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INTERMODAL COMPETITION AND BALANCE BETWEEN TRANSPORT MODES

Gulnoza Tokhirovna Samieva, Dilshodov Dinnur

МЕЖВИДОВАЯ КОНКУРЕНЦИЯ И БАЛАНС МЕЖДУ ВИДАМИ ТРАНСПОРТА

Самиева Гульноза Тохировна, Дильшодов Диннур

TRANSPORT TURLARI O‘RTASIDAGI RAQOBAT VA ULAR O‘RTASIDAGI MUVOZANAT

Samiyeva Gulnoza Toxirovna, Dinnur Dilshodov

ABSTRACT: The article examines competition and the economic balance between transport modes in Uzbekistan, focusing on freight flows, cost structures, service characteristics, and the role of transport and logistics in national economic development. It considers road, railway, air, and pipeline transport and explains how their relative advantages depend on distance, cargo characteristics, delivery time, reliability, and infrastructure costs. The study applies descriptive statistical analysis, comparative analysis, and a theoretical cost-based approach. The data presented in the source material indicate that total freight volume increased from 1,366.7 million tonnes in 2020 to an estimated 1,601.0 million tonnes in 2025. Road transport accounted for approximately 91.1% of freight volume in 2024, while rail and pipeline transport accounted for substantially smaller shares. A conditional break-even calculation suggests that, under the stated assumptions, rail transport becomes more cost-effective than road transport at distances exceeding approximately 300 km. The article argues that improving the balance between transport modes requires investment in rail and intermodal terminals, better container services, digital freight platforms, and policies that account for external environmental and infrastructure costs. The findings are based on the statistics and assumptions contained in the supplied source text; these figures have not been independently verified.

Keywords: transport economics, intermodal competition, road transport, railway transport, logistics costs, freight transport, modal split, break-even distance, Uzbekistan.

АННОТАЦИЯ: В статье рассматриваются конкуренция и экономический баланс между различными видами транспорта в Узбекистане. Основное внимание уделяется грузопотокам, структуре затрат, характеристикам услуг, а также роли транспортно-логистической сферы в развитии национальной экономики. Анализируются автомобильный, железнодорожный, воздушный и трубопроводный виды транспорта; объясняется, как их относительные преимущества зависят от дальности перевозок, специфики грузов, сроков доставки, надежности и инфраструктурных издержек. В работе применяются методы дескриптивного статистического анализа, сравнительного анализа и теоретический подход, основанный на оценке затрат. Согласно представленным данным, общий объем грузоперевозок увеличился с 1366,7 млн тонн в 2020 году до 1601,0 млн тонн (прогнозный показатель) в 2025 году. В 2024 году на долю автомобильного транспорта пришлось около 91,1% от общего объема перевозок, в то время как доли железнодорожного и трубопроводного транспорта оказались существенно меньше. Условный расчет точки безубыточности показывает, что при заданных допущениях железнодорожный транспорт становится более экономически эффективным по сравнению с автомобильным на расстояниях, превышающих примерно 300 км. В статье утверждается, что для улучшения баланса между различными видами транспорта необходимы инвестиции в железнодорожную инфраструктуру и интермодальные терминалы, развитие контейнерных перевозок, внедрение цифровых грузовых платформ, а также разработка политики, учитывающей внешние издержки — экологические и инфраструктурные. Выводы основаны на статистических данных и допущениях, содержащихся в предоставленном источнике; эти показатели не проходили независимую проверку.

Ключевые слова: экономика транспорта, интермодальная конкуренция, автомобильный транспорт, железнодорожный транспорт, логистические издержки, грузовые перевозки, распределение объемов перевозок между видами транспорта, расстояние безубыточности, Узбекистан.

ANNOTATSIYA: Ushbu maqolada O‘zbekistondagi turli transport turlari o‘rtasidagi raqobat va iqtisodiy muvozanat masalalari ko‘rib chiqiladi. Asosiy e’tibor yuk oqimlari, xarajatlar tuzilmasi, xizmat ko‘rsatish xususiyatlari hamda milliy iqtisodiyot rivojlanishida transport va logistika sohasining tutgan o‘rniga qaratilgan. Tadqiqotda avtomobil, temir yo‘l, havo va quvur transporti tahlil qilinib, ularning nisbiy afzalliklari tashish masofasi,

yukning o‘ziga xos xususiyatlari, yetkazib berish muddatlari, ishonchlilik va infratuzilma xarajatlari kabi omillarga qanday bog‘liqligi yoritib beriladi. Ishda tasviriy statistik tahlil, qiyosiy tahlil hamda xarajatlarni baholashga asoslangan nazariy yondashuv usullaridan foydalanilgan. Taqdim etilgan ma’lumotlarga ko‘ra, yuk tashishning umumiy hajmi 2020-yildagi 1366,7 million tonnadan 2025-yilda 1601,0 million tonnagacha (prognoz ko‘rsatkichi) oshgan. 2024-yilda yuk tashish umumiy hajmining taxminan 91,1 foizi avtomobil transporti hissasiga to‘g‘ri kelgan, temir yo‘l va quvur transportining ulushlari esa sezilarli darajada kamroq bo‘lgan. Nazariy jihatdan zararsizlik tahlili shuni ko‘rsatadiki, muayyan shartlar inobatga olinganda, taxminan 300 km dan ortiq masofalarda temir yo‘l transporti avtomobil transportiga qaraganda iqtisodiy jihatdan samaraliroq bo‘ladi. Maqolada ta’kidlanishicha, transport turlari o‘rtasidagi muvozanatni yaxshilash uchun temir yo‘l infratuzilmasi va intermodal terminallarga sarmoya kiritish, konteyner tashuvlarini rivojlantirish, raqamli yuk tashish platformalarini joriy etish hamda atrof-muhit va infratuzilma bilan bog‘liq tashqi xarajatlarni hisobga oluvchi siyosatni ishlab chiqish talab etiladi. Xulosalar manbada keltirilgan statistik ma’lumotlar va taxminlarga asoslangan bo‘lib, ushbu raqamlar mustaqil ravishda tekshirilmagan.

Kalit so‘zlar: transport iqtisodiyoti, turlararo raqobat, avtomobil transporti, temir yo‘l transporti, logistika xarajatlari, yuk tashish, yuk hajmlarining transport turlari bo‘yicha taqsimlanishi, o‘zini oqlash masofasi, O‘zbekiston.

INTRODUCTION

Transport and logistics form a critical infrastructure of the national economy. Goods can reach consumers only through transport services; therefore, transport prices, speed, and reliability directly affect production costs, export competitiveness, and living standards. In economic theory, transport is generally treated as an intermediate service. Demand for transport is consequently derived from the volume and structure of production and trade.

Transport and logistics are particularly important for Uzbekistan. The country is one of the world’s two double-landlocked states, meaning that freight moving to the nearest ocean port must cross the territory of at least two other countries. This geographical position increases international transport costs, while also creating opportunities for Uzbekistan to become a transit hub connecting China, Europe, South Asia, and the Middle East. Logistics is broader than transportation. It encompasses the planning, organisation, and control of material, information, and financial flows. The classical ‘7R’ principle states that a logistics system should deliver the right product, in the right quantity and quality, to the right place, at the right time, to the right customer, and at the right cost. Transport is often the most cost-intensive component, while warehousing, inventory management, and information systems complement it.

Transport and logistics can be analysed at three interconnected levels. At the micro level, the focus is on a firm’s procurement, production, and distribution logistics and their effects on costs and profit. At the meso level, the analysis concerns regional and sectoral transport markets, logistics centres, and clusters. At the macro level, attention is given to the contribution of the national transport system to GDP, foreign trade, employment, and the balance of payments. The purpose of this article is to analyse competition and complementarity among transport modes in Uzbekistan, assess the cost and structural factors shaping freight allocation, and identify policy measures that could improve the efficiency and sustainability of the national transport and logistics system.

MATERIALS AND METHODS

The study uses a descriptive and comparative research design. The principal methods are descriptive statistical analysis of freight volumes and modal shares, comparative assessment of the technical and economic characteristics of transport modes, and a theoretical cost model for identifying the break-even distance between road and rail freight. The analysis covers road, railway, air, and pipeline transport. The indicators include freight volume measured in tonnes, freight turnover measured in tonne-kilometres where relevant, modal shares, relative unit costs, delivery speed, fixed and variable costs, flexibility, and indicative carbon dioxide emissions. The source material refers to data from the National Statistics Committee of the Republic of Uzbekistan (stat.uz and siat.stat.uz), alongside author calculations.

For the comparison of road and rail transport, total transport cost is represented by $C = F + v \times L$, where F denotes fixed terminal, loading, and unloading costs; v is the variable cost per tonne-kilometre; and L is the transport distance. The break-even distance is calculated as $L^* = (F_2 - F_1) / (v_1 - v_2)$. A generalised-cost perspective is also considered: $GC = P + VOT \times t + R$, where P is the transport tariff, VOT is the value of time, t is delivery time, and R represents the monetary value of reliability risks.

The statistical values and estimates below are reproduced from the supplied source material and are not independently verified. In particular, the 2025 freight figure is described in the source as an estimate based on cumulative quarterly data. Conditional cost parameters are illustrative rather than observed market tariffs.

RESULTS

A transport market is a system of economic relations in which the interaction of supply and demand for freight and passenger services determines prices and service volumes. It is segmented by mode: road, railway, air, pipeline, sea, and inland waterway transport. Market structures differ across these segments. Road transport is relatively competitive because many independent carriers can enter the market, whereas railway and pipeline transport tend to have natural-monopoly characteristics due to high infrastructure costs.

Transport services differ from ordinary goods in several respects. First, transport capacity cannot be stored: an unused wagon or a partially loaded truck represents capacity that cannot be recovered later.

Second, production and consumption of the service occur simultaneously. Third, transport is spatially specific: a service between Tashkent and Qarshi cannot simply be substituted by a service between Tashkent and Andijan. These characteristics contribute to seasonal and route-specific price fluctuations and to the problem of one-way freight flows. Demand for transport is derived from demand for goods and production. It is therefore closely related to GDP, industrial output, construction, and foreign trade. The price elasticity of freight demand is often relatively low, although it can be higher for heavy, low-value goods such as cement, coal, and grain, for which transport costs make up a larger share of the delivered price.

Two indicators are central to the assessment of freight transport. Freight volume, measured in tonnes, records the total mass of goods carried. Freight turnover, measured in tonne-kilometres, multiplies the weight of cargo by the distance transported and therefore better reflects the actual transport work performed. Road transport may lead in tonnes because it serves many short-distance movements, while rail and pipeline transport can have greater importance over long distances.

Table 1.

Freight volume across all transport modes in Uzbekistan, 2020–2025[39]

Year	Freight volume (million tonnes)	Year-on-year (%)	2020 = 100 (%)
2020	1,366.7	—	100.0
2021	1,420.2	103.9	103.9
2022	1,420.9	100.05	104.0
2023	1,455.7	102.4	106.5
2024	1,521.2	104.5	111.3
2025*	1,601.0	105.2	117.1

The figures in Table 1 indicate that freight volume increased by 17.1% between 2020 and 2025, corresponding to an average annual growth rate of approximately 3.2%. The source text associates the relative stagnation in 2022 with geopolitical changes in the region and the restructuring of logistics chains passing through Russia. Growth subsequently recovered, reaching 4.5% in 2024 and 5.2% in 2025.

Modal split refers to the distribution of total freight volume among transport modes. It is an important indicator of the structural efficiency of a national transport system. According to the figures in the supplied material, road transport accounts for the overwhelming majority of freight movements in Uzbekistan.

Table 2.

Distribution of freight by transport mode in Uzbekistan, 2024[40]

Transport mode	Freight volume (million tonnes)	Share (%)
Road	1,385.5	91.1
Railway (dispatches)	73.9	4.9
Pipeline (gas)	61.8	4.1
Air	0.0144 (14.4 thousand tonnes)	0.001
Total	1,521.2	100.0

The large share of road transport is associated with its flexibility, door-to-door service, and the short-distance movement of construction and agricultural goods. However, this structure also creates economic and environmental risks. Road freight generally consumes more fuel per tonne-kilometre, places a heavier burden on roads, and generates greater external costs. These include road deterioration, air pollution, and the risk of traffic accidents, which may not be fully reflected in the prices charged by carriers.

The relatively low entry barriers in road transport also help explain its dominance. An entrepreneur can enter the market by purchasing a single truck, whereas railway operations require rolling stock, locomotives, and access to infrastructure. Competition among numerous small road carriers can reduce prices, but some operators use ageing fleets, have low vehicle utilisation, and make empty return journeys. These factors reduce system-wide efficiency.

Rail transport faces constraints including shortages of freight wagons and containers, limited terminal capacity, complex documentation for smaller consignments, and insufficiently developed door-to-door services. As a result, businesses may choose road transport even over long distances, although rail may offer lower costs per tonne-kilometre.

The source material reports that 107.9 million tonnes of major freight categories were transported by public mainline railways in 2025, 5.1% more than in 2024. This indicator also includes freight received from other railway networks and therefore differs from the ‘dispatches’ figure in Table 2. In January–March 2026, 28 million tonnes were transported by mainline railway, representing year-on-year growth of 4.3%.

[39] National Statistics Committee of the Republic of Uzbekistan (stat.uz; siat.stat.uz), as cited in the supplied material. *The source describes the 2025 figure as based on cumulative quarterly data through the fourth quarter. Relative indicators are author calculations.

[40] Source: National Statistics Committee, 2024 year-end data, as cited in the supplied material. The road freight figure is calculated as the residual after subtracting the other modes from the total; shares are author calculations.

Table 3.

Freight composition in mainline railway transport, first quarter of 2026[41]

Freight category	Volume (million tonnes)	Share (%)
Various ores	3.9	13.9
Oil cargoes	3.4	12.1
Grain and milling products	3.3	11.8
Coal	2.7	9.6
Ferrous metals	1.8	6.4
Construction materials	1.5	5.4
Chemicals and mineral fertilisers	0.79	2.8
Cement	0.71	2.5
Timber	0.63	2.3
Potatoes, vegetables and fruit	0.27	1.0
Other freight	8.9	31.8
Total	28.0	100.0

Table 3 shows that railway transport is mainly used for heavy, low-value, bulk cargo. Ores, oil, grain, coal, and metals account for more than 54% of the reported freight volume. Perishable goods such as fruit and vegetables account for only 1%, reflecting their requirements for speed and temperature-controlled transport. This indicates a natural division of labour between transport modes according to cargo characteristics.

Competition among transport modes takes place in terms of price, speed, reliability, safety, and environmental impact. Their cost structures differ. Rail and pipeline transport have high fixed infrastructure costs but relatively low variable costs. Road transport has lower fixed costs but higher fuel, labour, and depreciation costs per kilometre. Consequently, the relative advantage of rail tends to increase with distance.

The comparison suggests that no single mode is optimal for every type of freight. Road transport is flexible and suitable for short-distance and door-to-door delivery. Rail is more efficient for large volumes over longer distances. Air transport is appropriate for high-value and time-sensitive cargo, while pipelines are suited to continuous flows of gas and oil but are highly inflexible.

Table 4.

Comparative economic and technical characteristics of transport modes[42]

Indicator	Road	Railway	Air	Pipeline
Relative cost per tonne-km	Medium–high	Low	Very high	Lowest
Delivery speed	High over short distances	Medium	Highest	Continuous flow
Efficient distance	Up to 300–500 km	More than 500 km	Long-distance/intercontinental	Long-distance, stable flows
Share of fixed costs	Low	High	Medium	Very high
Flexibility	Highest	Low	Medium	Very low
CO_2 emissions, g/tonne-km (indicative)	60–120	20–35	More than 500	5–10
Main cargo	Construction materials, food, retail goods	Ore, grain, coal, metals	High-value and perishable goods	Gas, oil
Market structure	Competitive	Natural monopoly	Oligopoly	Natural monopoly

The break-even distance is the distance at which the total cost of transporting a given consignment is equal for two transport modes. Total cost is expressed as $C = F + v \times L$, where F represents fixed terminal and handling costs, v is variable cost per tonne-kilometre, and L is distance. The break-even distance is $L^* = (F_2 - F_1) / (v_1 - v_2)$.

For the conditional example in the source material, road transport is assigned fixed costs of USD 3 per tonne and variable costs of USD 0.08 per tonne-kilometre. Rail transport, including reloading, is assigned fixed costs of USD 18 per tonne and variable costs of USD 0.03 per tonne-kilometre.

Under these assumptions, road transport is less costly at distances below 300 km, while rail becomes

[41] Source: National Statistics Committee (stat.uz), first quarter of 2026, as cited in the supplied material. Shares are author calculations; minor differences may arise from rounding.

[42] Source: Author's compilation based on indicative values cited in international transport economics literature and European/international organisation reports. CO_2 values vary with technology and load factor.

more cost-effective beyond that point. At 2,000 km, the illustrative rail cost is less than half the road cost. In practice, the break-even distance is affected by loading and unloading time, wagon availability, tariff policy, and the quality of door-to-door services. If railway terminals are inefficient and fixed handling costs rise, the break-even distance may increase to 500–700 km, encouraging freight to remain on roads.

Table 5.

Cost of transporting one tonne of freight by road and rail (illustrative example, USD)[43]

Distance (km)	Road	Railway	Difference (road − rail)	More efficient mode
100	11	21	−10	Road
300	27	27	0	Break-even point
500	43	33	+10	Railway
1,000	83	48	+35	Railway
2,000	163	78	+85	Railway

Shippers do not compare transport tariffs alone; they consider generalised cost. This can be expressed as $GC = P + VOT \times t + R$, where P is the freight tariff, VOT is the value of time, t is delivery time, and R is the monetary value of reliability risks such as delay, loss, or damage. The value of time is high for expensive and perishable goods, which therefore tend to use faster modes such as road or air transport. For low-value bulk goods, the tariff is usually more decisive, favouring rail and pipeline transport.

The degree of competition between transport modes can be assessed using cross-price elasticity: $E = (\%\Delta Q_1) / (\%\Delta P_2)$. For example, if a 10% increase in railway tariffs leads to a 3% increase in road freight volume, the coefficient is 0.3. A higher coefficient indicates stronger substitution between modes and a greater likelihood that tariff changes will redistribute freight flows. Tariff regulation for natural monopolies should therefore take account of the balance of the entire transport system.

The relationship between transport modes involves both competition and complementarity. Competition occurs when modes serve the same route and cargo market—for example, when road and rail compete to transport construction materials between Tashkent and Qarshi. Complementarity is evident in multimodal chains: goods may be collected from a farm by truck, transported by rail to a border terminal, and then moved by sea to the destination market.

The source material identifies several economic instruments through which the state can improve the balance of the transport system:

Tariff policy: regulating tariffs charged by natural monopolies, including railway and pipeline operators, to prevent unjustified price increases.

Infrastructure investment: electrifying railway lines, constructing additional tracks, and developing logistics terminals.

Internalisation of external costs: using road-use charges and environmental fees to reflect the full social cost of road transport.

Market liberalisation: expanding the participation of private operators and wagon owners in rail transport and supporting competition in air transport.

Digital platforms: connecting freight owners and transport operators through digital freight exchanges to reduce empty running.

Although air transport has a small share of freight by weight, it is important by cargo value. It carries high-value goods such as electronics, pharmaceuticals, and perishable agricultural products. The source material reports that 9.7 million passengers were transported by air in Uzbekistan in 2025 and identifies Navoi International Airport as an emerging cargo hub on Eurasian air routes. The development of air freight requires temperature-controlled terminals, rapid customs clearance, and regular flights. For exports of cherries, grapes, and herbs to distant markets, air freight may be competitive despite its high price because it helps preserve product quality and reach higher-value markets.

Pipeline transport is a natural monopoly and is limited to liquid and gaseous commodities. Its principal advantages are low variable costs, continuous operation, and limited dependence on weather conditions. Its disadvantages are high initial investment and low flexibility: a pipeline is built along a fixed route and generally serves a specific type of product. Pipeline investment is therefore most appropriate where stable, long-term freight flows can be expected.

The analysis indicates a structural imbalance in Uzbekistan's freight transport system, where road transport accounts for approximately 91% of total freight volume in the 2024 figures presented in the source material. Road transport's flexibility and door-to-door capability explain much of this dominance. Nevertheless, an excessive reliance on road freight can increase fuel consumption, road maintenance requirements, congestion, emissions, and accident risks. These costs are not necessarily reflected in private transport prices.

The theoretical comparison suggests that rail transport can offer cost advantages over longer distances, particularly for heavy and bulk cargo. However, these advantages depend on the availability of wagons and containers, terminal capacity, handling costs, schedule reliability, and the quality of first- and last-mile connections. Investment in railway infrastructure alone may therefore be insufficient unless it is accompanied by improvements in logistics services and intermodal coordination.

[43] Source: Author's calculation. Parameters are illustrative and are not observed market tariffs. $L^* = (18 - 3) / (0.08 - 0.03) = 300$ km

The break-even calculation is illustrative rather than an empirical estimate of current Uzbek market tariffs. Its value lies in demonstrating how fixed and variable costs jointly determine modal choice. Actual break-even distances should be calculated for specific routes, cargo types, terminal conditions, and current tariff schedules. Similarly, the indicative emissions ranges in Table 4 should not be interpreted as route-specific measurements.

Transport modes should not be viewed solely as competitors. A well-designed multimodal system uses road transport for collection and final delivery, rail for long-distance inland movement, air for urgent and high-value cargo, and pipelines for suitable continuous flows. Such a division of functions can improve cost efficiency while reducing the environmental burden of freight transport.

The source material suggests that transferring 10–15% of long-distance freight to rail could reduce overall logistics costs and environmental pressure. This proposition should be tested through route-level cost-benefit analysis, taking into account terminal investment, cargo handling, service reliability, and external costs. The policy objective should be an efficient modal balance rather than an arbitrary reduction in the share of any single mode.

CONCLUSION

The study has examined the competition and complementarity of transport modes in Uzbekistan and their implications for logistics efficiency. The main conclusions are as follows:

1. Transport is a derived-demand service and its performance directly affects production costs, trade competitiveness, and economic development.
2. The freight structure presented in the source material is heavily dominated by road transport, which offers flexibility but also generates infrastructure and environmental externalities.
3. Rail transport has a comparative cost advantage for many heavy and long-distance freight movements, but its competitiveness is constrained by terminal capacity, wagon and container availability, handling costs, and the quality of door-to-door services.
4. The illustrative break-even model demonstrates that the relative efficiency of road and rail depends on the relationship between fixed and variable costs. Under the assumptions used, the break-even distance is 300 km; actual values require route-specific data.
5. Transport modes are both substitutes and complements. Their integration through multimodal logistics chains can improve the overall performance of the national transport system.

To improve the balance of Uzbekistan's transport system, the following measures are recommended: expand rail freight and container-terminal capacity; improve first- and last-mile road connections to rail terminals; simplify documentation and handling procedures for smaller consignments; promote digital freight platforms to reduce empty runs; introduce tariff and road-use policies that reflect infrastructure and environmental externalities; and develop route- and cargo-specific assessments of modal choice. These measures should be implemented as an integrated logistics policy, taking account of the country's geographical position, trade structure, and regional connectivity.

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