

MUHANDISLIK

& IQTISODIYOT

4-MAXSUS SON

*Ijtimoiy-iqtisodiy, innovatsion texnik,
fan va ta'limga oid ilmiy-amaliy jurnal*

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- 05.01.02 – Tizimli tahlil, boshqaruv va axborotni qayta ishlash
- 05.01.03 – Informatikaning nazariy asoslari
- 05.01.04 – Hisoblash mashinalari, majmualari va kompyuter tarmoqlarining matematik va dasturiy ta'minoti
- 05.01.05 – Axborotlarni himoyalash usullari va tizimlari. Axborot xavfsizligi
- 05.01.06 – Hisoblash texnikasi va boshqaruv tizimlarining elementlari va qurilmalari
- 05.01.07 – Matematik modellash
- 05.01.11 – Raqamli texnologiyalar va sun'iy intellekt
- 05.02.00 – Mashinasozlik va mashinashunoslik
- 05.02.08 – Yer usti majmualari va uchish apparatlari
- 05.03.02 – Metrologiya va metrologiya ta'minoti
- 05.04.01 – Telekommunikatsiya va kompyuter tizimlari, telekommunikatsiya tarmoqlari va qurilmalari. Axborotlarni taqsimlash
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- 05.05.05 – Issiqlik texnikasining nazariy asoslari
- 05.05.06 – Qayta tiklanadigan energiya turlari asosidagi energiya qurilmalari
- 05.06.01 – To'qimachilik va yengil sanoat ishlab chiqarishlari materialshunosligi
- 05.08.03 – Temir yo'l transportini ishlatish
- 05.08.06 – "G'ildirakli va gusenisali mashinalar va ularni ishlatish" (texnika fanlari)
- 05.09.01 – Qurilish konstruksiyalari, bino va inshootlar
- 05.09.04 – Suv ta'minoti. Kanalizatsiya. Suv havzalarini muhofazalovchi qurilish tizimlari
- 10.00.06 – Qiyosiy adabiyotshunoslik, chog'ishtirma tilshunoslik va tarjimashunoslik
- 10.00.04 – Yevropa, Amerika va Avstraliya xalqlari tili va adabiyoti
- 08.00.01 – Iqtisodiyot nazariyasi
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- 08.00.03 – Sanoat iqtisodiyoti
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- 08.00.07 – Moliya, pul muomalasi va kredit
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- 08.00.09 – Jahon iqtisodiyoti
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- 08.00.15 – Tadbirkorlik va kichik biznes iqtisodiyoti
- 08.00.16 – Raqamli iqtisodiyot va xalqaro raqamli integratsiya
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ROUTE-LEVEL PROFITABILITY ZONES IN RAILWAY PASSENGER TRANSPORT

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Abstract. The study examines how aggregate network-level losses in railway passenger transport can conceal substantial heterogeneity in route-level profitability. The research aims to classify individual routes and train types into break-even zones using two threshold coefficients: one based solely on the carrier's managed costs and the other incorporating both managed costs and contractual infrastructure charges. The analysis demonstrates that route-level classification, rather than network-wide averages, provides a more appropriate basis for tariff and investment decisions. Revenue and cost indicators were calculated for seven long-distance routes and four train types using 2023 traffic data and 2025 cost and tariff conditions. The results indicate that four of the seven routes generate revenues exceeding full costs and therefore fall within the commercial zone. In contrast, three routes generate revenues several times higher than managed costs but remain below the full-cost threshold, placing them in the potential-commercial zone. This outcome is primarily associated with route length and the predominance of the lowest fare class rather than cost inefficiency. A comparison across train types reveals that revenue per passenger ranges from near zero for suburban electric services to 201 thousand UZS for conventional long-distance trains. These findings confirm that tariff structure, rather than unit cost, is the principal factor underlying internal cross-subsidization within the railway passenger transport network.

Keywords: railway passenger transport, break-even analysis, route-level profitability, tariff differentiation, infrastructure charges, cross-subsidization.

INTRODUCTION

A railway passenger operator's network-level loss is a weighted average of route-level and train-type-level outcomes that can differ from one another by an order of magnitude: revenue per passenger-kilometre across routes has been observed to range from 0.02 to 548.5 som, while revenue per passenger ranges from 89.2 to 123.8 thousand som. Treating the network average as the unit of analysis for tariff or investment decisions may therefore result in applying a uniform approach to a fundamentally heterogeneous problem. The purpose of this thesis is to classify individual routes and train types into break-even zones defined by two threshold coefficients and to demonstrate that this classification, rather than the network aggregate, identifies where commercial viability already exists and where further structural adjustments may be required.

LITERATURE REVIEW

F. Ramsey's classical result on optimal taxation [1] establishes that a revenue requirement is met most efficiently by charging in inverse proportion to demand elasticity across markets, while W. Baumol and D. Bradford's application of that result to public-utility pricing [2] translates it into a break-even framework for a regulated network. However, neither work specifies how to classify individual routes within an already-regulated fare structure that cannot itself be freely reoptimised.

A. Kahn's treatment of tariff regulation under a network-wide revenue requirement [3] explains why a network-average deficit may conceal route-level heterogeneity but does not provide a route-level diagnostic tool. K. Talluri and G. van Ryzin's revenue-management framework [4] provides the inventory and pricing apparatus for a single route once its commercial status is known, yet it presupposes rather than establishes that status.

Consequently, the literature provides the efficiency logic for differentiated pricing (Ramsey; Baumol and Bradford), explains why network aggregation may conceal route heterogeneity (Kahn), and provides the pricing apparatus for a route once classified (Talluri and van Ryzin), but no prior work combines these elements into a route-level break-even classification applicable within an already-regulated fare structure. This thesis provides such a classification.



METHODS

For each route j , revenue per passenger-kilometre was computed from the trip's total revenue, average number of passengers carried, and tariff distance and was rescaled to 2025 price levels using the ratio of 2025 to 2023 average revenue per passenger-kilometre on the domestic network (1.79). Managed cost and contractual cost per occupied-seat-kilometre were obtained by dividing the network-average managed and contractual costs per vehicle-kilometre by the route's average car capacity. Two break-even coefficients were then defined:

$$k^* = \frac{c_b}{r}, \quad k^{**} = \frac{c_b + c_s}{r} \quad (1)$$

where c_b and c_s are the managed and contractual (infrastructure-charge) costs per occupied-seat-kilometre, respectively, and r is revenue per passenger-kilometre. A route or train type is classified as being in the loss zone if actual occupancy k falls below k^* , in the potential-commercial zone if k lies between k^* and k^{**} , and in the commercial zone if k exceeds k^{**} , since, in that case, revenue covers even the contractual infrastructure charge. The same threshold logic was applied to four train types (high-speed, Fergana-valley express, ordinary long-distance, and suburban electric) using per-trip revenue and assigned cost rather than per-passenger-kilometre figures to test whether the classification obtained at the route level is consistent with that obtained at the train-type level.

RESULTS

The break-even classification of seven long-distance routes is summarised in Table 1 and presented in Figure 1.

Table 1
Break-even coefficients and zone classification for seven long-distance routes¹

Route	k (occup.)	k^*	k^{**}	Zone
Tashkent–Urgench	0.98	0.475	1.361	Potential commercial
Andijan–Urgench	1.00	0.418	1.198	Potential commercial
Tashkent–Qonghirot	1.00	0.370	1.062	Potential commercial
Qonghirot–Andijan	1.00	0.307	0.879	Commercial
Tashkent–Termez	1.00	0.240	0.689	Commercial
Andijan–Termez	1.00	0.265	0.760	Commercial
Tashkent–Andijan	0.93	0.249	0.715	Commercial

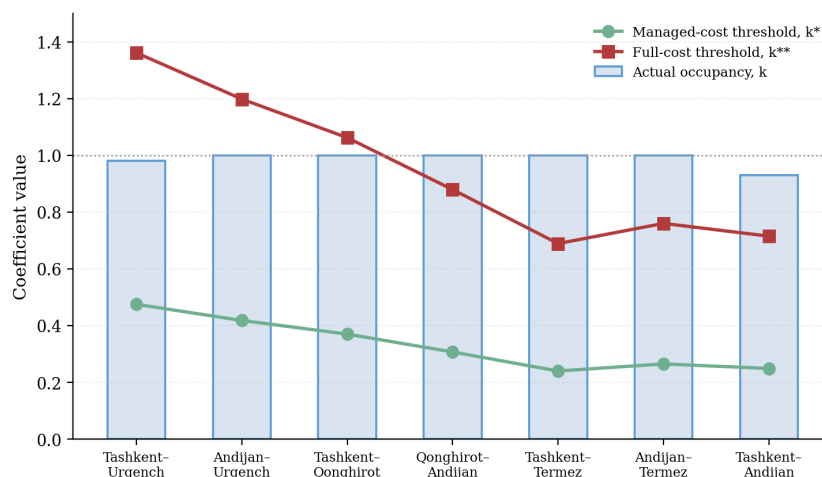


Figure 1. Actual occupancy against the managed-cost and full-cost break-even thresholds, seven routes²

¹ Source: author's calculations (2023 traffic, 2025 cost and tariff conditions).

² Source: author's calculations.

Four routes — Qonghirot–Andijan, Tashkent–Termez, Andijan–Termez, and Tashkent–Andijan — generate revenue per passenger-kilometre ranging from 343.9 to 563.9 som, equivalent to 1.4 to 2.3 times the domestic-network average, because their car composition includes a larger share of compartment and business classes over comparatively short distances; these four routes already occupy the commercial zone. The remaining three routes — Tashkent–Urgench, Andijan–Urgench, and Tashkent–Qonghirot — combine distances of 1,090 to 1,448 kilometres with a car composition dominated by the lowest fare class, resulting in revenue per occupied-seat-kilometre increasing more slowly than the distance-proportional infrastructure charge; consequently, these three routes remain in the potential-commercial zone even at full occupancy. The managed-cost threshold is exceeded on every route by a factor of two to four, indicating that managed costs are covered across all examined routes and that the principal constraint, where applicable, is associated with the contractual infrastructure charge rather than the carrier’s own operating costs.

The corresponding comparison across train types is summarised in Table 2 and presented in Figure 2.

Table 2
Trip-level revenue and cost recovery by train type³

Train type	Revenue per trip, mln UZS	Revenue per passenger, th. UZS	Revenue / assigned cost
Afrosiyob (2020)	35.9	139.9	7.1
Afrosiyob (2023)	42.1	118.6	5.3
Fergana valley express (2023)	—	123.8	—
Ordinary train, 7-route avg. (2023)	103.0	201.0	—
Electric (suburban, 2025)	0.001	0.002	—

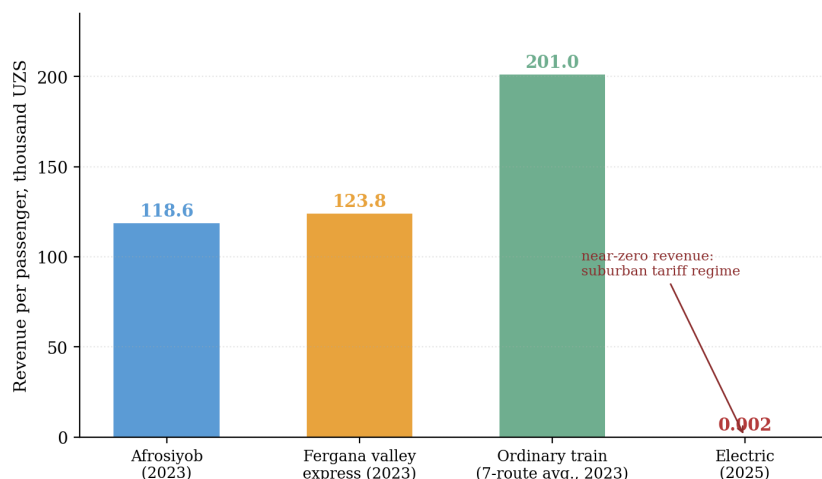


Figure 2. Revenue per passenger by train type⁴

Revenue relative to assigned managed cost on the high-speed service changed from 7.1 to 5.3 between 2020–2023 as the share of economy-class seating increased. Nevertheless, revenue per passenger on ordinary long-distance trains (201.0 thousand som) exceeds that on the high-speed service (118.6 thousand som), because ordinary-train fares are regulated at a level that, on the routes examined, corresponds to a longer average distance and a larger share of compartment-class accommodation than that observed across the high-speed network. Revenue per passenger on suburban electric services is two to three orders of magnitude lower, which is consistent with a tariff regime oriented primarily towards social rather than commercial objectives.

DISCUSSION

The finding that unit managed costs are covered on every route, while the infrastructure-charge threshold applies primarily to the three longest routes with the highest concentration of the lowest fare class, is consistent

³ Source: author’s calculations.

⁴ Source: author’s calculations.



with the efficiency logic developed by F. Ramsey and W. Baumol and D. Bradford [1; 2]. The routes remaining below the full-cost threshold are precisely those where the regulated plaskart-dominant fare structure results in revenue increasing with distance at a slower rate than the distance-proportional infrastructure charge. A. Kahn's account of network-wide revenue regulation [3] explains why this pattern may be less visible at the aggregate level: a regulator relying solely on the network-wide result may not fully distinguish between a route where the carrier's own costs constitute the primary constraint and one where the infrastructure charge is the principal constraint, although the appropriate measures differ in each case.

Extending K. Talluri and G. van Ryzin's revenue-management framework [4] to the route level, seat-inventory and pricing instruments may be prioritised on the three potential-commercial routes rather than applied uniformly, since these are the routes where a fare-structure adjustment, rather than an increase in occupancy, can contribute to closing the remaining gap. Network-average profitability indicators should therefore be supplemented by route- and train-type-level break-even classifications before tariff or investment decisions are made. The scope of the thesis is defined by its use of 2023 traffic patterns rescaled to 2025 price levels and its focus on seven long-distance routes.

CONCLUSION

This thesis has demonstrated that the network-level financial result reported for railway passenger transport encompasses a heterogeneous route-level pattern in which four of the seven examined long-distance routes already occupy a commercial break-even zone, while three remain in a potential-commercial zone despite full occupancy. This distinction is primarily associated with fare structure and distance rather than cost inefficiency, since managed costs are covered on every examined route. The train-type comparison further confirms that the tariff regime, rather than unit cost, is the principal factor underlying revenue dispersion across the network.

From a policy perspective, the two-threshold break-even classification developed here provides a route-specific diagnostic that complements network-average indicators and supports targeting fare-structure and infrastructure-charge revisions at the specific routes identified as potential-commercial rather than applying uniform measures across the network. Future research should extend the classification to the full route network using directly observed current-year data.

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