
- [Cap01] Concerted Action on Transport Pricing Research Integration CAPRI Final Report; *European Commission, Transport RTD programme; 2001.*
- [Cmh01] Cost Matrices Handbook: Estimates of the Short-Run Marginal Costs of Transport; *European Commission DG Transport & Energy, 2001.*
- [Csr01] Case Studies and First Round Reforms; *European Commission, DG Transport & Energy, 2001.*

- [Det99] Dpt. of the Environment, Transport and the Regions: Transport and the Economy – The Standing Advisory Committee on Trunk Road Assessment; *United Kingdom, 1999.*
- [Duf92] Duft, H.: Gegenwärtige Wohlfahrtskomponente; *Socialuntersuchung des Deutschen Institutes für Wirtschaftspsychologie, Berlin, 1992.*
- [Ecm65] European Commission: Possibility of Pricing Policy in Transport (Allais-Report); *Brussels, 1965.*
- [Ecm71] European Commission: Proposal for a Council Decision on the Introduction of a Common System for Transport User Charges; *Brussels, 1971.*
- [Ecm98] European Commission: White Paper on Fair Pricing for Transport Infrastructure Use; *Brussels, 1998.*
- [Ecm01] European Commission: Transport Policy for 2010: Time to Decide; *White Paper, Brussels, 2001.*
- [Ecn91] European Council: Council Directive 91/440/EEC on the Development of the Community's railways; *Brussels, 29 July 1991.*
- [Ecn95a] European Council: Council Directive 95/18/EC on the Licensing of Railway Undertakings; *Brussels, 19 June 1995.*
- [Ecn95b] European Council: Council Directive 95/19/EC on the Allocation of Railway Infrastructure Capacity and the Charging of Infrastructure Fees; *Brussels, 19 June 1995.*
- [Ecn01] European Council: Council Directive 2001/14/EC on the Allocation of Railway Infrastructure Capacity and the Levying of Charges for the Use of Railway Infrastructure and Safety Certification, *Brussels, 26 February 2001.*
- [Erc98] Economic Research Centre: User Charges for Railway Infrastructure; *Report of the Hundred and Seventh Round Table on Transport Economics, 1998.*
- [Eyn56] Eynern, G. v.: Das öffentlich gebundene Unternehmen; *Willersdorfer Verlag, 1956.*
- [Far00] Farkas, Gy.: A vasúti infrastruktúra használatáért fizetendő pályahasználati díj meghatározásának európai gyakorlata és módszertani kérdései; *Közlekedéstudományi Szemle, 6/2000.*
- [Feh97] Fehérvári, L.: A közép- és kelet-európai vasutak árufuvarozásának árpolitikája; *Közlekedéstudományi Szemle, 6/1997. p. 201-205.*
- [Fis97] Fischbach, R.: Volkswirtschaftslehre I.; *R. Oldenbourg Verlag, München, 1997.*
- [Fis01] Fiscus Summary Report: Cost Evaluation and Financing Schemes for Urban Transport, 4th framework programme, founded by the *European Commission, 2001.*
- [Fki02] Máv Rt. Fejlesztési és Kutató Intézet: A vasúti közlekedés átfogó reformjának megalapozása; A pályahasználati díjszint forgalomra gyakorolt hatásának vizsgálatára szimulációs modellel; *Budapest, 2002.*

- [Gil91] Gillen, D. W. – Oum, T. H.: Transportation Infrastructure: Pricing, Investment and Cost Recovery; *The 6th World Conference on Transport Research, 1991*.
- [Har94] Harbeson, R. W.: Are Fixed or Variable Costs Desired in Railway Transportation? *Transport Science and Research, Paris, 1994*.
- [Hen47] Henderson, A. M.: The pricing of Public Utility Undertakings; *The Manchester School, 9/1947*.
- [Hen60] Henderson, A. M.: A Review of the Pricing Methods of Public Companies; *The Manchester School, 2/1960*.
- [Hot38] Hotelling, H.: The General Welfare in Relation to Problems of Taxation and of Railway and Utility Rates; *Econometrica 6. 1938. p. 242-269*.
- [Hut60] Hutter, R.: Das Grenzkostenprinzip in der Preisbildung der Verkehrsträger und seine Bedeutung für die Verkehrsteilung; *Industrie- und Handelskammer zu Köln, 1960*.
- [Inf99] Infrac, Zürich – IWW, Karlsruhe: External Costs of Transport; *UIC, France, 1999*.
- [Jan80] Jansson, J. O.: Transport system optimization and pricing 1.; *The Economic Research Institute, Stockholm, 1980. p. 30-101*.
- [Jan84] Jansson, J. O.: Transport System Optimization and Pricing 2.; *John Wiley & Sons Ltd., 1984. p. 229-245*.
- [Käf55] Käfer, K.: Standardkostenrechnung; *C. E. Poeschel Verlag, Stuttgart, 1955. p. 282-289*.
- [Kah35] Kahn, R. F.: Some Notes on Ideal Output; *The Economic Journal, 1935*.
- [Kil93] Kilger, W. – Kurt, V.: Flexible Plankostenrechnung, und Deckungsbeitragsrechnung; *Graphischer Betrieb Konrad Triltsch, Würzburg; 1993. p. 56-109., 162-171., 274-279., 875-879*.
- [Kop97] Koppányi, M. (szerk): Mikroökonómia; *Műszaki Könyvkiadó, Budapest, 1997*.
- [Kor83] Kornai, J.: A bürokratikus és a piaci koordináció; *Közgazdasági Szemle, Budapest, 1993/09*.
- [Kri66] Krischer, U.: Einführung in die Deckungsbeitragsrechnung in Verkehrsbetrieben; *Vortschrittsberichte, VDI Zeitschrift, Düsseldorf, 1966*.
- [Lan66] Lansing, J. B.: Transportation and Economic Policy; *Free Press New York; 1966. p. 44-58*.
- [Ler64] Lerner, A. P.: The Economics of Control; *Oxford University Press, 1964*.
- [Lew49] Lewis, W. A.: Overhead Costs; *MacMillan, London, 1949*.
- [Li_00] Li, C-Z.: What is Sustainable Transport? *Dpt. of Economics, University of Dalarna, 2000*.
- [Lie95] Liebowitz, S. J. – Margolis, S. E.: Are Network Externalities a New Source of Market Failure? *University of Texas, Dallas, 1995*.

- [Lit77] Littlechild, S. C. – Thompson, G. F.: Aircraft Landing Fees: A Game Theory Approach; *The Bell Journal of Economics*, 8/1977.
- [Lit81] Littlechild, S. C. – Thompson, G.F.: Overhead Capacities of Public Companies: Reasons and Results; *The Bell Journal of Economics*, 2/1981.
- [Lit87] Little, I. M. D.: A Critique of Welfare Economics; *Econometrica*, 4/1987.
- [Lös63] Lösenbeck, H-D.: Die Preisbildung der öffentlichen Unternehmen; *Dunckner & Humblot, Berlin, 1963.* p. 72-117.
- [Mai76] Maigny, Y.: La vente au coût marginal; *Paris-Versailles, 1963.*
- [Mai99] Maibach, M. – Schreyer, C. – Banfi, S. – Iten, R. – Haan, P.: Faire und effiziente Preise im Verkehr; *Bericht des Forschungsprogrammes „Verkehr und Umwelt“*, Bern, 1999. p. 41-158., A58-A73.
- [Man02] Mann, P. C. – Clark, D. M.: Marginal Cost Pricing: Its Role in Conservation; *Journal of the American Water Works Association*, 2002.
- [Mar16] Marshall, A.: Principles of Economics; *Macmillan London, 1916.*
- [Máv96] MÁV Rt. Számvetési Szakigazgatóság: A Magyar Államvasutak Rt. vasúti tevékenység önköltségszámítási szabályzata; *MÁV Dokumentációs Hivatal, 1996.*
- [Máv02a] Magyar Államvasutak Rt.: A MÁV Rt. 2003. január 1-jével bevezetendő új működési mechanizmusa és szervezeti struktúrája (tervezet); *Budapest, 2002.*
- [Máv02b] Magyar Államvasutak Rt.: Értesítő a MÁV Rt. 2002. január 1. napjától érvényes számlarendjéről, 17. szám. 2002. április 26.
- [Máv02c] A Magyar Államvasutak Rt. Hálózati Üzletszabályzata; MÁV Rt. Prototípus; *Infrastruktúra-használati Díjmeghatározó és Kapacitáselosztó Főosztály (IDKF), Budapest, 2002.*
- [Mea55] Meade, J. E.: The Theory of Inland Economic Policy: Trade, Transport and Welfare; *The Royal Institute of Internal Affairs; London, 1955.*
- [Mey72] Meyer, J. R. – Straszheim, M.: Techniques of Transport Planning, Vol 1; *The Brookings Institution, Washington D. C., 1972.* p. 11-29; 165-181.
- [Moi00] Moilanen, P.: Assessing the Economic Impacts of Marginal Cost Pricing with a Geographic Model for Helsinki Region; *Transport Systems – Organisation and Planning Research Conference, Stockholm, June 13-14. 2000.*
- [Mon79] Montgomery, R. H.: Government Ownership and Operation of the Electric Industry; *American Academy Annals, CCI, 1979.*
- [Mon00] Monigl, J.: A városi közlekedés valós költségeinek és finanszírozásának egyes kérdései; *Városi közlekedés, 2000/1. p. 33-48.*
- [Mül50] Müller, A.: Rechnung mit Grenzkosten als wirtschaftlicher Gefahrenquelle? *Verein Deutscher Maschienebau-Anstalten E. V., Frankfurt am M., 1950.* p. 10-15.

- [Nas02] Nash, C. – Matthews, B.: Rail Infrastructure Charging in Europe – principles and practice; *European Transport Conference, Cambridge, 10-11. September 2002.*
- [Nie93] Niehans, J.: Falsche Verkehrspolitik durch falsche Kostenrechnung; *Internationale Transportzeitschrift, Basel, 1993.*
- [Nis01] Niskanen, E. et al: MC-ICAM Approach to Pricing in Transport; *5th Framework Programme – DGTREN, 2001.*
- [Oor61] Oort, C. J.: Der Marginalismus als Basis der Preisbildung in der Verkehrswirtschaft; *Rotterdam, 1961.*
- [Pál03] Pálfalvi, J.: Árképzés és személyszállítás (II. rész); *Közlekedéstudományi Szemle, 2003/02. p. 41-53.*
- [Pap00] Papaioanou, P. – Parathira, C. – Vasiliadou, J. – Kopelias, P.: Marginal Cost Pricing: How Feasible it is? – The Athens Experience; *Athen, 2000.*
- [Peg78] Pegrum, D. F.: The Economic Basis of Public Policy for Transport; *Land Economics, Vol. 55, 1978.*
- [Pig24] Pigou, A.: The Economics of Welfare; *Macmillan London, 1924.*
- [Pla68] Plaut, H-G. – Müller, H. – Medicke, W.: Grenzkostenrechnung und Datenverarbeitung; *Verlag Moderne Industrie, 1968. p. 165-187.*
- [Pla88] Plaut, H-G.: Grenzplankostenrechnung; *Gabler Verlag, Wiesbaden; 1988. p. 74-104.*
- [Pol90] Polak, J. B. – Heertje, A.: Analytical Transport Economics; *Edward Elgar, Northampton, MA, U. S. A. 1990. p. 172-207., 216-223.*
- [Ram27] Ramsey, F. P.: A Contribution to the Theory of Taxation; *Economic Journal 37, 1927.*
- [Ree86] Rees, R.: Indivisibilities, Pricing and Investment: The Case of the Second Best; *Journal of Economics, 5/1986.*
- [Rie59] Riebel, P.: Das Rechnen in Einzelkosten und Deckungsbeiträgen; *Zeitschrift für Handelswissenschaftliche Forschung, 11/1959.*
- [Rkw60] Rationalisierungs-Kuratorium der deutschen Wirtschaft: Direct Costing – Das Rechnen mit Grenzkosten; *Beuth-Vertrieb GmbH, Berlin, 1960, p. 46-49; 64-71.*
- [Rkw69] RKW-Reihe: Direct Costing in der Praxis; *Forkel Verlag, Stuttgart, 1969. p. 56-79.*
- [Rot01a] Rothengatter, W.: How Good is First Best? Marginal Cost and Other Pricing Principles for User Charging in Transport; *University of Karlsruhe, under press, 2001.*
- [Rot01b] Rothengatter, W.: Flexible Cost Estimates for Transport Infrastructure Provision as a Base for User Charging Schemes; *University of Karlsruhe, under press, 2001.*
- [Rot02a] Rothengatter, W., Rommerskirschen, S.: Wegekostenrechnung für das Bundesfernstraßennetz als Grundlage für Streckenbezogene Straßenbenutzungsgebühren; *Studie für den Bundesminister für Verkehr, Bau- und Wohnungswesen, 2002.*

- [Rot02b] Rothengatter, W.: Pros and Cons of Cross-Financing from a Scientific Point of View; *IWW Karlsruhe*, 2002.
- [Rot72] Rothengatter, W.: Kosten- und Nachfrageorientierte Preisbildung im Verkehrssektor; *Akademische Dissertation, Universität Fridericiana (TH), Karlsruhe*, 1972. p. 81-149.
- [Rot91] Rothengatter, W.: Infrastructure Pricing, Cost Allocation and Investment in Europe; *Institute for Economic Policy Research of the University of Karlsruhe*; 1991. p. 21-28.
- [Rug72] Ruggles, N.: Recent Developments in the Theory of Marginal Cost Pricing; *The Review of Economic Studies*, 1972.
- [Sch83] Schneider, H. K.: Prinzipien der Energiepreisbildung; *Henker & Söhne Verlag, Hamburg*, 1983.
- [Tán00] Tánczos, K.: Az integrált közlekedési infrastruktúra hatékony működtetésének feltételrendszere; *MTA doktori értekezés*, 2000.
- [Tán01] Tánczos, K. - Farkas, Gy.: A vasúti pályahasználati díj EU-kompatibilis kialakítása; *Kutatási eredmények és hasznosításuk a közlekedésben konferencia, Győr*, 2001.11.08.
- [Tán98] Tánczos, K.: Igazságos és ésszerű árképzés a közlekedési torlódások kezelésére; *Közúti és Mélyépítési Szemle*, 1998/9, p. 323-330.
- [Tau91] Taussig, F. W.: A Contribution to the Theory of Railway Rates; *The Quarterly Journal of Economics, Boston*, 1991.
- [Thi64] Thiemeyer, T.: Grenzkostenpreise bei öffentlichen Unternehmen; *Westdeutscher Verlag, Köln und Opladen*, 1964.
- [Tim01] Timár, A.: Közlekedési létesítmények gazdaságtana; *Műegyetemi Kiadó, Budapest*, 2001.
- [Uic92] Nemzetközi Vasútegylet: Szállítási költségek megállapításának elvei és módszerei a nemzetközi vasúti forgalomban, 374. döntvény; *Paris*, 1992.
- [Var96] Varian, H. R.: Differential Pricing and Efficiency; *First Monday, New York: Norton*, 1996.
- [Wal87] Walras, L.: Elements of the Theoretical Economics; *Lausanne, Switzerland*, 1887.
- [Wei93] Weisser, G.: Art der Wirtschaft, in: Handbuch der Soziologie; *Hamburg, Neuseeler Verlag*, 1993.
- [Wie93] Wied-Nebbeling, S.: Markt- und Preistheorie; *Springer Verlag, Berlin*, 1993.
- [Wil62] Wilson, G.: Essays on Some Unsettled Questions in Transportation; *Foundation for Economic and Business Studies, Indiana University*, 1962.
- [Wil78] Willig, R.: Pareto-Superior Nonlinear Outlay Schedules; *The Bell Journal of Economics*, 9/1978.
- [Wil89] Williamson, O. E.: Transaction Cost of Investment Economics; *Handbook of Industrial Organization*, 1989.