Competition in Transport and the Cross Elasticity

VIKTORIE JÍROVÁ, ZDENĚK ŘÍHA
Faculty of Transportation Sciences, Department of Logistics and Transport Management
Czech Technical UniversityTU,
Horská 3, Prague 2, CZ-12803;
email: riha@fd.cvut.cz; VJirova@seznam.cz

Abstract. It holds in general that for a perfect competition the following four conditions must hold: perfect information of buyers and sellers, zero transaction costs of provider change, homogenous product and big number of suppliers. If we aim at the condition of a homogenous product, i.e. all sellers supply products of the same features, we find out that this condition can be fulfilled in practice only in a very limited number of cases like e.g. the market of primary raw materials. Then it is interesting to analyse, whether the rival products are substitutes. This question is solved by the so called cross elasticity. This topic is also aimed at in this paper that analyses the development of oil and fuel prices and studies their impact on the output of passenger rail transport. If we mention the cross elasticity, two goods A and B are compared that are either substitutes (i.e. mutually replaceable), complements (or additional goods) or there is no similar relation between them. The cross elasticity indicates the volume that changes in the demand of the good B when it comes to a unit change of good A. The paper analyses in this way the transport market and presents another interesting statistics that have featured the transport in the past ten years.

Keywords: Rail transport, individual car transport, competition, cross elasticity, costs, fuel prices, Czech Republic.

1. Introduction

The concept of invisible hand [5] is mentioned in the economics, often in a mythic way. Of course, to enable this invisible hand to function right the market must be as close as possible to the ideal market and we can legitimately ask how close to the ideal is the transport market. It holds in general that for a perfect competition the four following conditions must be met [1]:

- perfect information of buyers and sellers
- zero costs of supplier change
- homogenous product
- big number of suppliers (sellers)

The transport market has considerable limitations in this respect. The main problem is that the particular products, i.e. various transport modes, are not homogenous, by other words the product of the road transport has other qualitative parameters than the product of the rail or air transport. The heterogeneity will be also the case of the competition within one transport mode, above all with respect to departure and arrival times of competing transport connections, when the quality or price need not play the main role by the connection choice for a passenger, but departure and arrival times (in general the character of transport will determinate the choice of a transport operator)

The problem is also the large number of suppliers that is limited by three factors. Technical and technological barriers related above all to the limited capacity of a transportcommunication are the first problem. The second group is represented by the financial barriers, thus the necessity of high capital expenditures at the start of enterprising and the third one the legislative barriers, mainly the legal conditions of the enterprising in the transport industry. These natural barriers will again determine the market and the origin of efficient competition.

A market also need for its function sufficiently elastic supply and demand. But the transport demand is a derived demand, i.e. the transport is always derived from the need for transfer and it will not be tied as much to price changes. At the same time the transport demand is distributed unevenly in time, what causes problems of capacity use of transport connections. And finally, for elastic supply the product of transportation must be keepable, what is also not fulfilled. (The demand is elastic, when the suppliers are able to supply the given product to the market at the moment of price increase.)
Furthermore the additional demand is tied to the further increase of the necessary capacity of transport means, what may collide with the above mentioned economic barriers.

The consequence of such conditions that make the market closer to perfection (to the state of monopolistic competition) for the supplier (entrepreneur) is his ability to influence the price. In the perfect competition the supplier is a price-taker, his supply curve is perfectly elastic, i.e. he will not be able to influence the resulting price (that will be given by the intersection of the supply and demand curves).

In the case of imperfect competition the possibility to influence the price is higher, if a local supplier increases the price, it need not to mean a decrease of demand for him in case of nonzero costs of supplier change (a buyer will account these costs into his resulting price).

Another condition of a perfect market is a homogenous product, i.e. all suppliers will supply a product of the same composition or features, in practice this condition can be fulfilled only in a very limited number of cases, as e.g. the market of primary raw materials or cereals. It is ten interesting to analyse, whether the competing products are substitutes. This question is solved by the cross elasticity.

2. Cross elasticity of demand for individual car transport and rail passenger transport

In the case of the cross elasticity two goods A and B are compared that are either substitutes or complements or independent goods. The constant price of the good A is an important presumption.

To assess the substitutability relation between transport modes based on the cross elasticity, it is necessary first to describe properly the development of fuel prices or crude oil prices. Its volatility since 2007 enables to analyse by an interesting way, whether the increasing costs in the transport modes with oil as the primary energy source have been leading to an increase of transport outputs of the public transport, while we concentrate on the rail transport.

Fuel price depend of course on crude oil prices that have been very volatile in the last six years. The way they result in the fuel prices depends e.g. on the exchange rate of the US dollar that has been strengthening in the last time. Fuel prices in the Czech Republic are shown in the following Fig. 1 where we can see a.o. that the real fuel prices have been oscillating around the level of 28 CZK/l. However a more permanent increase started in 2011 that has been expressing in transport operator prices.

![Graph](image_url)

**Fig. 1. Development of real fuel prices in the Czech Republic [CZK/l] [3]**

The principle of the elasticity suggests itself for the explanation of the influence of the price for the modal split. For instance we choose the relation between the individual car and the rail passenger transport, where we can use quarterly data of transport volumes in the last 10 years in the Czech Republic. We can advance according to the formula (1):

\[
e_{C,R} = \frac{Q_{R,t} - Q_{R,t-1}}{Q_{R,t} + Q_{R,t-1}} \times \frac{P_{C,t} - P_{C,t-1}}{P_{C,t} + P_{C,t-1}}
\]

where \(e_{C,R}\) is the cross elasticity of the demand on the rail transport in the dependence on fuel prices, \(Q_{R,t}\) transport volume of the passenger rail transport in the period \(t\), \(Q_{R,t-1}\)detto in the period \(t-1\), \(P_{C,t}\) price of the individual car transport in the period \(t\) (represented by the average fuel price) and \(P_{C,t-1}\)detto in the period \(t-1\).

The price of use of the individual car transport is consciously represented by the fuel price, outgoing from the presumption that the fuel price is the essential part of the perceived costs, other costs (car purchase, yearly fees etc.) are considered the sunk const. The researched period is 2002 to 2012 when substantial fuel price changes were occurring (remember the Fig. 1). From the viewpoint of data availability the quarter year was chosen as the shortest period. The results are summarized in the graph in the Fig. 2.
their decision-making criteria. The questionnaire collected information on the status of the company:

- Main types of commodities transported,
- Major transportation lines,
- Method of transport (road, rail, waterways),
- The volume of goods transported per year
- Average transport distance,
- Decision criteria when choosing the mode of transport.

Because the findings of decision criteria was the core questionnaire addressed in a separate section. Firms were asked to split between the different criteria a total of 100 points according to the weight they attach to them. The criteria, which are divided points were:

- Price (total price including shipping technology necessary steps for its hedging)
- Speed (speed of transport, including loading and unloading)
- Security (security products against damage and theft or loss),
- Time delivery guarantee (time accuracy check in unloading)
- Accessibility of services.

The survey involved a total of 18 companies from different industries and agriculture. Individual responses were processed into tables, where you can compare the decision criteria among themselves and in relation to the parameters of the individual companies. Questionnaires were at the request of some companies treated anonymously, but they certainly have explanatory power. [6] Firms differ in terms of both manufactured goods and the average transport distance and total annual volume of production. The first criterion, we use the average transport distance. Here it is clearly seen that for firms with greater distances are much greater use of rail. Virtually all firms, the average transport distance is greater than 300 km, we find the railway as one of the instruments of transportation. If some companies with large transport distances are used exclusively by road transport, it is primarily due to the high demands on transportation safety.

On the other hand, firms with transport distance of 150 km using only road transport, as it is usually the transport system of door-to-door and any take-away policy on such a small distance does not pay. Also, in terms of total transported volume per year, the company reported in the questionnaire indicates that companies with large volumes of used rail more than firms with less.

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**Fig. 2.** Values of the cross elasticity for the individual car and rail transport [2]

### 3. Freight Transportation Development

Similarly, not only the price and the quality of transportation is important in the freight transportation but also the character of the transported goods.

There was a survey developed at the Faculty of Transportation Sciences to determine the requirements of the customers. The survey was designed to find out their decision-making criteria when selecting a carrier. The survey involved companies, which may be considered for transfer of railway, mainly those involved in production engineering and metallurgical products, minerals, building materials, solid fuels, as well as agricultural products, wood and paper. Companies engaged in services, trade or manufacture of consumer goods in the survey were not included because there is not even a possibility to think about changes.

All companies were contacted by questionnaire asking their current situation and...
Cause a more constant demands on carriers, since business relationships are often negotiated for a longer period. Smaller firms use the flexibility of road transport to realize their relatively random requests. For freight transport we can say:

- The most important decision-making criterion, the majority of companies showed price. But you cannot say that the price would be the deciding factor, according to which the carriers decide when choosing between rail and road transport (questionnaire confirmed that for this decision will be the basic nature of transport);
- The speed of transport is an essential criterion for companies that carry goods for shorter distances or transported fresh goods must be delivered as soon as possible buyers;
- Time accuracy of deliveries is preferred by companies carrying coal to power plants or steel products shipped directly to production to another processing;
- The key factors that affect the modal split, the nature of transport, which also determines the demands of carriers in the quality of transport.

4. Conclusions

It is of course questionable how to interpret these results in the most exact way. According to the standard economic theory we can say that these two goods are neither substitutes nor complements, with respect to the high variability of values. If we did not know, what goods they are, we probably would conclude that they are independent. Another interpretation could be that there is no transfer of demand from the individual transport to the railway one in the chosen time period and in the given price interval. Another possible conclusion is that in spite of the fact that the resulting effect of both goods, i.e. the displacement, is the same, they are no substitutes, because they have markedly different qualitatively and quantitatively parameters. If we wanted to summarize all the factors of the demand on various transport modes, we can show them in Fig. 3.

The following ascertainment can be added:

1. The individual transport offers much higher qualitative parameters (speed, accessibility, comfort etc.) than the public one. The preference of the individual car transport can be interpreted so that a passenger is willing to pay extra for this higher quality or by other words the cost difference between the individual car and rail transport can be identified as the price of this higher quality.

2. The demand on the individual car transport is inelastic, a substantial transfer of passengers to the public transport can occur only in the case of a fundamental economic change (decrease of GDP and living standard, incremental and strong increase of fuel prices), if not to speak directly about a legislative intervention into the free choice of the mean of transport.

3. The life style leads to a higher mobility demand, what implies the emphasis on the individual car transport that is able to ensure this mobility.

4. However the statistical data show that the motorization rate does not increase steady with the growth of the living standard, the value of this indicator stagnates about 2 persons to one car [7].

5. The modal split is also influenced by additional factors like employment, age structure of the population or the dislocation of travel destinations.

![Fig. 3. Factors of the modal split in the passenger transport (source authors)](image-url)
References:


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