FARE SIGNIFICANCE AND EFFECTS ON PASSENGER PUBLIC TRANSPORT

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A fare is probably the most intensive studied factor of transport demand. It is because of two reasons: fare and its changes are relatively easy identifiable and measured and it is also the most easy and most often modified factor. A fare is crucial factor for public transport service, because it is the main source of income for operators. Generally, while a fare increases, demand decreases. If the sales following fare increase will grow or come down, is depend on functional relation between fare and demand, i.e. demand curve.

Systems of fare could have various forms, for examples they could be areal, zonal or structured. Each one of them has its own attributes.

It is usual to express the relation through elasticity concept. But fare elasticity isn't just theoretical concept. It is also important tool for public transport planning and controlling. Elasticity is used for estimation of patronage and sales changes, which is based on fare changes.

Key words: fare, elasticity, demand, passenger public transport

1 Introduction

Fare tariff setting is the foundation for public transport running, because it is the main source of operators' incomes. Generally we could say that if the fare increases, the number of passenger will decrease. If the receipts will increase or decrease as consequence of fare increase is depend on functional relationships between fare and demand, and it is shown by demand curve. It is common to express it through conception of elasticity.

It is also important think about consequences of fare changes to others modes of transport. The method, which is generally used, is cross elasticity, which estimates demand elasticity given by changes in different mode, for example bus demand elasticity given by changes in fare on railways.

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2 Fare elasticities

The current research indicates that elasticities are dynamic. That means that during times the elasticity is changing, because the fares are changing. This is why it is more difficult to distinguish between short-run and long-run and sometimes medium-run values of elasticity. And also it is reason why there is so many definition of short, middle and long time, but most of authors take for the short time the period about 1 or 2 years and the long time the period about 12 or 15 years (sometimes it is 20 years). The middle time is usually about 5 or 7 years.

There are two methods for distinguishing between short and long time elasticities in these days.

The first one defines in advance certain models of behavior, which is interpreted as indicator of short or long time scale of response.

The second method uses dynamic econometric model, in which are used time series with model specification determined gradual response in time.

Elasticity could be estimated by several methods such as trends of time, exploration of set and revealed preferences, studies of arrangement efficiency, time series analysis and logit model.

Passenger response for fare changes will be depend on the fact how important role plays the fare in making decision about taking the journey or modal choice. For example it is important the ways to school and to work should be as short as possible. In long terms people could change there homes and their individual conditions probably will change in different ways, because of change in ages incomes, level of education, situation in their jobs, family situation and so long. All of these factors have impact on the decision if people carry out the concrete journey by the concrete mean of transport. People could travel in different times of the day to use fare benefits of the day time or they could use subscription price reduction cards for different groups of passengers (children etc.). There is evidence that after fare increase people rather change type of ticket than mode of transport [2].

3 Types of fares

Systems of fare could have different forms, for example they could be areal, zonal or progressive.

Flat fare – individual fare is paid independently of mileage

Zonal fare – areal fare is requires for traveling inside marked zone.

Graduated fare – fare invoiced according to mileage.

Season ticket – weekly, monthly or year seasonal tickets offer discount outside tickets for individual journey and could bring savings for passengers.

Travelcard – this card enables unlimited using of public transport in specific area during fixed time season) for example one day or week, or a year). It could be used for all modes in public transport (city transport ensured by different modes) or for limited individual modes or operators.

4 Effects of types of fare change

Value of fare change

Fare elasticity can be affected by size of fare change. Generally higher increase of fare brings higher values of elasticity then lower increase. The differences are bigger with long- term elasticity.

Regulation of fare change

The response to fare increase cannot be the same as response to fare decrease, so the elasticity doesn't need to be symmetric. However there is not enough opportunities for studies of effects of fare decrease, so there is no convincing evidence of this asymmetry.

Level of fare

Fare elasticity is also affected by current level of fare considering people's income. It is shown on consequences of London buses, where for extremely low fare between October of 1981 to March 1982 there were elasticity between -0,30 to -0,33, but for relatively higher fare level in 1983 the elasticity was -0,40.

5 Changes of elasticity with type of area

There is enormous change between different types of areas in characteristics, types and level of service of public transport and of course in demands for these services. People living in areas with low density of population tend to rely more on individual cars and less on public transport in compare with people living in municipal areas, and that is why it is more likely they will change transport mode if the fare in public transport is increasing.

Municipal and rural areas

Elasticity values are higher in rural areas than in municipal. It likely could be because more people in rural areas have cars so they can left public transport when the fare is increasing.

Effect of size of city

Citizens of bigger cities are likely more depend on public transport then citizens of smaller towns, and it is shown in differences in fare elasticity. However the evidence is not as obvious.

6 Fare elasticities for different fare requirements

Peak and off--peak demand

Journeys taking place in peak are journeys to work and school, and they tend to be relatively fixed in time and place. Journeys out of peak tend to include leisure time journeys and journeys to shopping, where is more flexibility in aims of journeys and time. So we can expect higher elasticity out of peak. For example in Great Britain out of peak elasticity are double of values of peak elasticity, with insignificant higher change in suburban rail transport than in other modes. It could be evidence of bigger using of out of peak fare reduction on railways than on buses and undergrounds. Out of Great Britain there is average peak elasticity for buses about -0.24, meanwhile the same out of peak elasticity has value -0.54, which indicates slightly higher difference between peak and out of peak. For underground and suburban railway systems outside of Great Britain there wasn't enough values which enables count similar calculations.

Division of peak and out of peak elasticity finally isn't easy, because there could be several groups of elasticity: peak, off-peak, evenings, Saturdays and Sundays.

Fare requirements

People, who travel to work and school, generally can't choose the ends and timing of their journeys. These journeys are reason of peak and congestions, which leads to slower journeys taking by car. So we can expect lower values of elasticity for journeys to work and school then for other fare requirements.

7 Railway travel elasticity

7.1 Railway elasticity in Czech republic

Data for elasticity calculation were based upon internal data of Czech railways form years 2000 – 2008. Elasticity coefficient was calculated upon formula of arc elasticity [5], which describes responsiveness between two periods.

$$e_{arc} = \frac{y_1 - y_0}{y_1 + y_0} : \frac{x_1 - x_0}{x_1 + x_0}$$

y_0… number of passengers, or passengers' kilometers in base period
y_1… number of passengers, or passengers' kilometers in current period
x_0.. revenue rate for passengers' kilometer in base period
x_1… revenue rate for passengers' kilometer in current period

From particular values, which express elasticity between two near by years, was calculated values of average short run elasticity, which express change both in relation with transported passengers and in relation with passenger kilometers. These results are shown in table 1 and 2.

Table 6 Elasticity of passengers in Czech railways

	Average short run elasticity
Total fare	-0,05
Customer fare	-0,534
Track tickets	-1,42
Netting tickets	-3,17
Pupils' fare (-15)	-2,38
Pupils's fare (+15)	0,30
Fare for IDS	-3,47

As it is shown in table 1 elasticity for total fare is rather low. The highest values for elasticity coefficient are for category netting tickets and fare for IDS. We could suppose the most remarkable response to changes is fares in these categories, because the passengers have choices to choose another tariff or another transport mode.

Another sensitive category is track tickets, which could be given by the fact that passengers in the category could choose for their journey to work a car, if the price in railways increases.

Table 7 Elasticity of passengers' kilometres in Czech railways

	Average short run elasticity
Total fare	-0,37
Customer fare	0,63
Track tickets	-2,42
Netting tickets	-2,90
Pupils' fare (-15)	-0,96
Pupils's fare (+15)	-0,04

Fare for IDS -2,94

If we ponder over railway demand sensitivity expressed in passengers' kilometers, we could se the same results as in the case of demand expressed in passengers – the highest values are for categories netting tickets and fare for IDS

Except fare change the passengers could be influenced by their perception of quality in services on a train.

7.2 Total railway elasticity

Elasticity results calculated for Czech Republic can be compared with values stated in The demand for public transport: a practical guide [1].

Total average value of elasticity for railway is -0.41. It is similar as for buses (table 1). In Great Britain is this value higher than in other parts of the world. The difference is bigger than the difference for buses.

Table 8 Railway fare elasticity (short-term values)

Places	Elasticity	Number of samples
United Kingdom	-0.46	35
Non-UK	-0.33	20
Total	-0.41	55

Elasticity of railway fare as a whole has wide range. Particularly it is because wide variation of effect for competitive modes. Oum et all [3] ponders that travelling by train in city is likely significantly effected by competitive modes, and this is why the cross elasticity has significant tendency.

Values of elasticity in Czech Republic correspond with the results given in table 3.

8 Conclusion

Mentioned outcomes were estimated by using several methods. It is possible that elasticity values are function of methodology using for their taking away.

Many analytic studies about demand for public transport is based on analysis of observed behaviour of passengers, for example researching of passenger number in given mode before and after change of fares. This method uses "disclosed preference" data.

Alternative approach is using technique of "stated preference". Both these methods have been developed to help overcome problems of forecasting of potential using of alternative, which doesn't exist yet. The method uses presentation of many hypothetic questions on sample potential users. In these questions respondents are asked to compromise between pair of characteristics, which could affect their public transport demand.

If fare changes in all of mode of public transport at the same time, there is fewer place for passengers to change the modes. So it could be expected that values of elasticity based on fare change in one mode of public transport are higher than values based on fare changes in all modes. The first ones are sometimes label as "own elasticity" and the second ones as "conditional elasticity".

Another approach is based on a form of space transport modelling. Prognosis of travel demand is created from the model, and the elasticity is estimated from different level of demand for different fares given by the model. This approach is called "cross-sectional modelling".

There is only few publicised evidences for stated preferences, so most of outcomes are own elasticity of disclosed preference, conditional elasticity of disclosed preference and from cross-sectional modelling.

Reference literature

1. Balcome, R. et all. (2004) The demand for public transport: a practical guide.TRL Limited 2004
2. Steer Davies Gleave (1999a). ATOC – Railtrack literature review. London: Steer Davies Gleave.June.
3. Oum et all (1992). Concepts of price elasticities of transport demand and recent empirical estimates. Journal of Transport Economics and Policy, vol. 26, no. 2 pp. 139- 154
4. Interní statistické materialy ČD, a.s.
5. Melichar, V.: *Cenová elasticita poptávky ve veřejné osobní dopravě.* Sci. Pap. Univ. Pardubice Ser. B, 8, s. 5-38 (2003), ISSN 1211-6610, ISBN 80-7194-513-7