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SUPPLY AND DEMAND EQUILIBRIUM IN TRANSPORT SECTOR

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1. Basic principles of economic equilibrium in transport market

The principles of supply and demand in the transport sector come out from basic economic rules, which are generally valid also in other economic sectors. If we come out from this premise, market equilibrium will occur (and not only in the transport sector) at such price and quantity, when supply and demand are balanced. At this price and quantity the amount of goods (services) that consumers would like to buy are balanced with the amount of goods (services) that sellers would like to sell. Equilibrium price and quantity are then constant as long as the other conditions are constant. Following Fig. 1 shows equilibrium price and quantity as a point of intersection of the supply and demand curves [7].

If economic equilibrium arises when supply and demand are balanced, then it is imperative to determine factors that have influence on supply and demand. Following Tab. 1 and Tab. 2 show these factors [2].

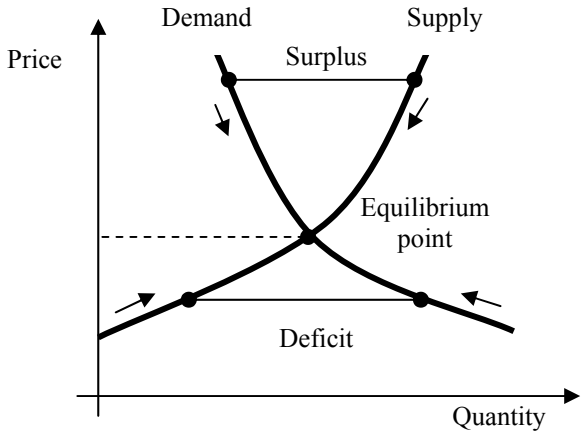

***Fig. 1** Market equilibrium*

Source: SAMUELSON, P. A.; NORDHAUS, W. D. *Ekonomie*

***Tab. 1** Examples of factors influencing supply*

Factors influencing supply	Examples
Price	Higher price makes goods more attractive for producers (higher profit) so it increases supply
Production cost:	
- technology	New car engines reduce petrol consumption, thereby also transport cost. So it increases supply
- input prices	Higher prices of petrol increase cost, thereby reduce supply
Prices of substitution products	Lower prices of railway transport increase road transport supply
Market organization	Liberalization of railway transport increases railway transport supply
Other factors	Lower taxes of road transport will probably increase road transport supply

Source: SAMUELSON, P. A.; NORDHAUS, W. D. *Ekonomie*

2. Practical examples of supply and demand equilibrium

The instruments of supply and demand don't ever work only in static and constant conditions, but especially in dynamic conditions, i.e. conditions that are changing permanently. Following Fig. 2 shows the utilization of dynamic model of supply and demand net on the example of traffic-jam [4].

***Tab. 2** Examples of factors influencing demand*

Factors influencing demand	Examples
Price	Higher price makes goods less attractive for consumers so it reduces demanded quantity
Average income	Higher incomes increase for example demand for cars
Population	More people mean more potential consumers, so it also increases demand for cars
Prices of substitution products	Lower petrol prices increase demand for cars
Hobbies	Using individual kind of transport on the basis of other uneconomic criterion
Other factors	Accessibility of railway transport etc.

Source: SAMUELSON, P. A.; NORDHAUS, W. D. *Ekonomie*

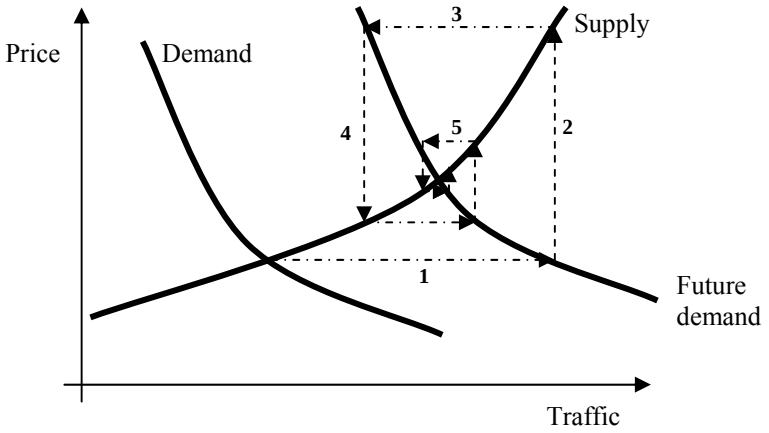

***Fig. 2** Supply and demand net*

The numbers in Fig. 2 mean:

1 Demand increase at constant price
2 Resulting price increase due to traffic-jam
3 Demand „answer“ to traffic-jam
4 Reduction in demand decreases traffic-jam
5 The process converges to solution

Source: *Macro-Economic Evaluation of Transport Infrastructure Investments*

Further example of the practical application of supply and demand equilibrium can be the model of „tax expansion effect“. This model (see Fig. 3 and Fig. 4) shows impacts

of tax expansion (when traffic road tax is imposed) on the number of journeys realized by individual users in case of elastic and inelastic supply and demand [4].

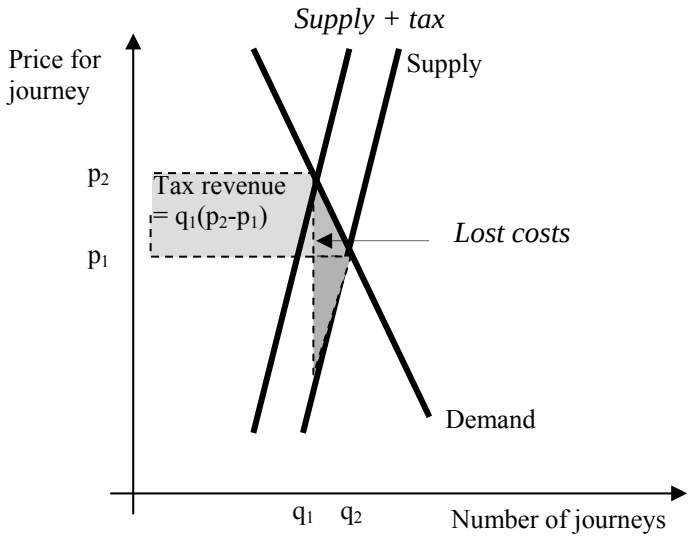

Fig. 3 *Social effect of tax expansion in case of inelastic demand and supply*

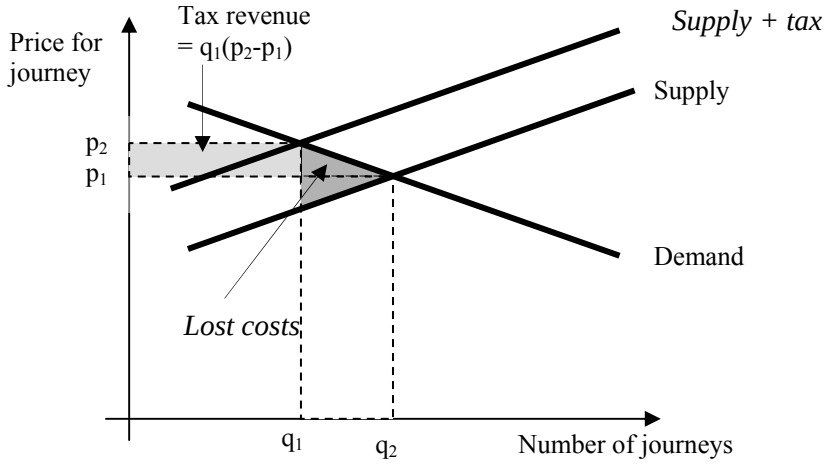

Fig. 4 *Social effect of tax expansion in case of elastic demand and supply*

There is evident that the lost costs will be much lesser in case of inelastic supply (coming out from marginal costs) and demand (representing marginal utility) than in case of elastic supply and demand, when we impose the tax on traffic road, for instance (see Fig. 3 and Fig. 4). So it is clear that the smallest impact will have (if the other conditions are the same) such tax expansion that refers to products and services with inelastic demand, i.e. demand relatively independent on price.

Finally, it is necessary to emphasize that though transport system must fully respect basic market principles (supply and demand relationship), it is also determined by further largely macroeconomic impacts (e.g. government legislative measures, EU regulations, international treatments), which ensues mainly from the global character of transport. That is why the basic structure of the real transport model is always only a part of the social and economic system of society [9].

3. Equilibrium in transport nets

Analysis of customer behaviour (demand)

It stands to reason, that the analysis of equilibrium in transport system is necessary to start with the analysis of transport system user (customer) as a subject that in compliance with his preferences evaluates a wide scale of decisive factors with his choice. On the top of it, some of these factors can not be quantified (e.g. comfort, safety). Customer's aim is to maximize utility or (if you like) to find optimal variant how to meet his need [1].

It is possible to accept time and price as decisive factors for such decisions concerning transport service choice. Time horizon of transport service does not mean only the time spent in transport means but also secondary time (coming to a stop, waiting for connection, handover of a consignment etc.). The thing is to choose such combination of price and transport time that brings maximum utility for the user. For illustration of this situation we can come out of indifference analysis, which makes use of indifference curve for depiction of consumer combinations (preferences) with the same utility [6].

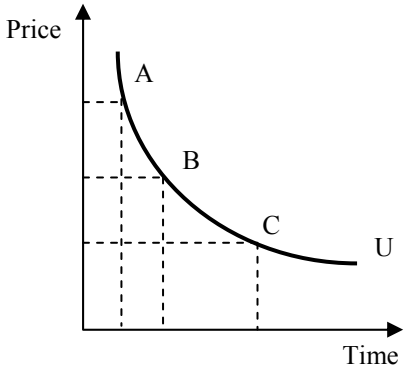

Fig. 5 *Indifference curve in term of factors for transport service choice*

Source: LIBERADZKI, B. *Transport: Popyt. Podaz. Równowaga*.

From indifference curve characteristics is evident, that points A, B, C lying on the indifference curve (see Fig. 5) represent various combination of price and time that bring the same total utility for the user (the user is indifferent in the face of these combinations). The indifference map then illustrates indifferent curves with various total utility.

Total utility can be interpreted mathematically as the following function [3]:

$$U = f(S, \theta),$$

where:

U represents utility,

S represents vector of provided services level S = (t, p), that means time and price,

θ represents significance vector or more precisely parameters of time and price evaluation θ = (α, β).

Significance vector reflects preferences of particular customers, substitution relationship of these parameters can be presented as ratio α/β.

Preferences of the user choosing between particular kinds of transport are illustrated in Fig. 5. Suppose that the user make a decision between road and railway transport, for instance. The number of journeys realized by means of road transport is represented by X in Fig. 5, the number of journeys realized by means of air transport by Y. Curves U_1, U_2, U_3 depict various utility levels connected with combinations of journeys by means of these kinds of transport. Every curve represents the combinations that bring the same utility to the user.

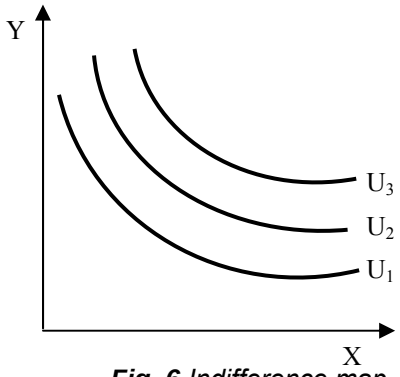

***Fig. 6** Indifference map*

Source: SAMUELSON, P. A.; NORDHAUS, W. D. *Ekonomie*

However, user´s decision-making of transport service selection comes out not only from his preferences, but it is also influenced by his market possibilities (his income in relation to prices of particular transport services). Let us consider again, that user decides to realize travels by air or road transport. User´s choice from viewpoint of his market possibilities can be illustrated by so called budgetary consumption-possibility line, which represents maximally available combinations of consumer´s income distribution for purchase of two goods, in our case purchase of two transport services (figure 6).

Budgetary consumption-possibility line can be matematically expressed by equation [3]:

$$I = Px \,.\, X + Py \,.\, Y$$

where:

I – consumer´s disponible income,

Px, Py – prices of travels realized by road transport (X) and by air (Y)

X, Y – volume of travels realized by road transport (X) and by air (Y)

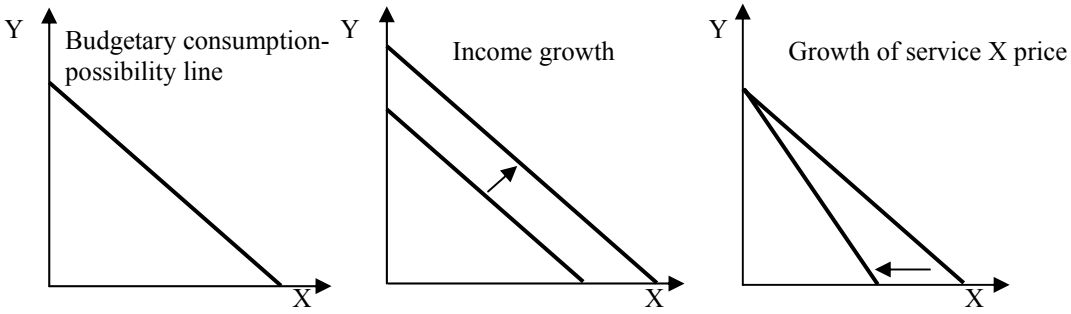

***Fig. 7** Budgetary consumption-possibility line*

Source: SAMUELSON, P. A.; NORDHAUS, W. D. *Ekonomie*

where:

X – volume of travels realized by road transport,

Y – volume of travels realized by air.

As we said before, user chooses such transport service by which he maximizes utility. Now we furthermore precise this fact, that choice of this optimum depends on his preferences and his market possibilities. If we come out of above-mentioned example with choice of travels combination realized by road and air transport, then optimal user choice will be graphically reflected by tackpoint (point E on the picture 7) of budgetary consumption-possibility line and the highest available indifference curve (it illustrates in this case combination of travels volume realized by road (X) and air (Y) transport bringing the same user´s utility.

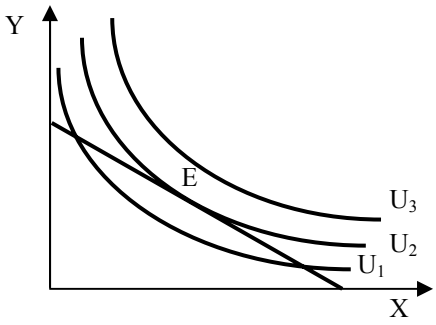

***Fig. 8** User´s equilibrium*

Source: SAMUELSON, P. A.; NORDHAUS, W. D. *Ekonomie*

Analysis of transport firms behaviour (supply)

The basis of firm supply analysis is analysis of their costs. Supply of transport services then depends on marginal costs [10].

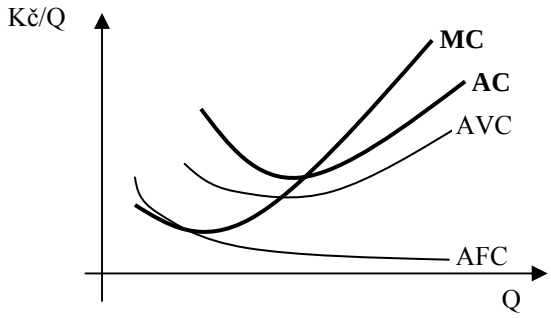

Fig. 9 *Costs of firm offering transport services*

Source: WILKINSON, N. *Managerial Economics*

where:

MC – marginal costs,

AC – average costs,

AVC – average variable costs,

AFC – average fixed costs,

Q – volume of offered services

Analysis of these costs leads to three basic situations:

- MC < AC – each next additional unit of production requires lower costs than previous unit. Average costs decrease, their curve is degressive. We can say, that increasing of volume of offered transport services is economical.
- MC > AC – additional unit of production can be realized only with higher costs than previous unit. Average costs therefore grow, their curve is rising. MC will increase above AC level – additional increasing of offered transport services volume is not economical – services providing becomes more expensive.
- MC = AC – average costs are minimal. Volume of provided services is optimal in point, where marginal costs equal average costs. Average costs must be minimal in this point, this fact is valid also for average variable costs (AVC).

Similary to consumer´s behaviour analysis, when we survey his optimum, we came out of indifference curve and budgetary consumption-possibility line, analysis of transport enterpreneuer behaviour (hence behaviour of subject supplying his services on the market) comes out of isoquantum curve (indifference production curve) and isocost line. Isoquantum curve is therefore analogy of indifference curve on the side of supply,

consequently describes combinations of factors of production – inputs, with the assistance of them it is possible to produce the same volume of production. Isoquantum curve is always related to certain concrete volume of output. Isoquantum curves map is analogical to indifference map, but there is important difference – values on axis X and Y are determinated by inputs as labour and capital, no by final products (services).

Isocost line (line of the same total costs) is analogical to budgetary consumption-possibility line. Isocost line contains all maximal combinations of labour and capital, which are available within given concrete value of total costs. Its equation is [10]:

$$TC = P_L \,.\, L + P_K \,.\, K$$

TC – total costs,

P_L – price of labour unit,

P_K – price of capital unit,

L – volume of used labour,

K – volume of used capital.

Optimum of firm, thus optimal combination of inputs, is found out similary to consumer´s optimum. It is point, where line of the same total costs (isocost line) meets isoquantum curve (figure 9).

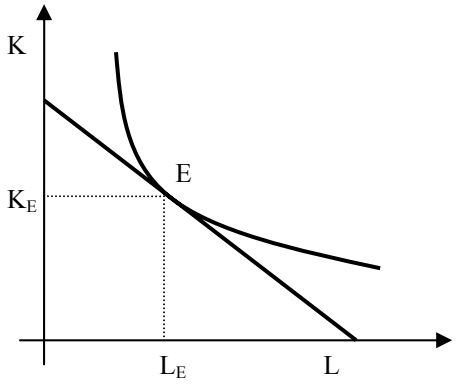

***Fig. 10** Firm optimum*

Source: WILKINSON, N. *Managerial Economics*

Not only for transport firm but also for every others, important policy is distinction from other firms through price or non-price competitive techniques, of course by continuous excess of supply over demand. The goal of this practice is dominate on the market and gain control over the customers by means of price-cutting and by qualitative parametres as delivery time, intactness of consignment, transport safety, patness, image building, equipment of transport means tec [8].

4. Conclusion

Supply and demand in transport sector comes out of basic economical rules and conditions valid also in other sectors of economy. Market equilibrium results from such price and volume, by which supply and demand are balanced.

However, supply and demand in transport market are impacted also by number of factors (except own price), which influence the balance, and it is very important these factors to consider by research of this balance. Supply is influenced e.g. by production costs, price of production substitutes, market organization etc., demand is influenced by e.g. average income, population, price of substitutes and complements, consumer tastes etc. Transport demand is also affected by development of other sectors. This dependence is the most noticeable in connection with tourism [5].

It is necessary to realize, that factors with impacts on supply and demand of transport never affect only in static and fixed situations, but especially in dynamic situations by which changes arise.

It is also important to emphasize the fact, that although transport system must fully respect basic market principles, it is also determinated by other mainly macroeconomical influences (e.g. legislative government measures, EU regulations, international agreements), which follows largely from global character of transport [2].

If we would speak about transport network equilibrium, it is necessary to start with demand analysis, thus behaviour of transport system user, who evaluates the whole range of factors on the basis of his own preferences. The result of this assessment should be utility maximization, thus finding of optimal variant of his need satisfaction. Critical decisive factors could be time and price. However, choice depends not only on consumer´s preferences, but also on market possibilities of transport system user.

Next there is necessary to pay attention to supply analysis, which comprises transport firms behaviour. This analysis reflects, that transport services supply depends on marginal costs. Not only for transport firm but also for every others, important policy is distinction from other firms through price or non-price competitive techniques, of course by continuous excess of supply over demand. The goal of this practice is dominate on the market and gain control over the customers by means of price-cutting and by qualitative parametres as delivery time, intactness of consignment, transport safety, patness, image building, equipment of transport means etc [9].

Note: The article is published within solution of research proposal VZ-MSM 0021627505 „The transport systems theory“.

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Resumé

ROVNOVÁHA NABÍDKY A POPTÁVKY V SEKTORU DOPRAVY

Rudolf KAMPF, Libor ŠVADLENKA, Helena BECKOVÁ, Daniel SALAVA

Příspěvek hodnotí základní vztah mezi nabídkou a poptávkou na makroekonomické úrovni a uvádí praktické příklady rovnováhy nabídky a poptávky.

Dále se příspěvek zabývá analýzou rovnováhy v dopravních sítích, a to z pohledu chování zákazníka (poptávky) a z pohledu chování dopravních firem (nabídky).

Příspěvek je publikován v rámci výzkumného záměru „Teorie dopravních systémů“, řešeného na Dopravní fakultě Jana Pernera Univerzity Pardubice.

Summary

SUPPLY AND DEMAND EQUILIBRIUM IN TRANSPORT SECTOR

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The paper evaluates basic relation between supply and demand at macroeconomic level and shows practical examples concerning supply and demand equilibrium.

Furthermore the paper deals with the analysis of equilibrium in transport networks, namely from the customer behaviour (demand) point of view and from the viewpoint of transport firm behaviour (supply).

The article is published within the research proposal “Transport systems theory”, which is being solved at Jan Perner Transport Faculty of the University of Pardubice.

Zusammenfassung

DAS GLEICHGEWICHT DES ANGEBOTS UND DER NACHFRAGE IM TRANSPORTSEKTOR

Rudolf KAMPF, Libor ŠVADLENKA, Helena BECKOVÁ, Daniel SALAVA

Der Beitrag bewertet grundlegende Beziehung zwischen dem Angebot und die Nachfrage auf dem makroökonomischen Niveau. Weiter leitet die praktischen Aufgaben des Gleichgewichts des Angebot und der Nachfrage ein.

Der Beitrag löst auch die Analyse des Gleichgewichts in den Transportnetzen und das aus der Niveau der Verhaltung des Kunden (Nachfrage) und auch der Niveau der Transportunternehmen (Angebot).

Dieser Beitrag ist im Rahmen der Forschungsprojekt “Theorie der Transportsystemen“ an der Fakultät für Transportwesen an der Universität Pardubice publiziert.