

Dynamic Pricing on the Czech Railway Passenger Transport Market From a Marketing Perspective: an Interpretative Case Study

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Abstract

The Czech Republic has the densest railway network in Europe and its importance on the transport market corresponds to this fact. Historically, railway transport in the Czech Republic was operated by the only monopoly carrier – the Czech national carrier, former incumbent Czech Railways Company. Subsequently, the market was liberalized. RegioJet entered the market in 2011 and Leo Express in 2012, followed by other carriers. Railway passenger carriers have had to adjust their marketing practices and strategies to reflect the new highly competitive market situation. The most interesting situation arose on the Prague – Ostrava region route, which is currently operated exclusively at commercial risk. This article is focused on the dynamic pricing of Leo Express railway passenger carrier on the Prague – Ostrava region route. The article is based on the results of a primary research on the price evolution of Leo Express in four different fare classes and on four different connections in 2022. The aim of the article is to analyse the basic principles of dynamic pricing of Leo Express on the route Prague – Ostrava region from a marketing perspective. The article is based on the use of the scientific method of literature review, primary research, and interpretive case study. The analysis shows that Leo Express sets the default ticket prices according to the fare class and departure time of the connection (connections at peak times are more expensive than connections at off-peak times). Another important factor that affects the price is the number of tickets remaining. This factor has a major impact on the final ticket price and can affect the price of a ticket by tens of percent.

KEY WORDS: *revenue management; dynamic pricing; differential pricing; Leo Express*

1. Introduction

The Czech Republic boasts the densest railway network in Europe, highlighting its significant role in the country's transportation market. In the past, the Czech national carrier, Czech Railways Company, operated as the sole monopoly in the railway transport sector. However, the market underwent liberalization, leading to the entry of new players. RegioJet made its debut in 2011, followed by Leo Express in 2012, and subsequently, other carriers joined the market, for example Arriva vlaky, GW Train Regio, Vogtlandbahn/Die Länderbahn, KŽC Doprava, MBM rail, and Railway Capital. With the increased competition, railway passenger carriers have been compelled to adapt their marketing practices and strategies to thrive in this new environment.

One particularly intriguing scenario has emerged on the Prague – Ostrava region route, which is currently exclusively operated at commercial risk. Understanding the intricacies of dynamic pricing on the Czech railway passenger transport market is essential for both academic researchers and industry professionals seeking to gain a comprehensive perspective on the marketing strategies employed by prominent carriers. By delving into the case study of Leo Express on the Prague – Ostrava region route, this article aims to contribute to the existing body of knowledge in this domain and shed light on the complex interplay between pricing, competition, and consumer behaviour in the dynamic market landscape of railway passenger transport. This article is structured as follows: section 2 – Theoretical background, section 3 – Methods and materials, section 4 – Results, and section 5 – Conclusions.

2. Theoretical Background

Revenue management is a combination of different approaches [1] – it involves dynamic pricing, use of pricing structure and different pricing tactics [2], use of demand forecasting, management of capacity and overbooking. Particular attention is focused on estimating demand distribution, customer behaviour [1] and knowledge of demand elasticity [3]. This is a crucial micro-factor [4]. All this information forms the basis for decision-making processes [4] related to pricing. At the same time, all this knowledge is used to increase the revenue of the company [1, 5].

Revenue management combines the supply and demand aspects. It primarily considers the relationship between price and demand [6] and a dynamic pricing strategy is applied in the phase of marketing. Considering the relationship between price and supply [6], revenue management allows offering services at different prices (uses price discrimination) in the planning and resource allocation management phase. Thus, it optimizes the efficiency of resource allocation and improves the revenue of the company. Revenue management has long been used in several service sectors [3] – hospitality, hotels, maritime transport, and air transport. In the airline sector, revenue management is a common practice [7].

It represents a balance between forecast booking requirements and available seat capacity [7]. The allocation of seats is done by optimization usually through mathematical modelling and iteratively applied on a continuous time horizon until the time of departure according to demand and updating the remaining seats [7]. With revenue management techniques, an airline companies can charge different prices for the same flight depending on passenger characteristics [8]. With advanced revenue management techniques, the airline company can charge each passenger a price that is close to their willingness to pay [8].

Revenue management in the air transport sector has received attention for a long time [9, 10, 11] (since the 1970s [1]). Revenue management in rail transport has only been studied more in the last ten to fifteen years. It is often attended only marginally – as a complementary pricing strategy [3]. Even though rail transport has good potential for the application of revenue management [9]. It is therefore a new research trend [12]. The need of research in this field is gradually confirmed by researchers [3].

The need for research is also increased by the progressive development of high-speed lines in rail transport [11, 13]. High-speed railways are expanding rapidly around the world, and they provide fast, convenient, and rapid transportation [14]. High-speed rail is expected to be more significantly flexible in pricing policies compared to conventional rail [3]. Appropriate pricing policies for high-speed rail can enhance its competitiveness in the intramodal market [6]. At the same time, it can also increase competitiveness in the intermodal market in competition with air transport, in which revenue management is commonly used [14].

However, current research is focused mainly on the formulation of mathematical models [15, 16, 17]. Less attention has been focused on price differentiation and pricing policy [2]. At the same time, there is a significant lack of empirical studies, although elaborate studies demonstrate that revenue management is important in rail transport [11]. A more detailed empirical study for selected European countries was produced in 2022 [18]. The study also analysed the use of dynamic pricing in passenger rail transport in the Czech Republic. The research focused on the services of České dráhy, a.s. on the Prague – Olomouc/Ostrava line. The research showed that České dráhy primarily uses uniform prices. The research indicated that prices do not change depending on the advance purchase of the ticket. This is inconsistent with the claim that the liberalisation of the railway market generally motivates carriers to increase competitiveness and apply new pricing strategies [18] (including the use of revenue management and dynamic pricing).

However, the limited use of revenue management may be related to the specificity of this pricing in rail transport sector. What rail passenger transport has in common with air transport is the attempt to sell the right seat at the right time and at the right fare to the right person before the time of departure [7]. For rail companies, if seats on the trains they operate are not sold before the scheduled departure time, the economic value of those seats becomes zero [10]. In short, the problems of passenger rail and air transport are quite closely related [9]. However, they also have important differences. Passenger rail prices are not as dynamic as airline prices and usually less differentiated [11]. Furthermore, for the rail system, the journey itinerary is usually made up of several parts. Each part of the journey is identified by two consecutive stations through which a particular train passes [11]. Thus, compared to air transport, revenue management of the railway system can be considered as a pricing problem for multiple train journey parts with a single fare. Therefore, the objective of revenue management is to find the optimal number of passengers on each part to maximize the total revenue. However, this can be difficult, mainly because of the considerable price heterogeneity in some markets and routes [19]. In contrast, air services are typically point-to-point [3], which makes the application of revenue management principles easier. The aim of the article is to analyse the basic principles of dynamic pricing of Leo Express on the route Prague – Ostrava region from a marketing perspective.

3. Methods and Materials

This article is based on an interpretive case study. The interpretative case study has demonstrated great applicability in the realm of exploratory research [20]. By employing the interpretative case study approach, the proximity between the researcher and the central decision-maker is reduced to a minimum [21]. The core determinations in interpretive case studies revolve around prior theories, the choice of unit(s) of analysis, the quantity and selection of cases, the methods employed for data collection, and the approach(es) utilized for data analysis [22]. The interpretative case study is based on a detailed study of one case and the presentation of the results and conclusions.

The research methodology is presented in Fig. 1. Based on the theoretical background, the following research question was established. How does Leo Express use dynamic pricing? Subsequently, three hypotheses ($H_1 - H_3$) were established:

- H_1 : The ticket price changes according to the time remaining until the departure of the connection.
- H_2 : The ticket price changes according to the number of tickets remaining in the connection.
- H_3 : Is the percentage change in price possibly the same in all fare classes?

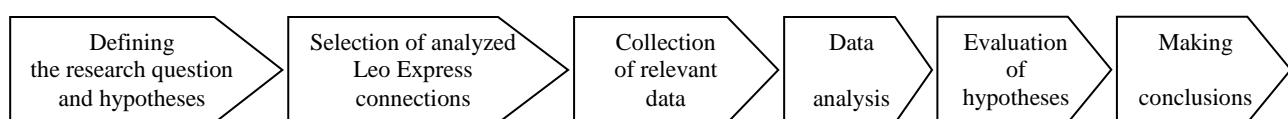


Fig. 1 Methodology [authors]

The observation period was deliberately set from 1 June 2022 to 30 June 2022. It is not a period of summer holidays, major holidays or other circumstances that would have a significant impact on the data analysed. The route from Prague to the Ostrava region was chosen as the analysed route because it is currently operated exclusively at commercial risk. Leo Express operated the following connections on the route Prague – Ostrava region during this period: LE 1231, LE 1251, LE 1241, LE 1257, LE 1235, LE 411, LE 1237, LE 413, LE 1259, LE 1261, and LE 1263. Due to the need to obtain consistent and comparable data for the analysis, only daily connections on the Prague – Ostrava region route were considered (connections LE 1251, LE 1241, and LE 411 – see Table 1). Connections to foreign countries, where a different type of pricing may be set, were excluded from the analysis.

Table 1 Overview of Leo Express connections analysed [authors based on 23]

Connection	Variable	Departure location and time	Arrival location and time	Final station and time
LE 1251	α	Prague m. s. (08:28)	Ostrava m. s. (12:17)	Bohumín (12:25)
LE 1241	β	Prague m. s. (09:28)	Ostrava m. s. (13:14)	Bohumín (13:20)
LE 411	γ	Prague m. s. (15:28)	Ostrava m. s. (19:15)	Bohumín (19:23)

Notes: m. s. = main station

Relevant data was collected during the period under review on the Leo Express website [24] in the Search Connections section. Data collection was always done in an anonymous window to eliminate cookies. Attention was focused on ticket prices in individual fare classes, the number of tickets remaining and the number of days remaining until the departure of the given connection.

Leo Express operates five-part Stadler Flirt trains and offers 6 Premium seats, 19 Business seats and then Economy and Economy Plus seats in each train. All fare classes share low-floor boarding, free Wi-Fi, electrical socket, and air conditioning. Other above-standard services vary, for example, in Economy class refreshments are available for purchase, whereas in other classes selected drinks and snacks are included in the ticket price. The Business and Premium fares provide all the amenities for business travellers, including more privacy, a quiet compartment, and priority service [24].

The following relationships (1-2) were used to analyse the data in relation to hypothesis 1 (H_1), the following relationships (3-4) were used to analyse the data in relation to hypothesis 2 (H_2), the following relationship (5) was used to analyse the data in relation to hypothesis 3 (H_3):

$$p^{k_{ij}}; i \in Pr, Bu, Ep, Ec; j \in \langle 1, 132 \rangle; k \in \alpha, \beta, \gamma, \quad (1)$$

$$\Delta p^{k_{ij}}; i = \text{constant}; j \in \langle 1, 132 \rangle; \Delta j = 1; k = \text{constant}, \quad (2)$$

$$p^{k_{il}}; i \in Pr, Bu, Ep, Ec; k \in \alpha, \beta, \gamma; l \in Z^{0+}, \quad (3)$$

$$\Delta p^{k_{il}}; i = \text{constant}; k = \text{constant}; \Delta l \in Z^{0+}, \quad (4)$$

$$\Delta P = \{[1 - (p^{k_{il}} / p^{k_{il}})] \cdot 100 \%\}; i \in Pr, Bu, Ep, Ec; k \in \alpha, \beta, \gamma; l \in Z^{0+}, i = \text{constant}; k = \text{constant}; \Delta l \in Z^+, \quad (5)$$

where $p^{k_{ij}}$ – the cheapest ticket price [CZK currency] in fare class i with the number of days until the departure of connection [day] j and for connection k ; i – fare class; j – the number of days until the departure of connection; k – connection; Pr – Premium fare class, Bu – Business fare class, Ep – Economy Plus fare class, Ec – Economy fare class; α – connection LE 1251 (Table 1), β – connection LE 1241 (Table 1), γ – connection LE 411 (Table 1); $p^{k_{il}}$ – the cheapest ticket price [CZK currency] in fare class i in the connection k with the number of available tickets l ; l – the number of available tickets; P – the percentage change of ticket price [%] in fare class i in the connection k with the number of available tickets l .

4. Results

The results section is structured according to the individual hypotheses ($H_1 - H_3$).

4.1. Hypothesis 1 (H_1)

Hypothesis 1 (H_1) was established as follows: The ticket price changes according to the time remaining until the departure of the connection. This hypothesis was evaluated for each connection separately and for each fare class separately. The evaluation was carried out by monitoring the change in the ticket price in a given fare class and on a given connection in the context of the changing time remaining until the departure of the service. The hypothesis is considered as confirmed when:

- the number of remaining tickets in a given fare class and on a given connection has not changed, and at the same time,
- the number of days remaining until the departure of the given connection has changed, and at the same time,
- the price of the cheapest ticket in a given fare class and on a given service has changed (increased).

If the above conditions for confirming hypothesis 1 (H_1) are not met, the hypothesis is rejected. The Fig. 2 presents an example of data analysis of the ticket price changes according to the time remaining until the departure of the connection α (LE 1251) with departure on 1 June 2022 from Prague m.s. for all fare classes analysed.

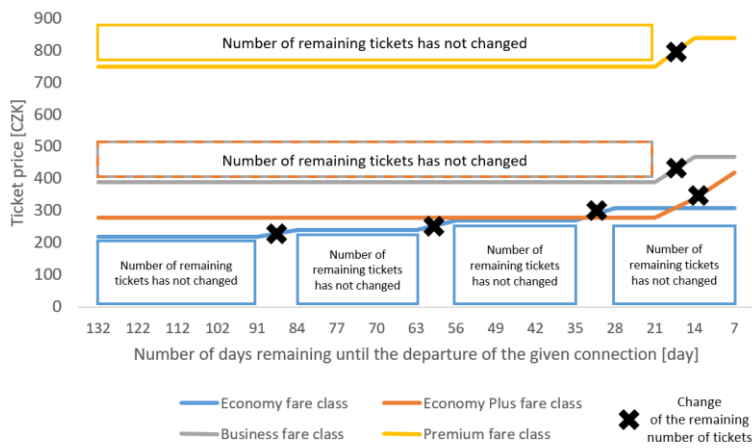


Fig. 2 Ticket price changes according to the time remaining until the departure of the connection [authors based on 25]

Fig. 2 shows that the price in the Premium fare class was constant between 132 days and 21 days before the departure of a given service (CZK 749). Furthermore, the price was constant between 14 and 7 days before the departure of a given service (CZK 839). In the Business fare class, the price was constant in the same period from 132 days to 21 days before the departure of a given connection (CZK 389). Furthermore, the price was constant in the period from 14 to 7 days before the departure of a given connection (CZK 469). In Economy Plus fare class, the price was constant in the same period from 132 days to 21 days before the departure of a given connection (CZK 279). In Economy fare class, the price was constant from 132 days to 91 days before the departure of a given connection (CZK 219), from 84 days to 63 days (CZK 239), from 56 days to 35 days (CZK 269), and from 28 to 7 days (CZK 309). The price change is not caused by a change in the number of days remaining until the departure of the connection, but by a change in the number of remaining tickets in a given fare class.

The same analysis was also carried out for the other examined connections (β , γ) with departures during June 2022 from Prague m.s. and for all fare classes and the same conclusions were reached. Based on Fig. 2, it can be concluded that the ticket price does not change depending on the changing time to departure of the connection. Conclusion: hypothesis 1 (H_1) is rejected.

4.2. Hypothesis 2 (H_2)

Hypothesis 2 (H_2) was established as follows: The ticket price changes according to the number of tickets remaining in the connection. This hypothesis was evaluated for each connection separately and for each fare class separately. The evaluation was carried out by monitoring the change in the ticket price in a given fare class and on a given connection in the context of the changing number of remaining tickets. The hypothesis is considered as confirmed when:

- the number of remaining tickets in a given fare class and on a given connection has changed, and at the same time,
- the number of days remaining until the departure of the given connection has not changed, and at the same time,
- the price of the cheapest ticket in a given fare class and on a given service has changed (increased).

If the above conditions for confirming hypothesis 2 (H_2) are not met, the hypothesis is rejected. Fig. 3 and 4 present an example of data analysis of the ticket price changes according to the number of tickets remaining in the connection with departure in June 2022 from Prague m.s.

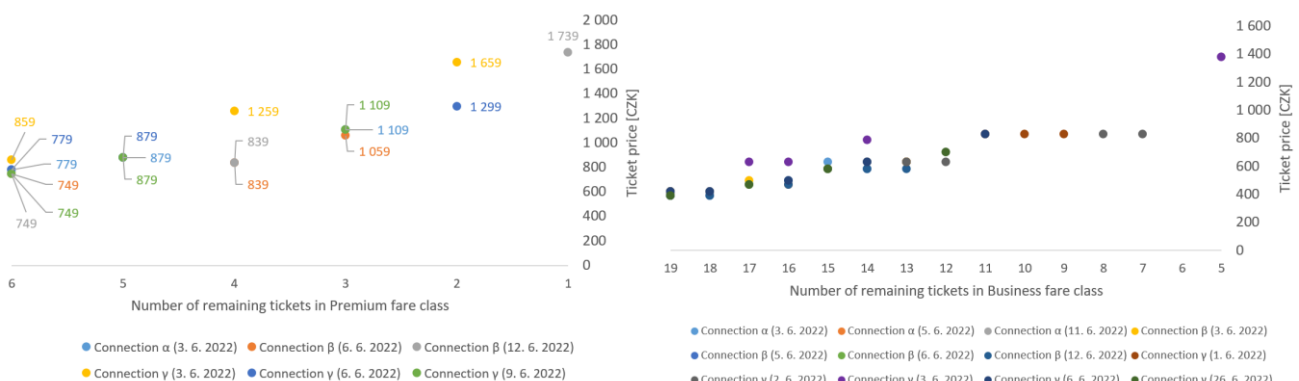


Fig. 3 and 4 Ticket price changes according to the number of tickets remaining in the connection [authors based on 25]

Fig. 3 shows that for connection α (departure 3 June 2022) the price changed as follows according to the number of remaining tickets (hereinafter r. t.) in the Premium fare class (6 r. t. – CZK 779, 5 r. t. – CZK 879, 3 r. t. – CZK 1 109), for connection β (departure 6 June 2022) the price changed as follows (6 r. t. – CZK 749, 4 r. t. – CZK 839, 3 r. t. – CZK 1 059), for connection β (departure 12 June 2022) the price changed as follows (6 r. t. – CZK 749, 4 r. t. – CZK 839, 1 r. t. – CZK 1 739). Based on Fig. 4, the same conclusions can be drawn as in Fig. 3, but in the Business fare class. The same analysis was also carried out for all connections with departures during June 2022 from Prague m.s. and for all fare classes and the same conclusions were reached. Based on Fig. 3 and 4, it can be concluded that the ticket price does change depending on the changing number of remaining tickets in the connection. Conclusion: hypothesis 2 (H_2) is confirmed.

4.3. Hypothesis 3 (H_3)

Hypothesis 3 (H_3) was established as follows: The percentage change in price is the same in all fare classes. This hypothesis was evaluated for each connection separately and for each fare class separately. The evaluation was carried out by monitoring the change in the ticket price in a given fare class and on a given connection in the context of the changing number of remaining tickets. The hypothesis is considered as confirmed when the percentage change in price is the same (is constant) in all fare classes when changing the remaining number of tickets by one unit. Table 1 presents examples of price changes on the connection α according to individual fare classes and the changing number of remaining tickets.

Table 1 Examples of price changes on the connection α according to individual fare classes and the changing number of remaining tickets [authors based on 25]

Departure day	Fare class	Price		Change the remaining number of tickets	Percentage price change
		Original	New		
1. 6. 2022	Premium	749 CZK	839 CZK	from 6 to 5 ($\Delta = 1$)	12.016 %
1. 6. 2022	Economy Plus	339 CZK	419 CZK	from 18 to 17 ($\Delta = 1$)	23.599 %
3. 6. 2022	Business	499 CZK	629 CZK	from 16 to 15 ($\Delta = 1$)	26.052 %
3. 6. 2022	Premium	779 CZK	879 CZK	from 6 to 5 ($\Delta = 1$)	12.836 %
5. 6. 2022	Business	469 CZK	579 CZK	from 16 to 15 ($\Delta = 1$)	23.454 %
10. 6. 2022	Economy Plus	399 CZK	499 CZK	from 18 to 17 ($\Delta = 1$)	25.062 %
14. 6. 2022	Premium	749 CZK	839 CZK	from 6 to 5 ($\Delta = 1$)	12.016 %
20. 6. 2022	Economy Plus	339 CZK	419 CZK	from 18 to 17 ($\Delta = 1$)	23.599 %

Table 1 shows that the percentage change in ticket price varies, except in a few cases. This is due to the fact that different connections have different prices for the same number of tickets remaining. This results in a different percentage change in ticket price. In the case of a change in the price of tickets from the same original price to the same new price depending on a change in the number of remaining tickets by one unit, the percentage change in price is identical. At the same time, it was found that the percentage change in price is not constant, or that the ticket price does not increase linearly when the number of remaining tickets changes by one unit. The same analysis was also carried out for all connections with departures during June 2022 from Prague m.s. and for all fare classes and the same conclusions were reached. Based on Table 1, it can be concluded that the percentage change in price is not the same in all fare classes. Conclusion: hypothesis 3 (H_3) is rejected.

5. Conclusions

Although according to theoretical recommendations, revenue management seems to be suitable for rail transport, its implementation in practice is difficult [26] (e.g., due to the high heterogeneity of passengers [27] and different user behaviour [28]), which is evidenced by the conclusions of the present study. Hypothesis 1 (H_1) was established as follows: The ticket price changes according to the time remaining until the departure of the connection. Conclusion: hypothesis 1 (H_1) is rejected. This conclusion is inconsistent with the general research which argues that revenue management uses time-based revenue optimization strategies [3]. However, it may be related to conclusions from the rail industry that indicate that the pricing mechanism is more focused on the marketing design phase [6] (in relation to demand). Furthermore, research shows that, in general, railway companies only need to modify their pricing structure marginally (in relation to supply) to achieve opt. system performance [29]. It can be concluded that the ticket price does change depending on the changing number of remaining tickets in the connection. Conclusion: hypothesis 2 (H_2) is confirmed. This conclusion is in harmony with other research which states that although the pricing mechanism in rail transport is not clearly known due to competition, it is probable that prices are set according to the supply of available seats [30]. Based on Table 1, it can be concluded that the percentage change in price is not the same in all fare classes. Conclusion: hypothesis 3 (H_3) is rejected. This conclusion indicates that the intensity of demand and its elasticity are not the same in all tariff classes. Passengers in the rail system make subjective travel decisions to minimize their generalized costs [29]. Carriers have responded to this by using different pricing policies for different groups of passengers [28] – price differentiation and the use of discrimination pricing. Dynamic pricing and discrimination pricing are two important approaches that rail companies can use to increase their revenues [3].

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