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ASSESSMENT OF THE EFFICIENCY OF FIXED ASSETS UTILIZATION IN RAILWAY ENTERPRISES: EVIDENCE FROM UZBEKISTAN

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Abstract. This paper assesses the efficiency of fixed asset utilization in the railway transport sector of Uzbekistan during 2014–2024, using the case of “Uzbekistan Railways” JSC. Based on the methodological framework proposed by the International Transport Forum (ITF/OECD) for measuring railway efficiency, the study combines financial indicators, including the operating ratio, gross profitability and depreciation intensity, with physical asset utilization indicators, such as locomotive and wagon productivity, turnaround time, traffic density and cost-structure analysis.

The results reveal a specific imbalance: while physical productivity indicators of rolling stock improved steadily, with locomotive productivity increasing by 19.5 percent and wagon productivity by 31.0 percent during 2014–2023, the financial efficiency of freight operations showed a declining trend. The operating ratio has persistently exceeded 100 percent since 2019, while the gross profitability of freight transport decreased from about 53.0 percent in 2020 to nearly zero in 2022–2023.

This trend is explained by a cost structure in which energy and labour costs increased faster than revenue, reflecting the ageing of the rolling stock fleet and growing maintenance requirements. The paper argues that asset utilization efficiency in railways cannot be assessed using physical indicators alone. Therefore, it proposes a combined financial and operational monitoring framework for railway enterprises in transition economies.

Keywords: railway transport, fixed assets, asset utilization efficiency, operating ratio, depreciation, rolling stock productivity, Uzbekistan.

Аннотация. В данной статье оценивается эффективность использования основных средств в железнодорожном транспорте Узбекистана за период 2014–2024 гг. на примере АО «Узбекистон темир йуллари». Исследование основано на методологическом подходе Международного транспортного форума (ITF/OECD) к оценке эффективности железнодорожного транспорта и объединяет финансовые показатели (коэффициент операционных расходов, валовая рентабельность, интенсивность амортизации), показатели использования подвижного состава (производительность локомотивов и вагонов, оборот вагонов, плотность перевозок), а также анализ структуры затрат.

Результаты исследования выявили определённый дисбаланс: несмотря на устойчивый рост показателей производительности подвижного состава, включая увеличение производительности локомотивов на 19,5 % и вагонов на 31,0 % в 2014–2023 гг., финансовая эффективность грузовых перевозок демонстрировала тенденцию к снижению. Коэффициент операционных расходов с 2019 года стабильно превышал 100 %, а валовая рентабельность грузовых перевозок снизилась примерно с 53 % в 2020 году до практически нулевого уровня в 2022–2023 гг.

Данная тенденция обусловлена структурой затрат, в которой расходы на энергоресурсы и оплату труда росли более высокими темпами по сравнению с доходами, что связано со старением подвижного состава и увеличением затрат на его техническое обслуживание. В статье обосновывается, что эффективность использования основных средств на железнодорожном транспорте не может оцениваться исключительно на основе физических показателей. В связи с этим предлагается комплексная система мониторинга, объединяющая финансовые и эксплуатационные показатели деятельности железнодорожных предприятий в странах с переходной экономикой.

Ключевые слова: железнодорожный транспорт, основные средства, эффективность использования активов, коэффициент операционных расходов, амортизация, производительность подвижного состава, Узбекистан.

INTRODUCTION

Railway transport occupies a strategic position in the economy of Uzbekistan, a double-landlocked country where rail infrastructure serves as the main mode of long-distance freight transportation and plays an increasing role in passenger mobility. Between 2018 and 2024, the net revenue of “Uzbekistan Railways” JSC (hereafter UTY) increased 2.6 times, while the company’s share in national rail freight turnover rose from 32.3 percent in 2019 to a peak of 34.9 percent in 2023. At the same time, the share of road transport in freight turnover increased from 21.9 percent to 30.1 percent over the same period, intensifying intermodal competition.

In this context, the efficiency of fixed asset utilization in railway transport — including track infrastructure, traction equipment, locomotives, and wagons — becomes a decisive factor for the sector’s competitiveness and long-term sustainability. Fixed assets in railway enterprises are capital-intensive, long-lived, and heterogeneous, which makes it difficult to assess their efficiency using a single indicator.

The purpose of this paper is to empirically assess how the efficiency of fixed asset utilization in UTY evolved during 2014–2024 using a multidimensional set of indicators consistent with international practice, and to identify the structural factors influencing the observed dynamics.

LITERATURE REVIEW

The measurement of railway efficiency has been widely examined in international research. Thompson and Bente (2014), in a discussion paper prepared for the ITF/OECD Roundtable on Efficiency in Railway Operations and Infrastructure Management, argue that no single indicator can fully assess railway efficiency. Instead, a set of indicators related to scale, asset productivity, labour productivity, and financial performance should be used together. Among financial indicators, the operating ratio — operating expenses as a percentage of operating revenue, including depreciation — is identified as a key measure of financial sustainability. Values above approximately 85 percent may indicate increasing dependence on external support.

Thompson and Bente (2014) also propose a Balanced Railway Efficiency Scorecard (BRESC), which includes the scope of the railway system, utilization of infrastructure and fleet assets, human resource deployment, operational performance, financial performance, and customer-oriented performance. The authors emphasize that asset utilization is one of the most important determinants of railway economic performance and that normalized full cost per train-kilometre and per unit of maintained infrastructure can serve as useful proxies for management performance.

A related ITF/OECD roundtable report by Beck and Bente (2013) further develops the asset-utilization approach. The report shows that train density on infrastructure and the capacity utilization of trains jointly determine the gap between actual and potential output of railway fixed assets. It also recommends combining top-down econometric benchmarking methods, such as Stochastic Frontier Analysis and Data Envelopment Analysis, with a bottom-up engineering-based explanation of the factors that drive railway performance.

Frontier-based efficiency measurement methods have also been widely applied in international railway studies. Sakai (2022) used Data Envelopment Analysis (DEA) to evaluate the efficiency of Japanese National Railways before and after its 1987 privatization and restructuring. The study classified railway activities into cost, operational-resource, operational-output, and revenue phases and found substantial efficiency gains after restructuring. Lin et al. (2025) applied the DEA-BCC model under variable returns to scale to assess the potential of rail freight transport on high-speed lines. Their findings showed that increases in train speed can significantly improve measured efficiency, which is relevant to speed-related productivity gains observed in railway enterprises.

At the regional service level, two-stage DEA and double-bootstrap truncated regression methods have been used to analyse how rolling stock management and fleet composition affect the efficiency of regional rail services. These studies show that fleet renewal decisions require careful assessment because they influence not only operational productivity but also capital consumption and depreciation costs.

Research on post-Soviet and transition-economy railways highlights the relationship between physical productivity and financial efficiency. While engineering productivity indicators may improve as traffic intensity increases, financial efficiency remains sensitive to input price growth, exchange-rate changes, depreciation policy, and maintenance costs related to ageing rolling stock. Pittman (2013), analysing restructuring experience in freight railways of the former Soviet Union, notes that reforms aimed at improving asset utilization and commercial efficiency have produced different results across railway systems.

Evidence from North American Class I railroads also shows that operational concepts such as Precision Scheduled Railroading can improve labour and asset-utilization productivity. However, these gains should be supported by adequate reinvestment in fleet renewal and infrastructure development in order to maintain long-term financial sustainability.

Overall, the reviewed literature suggests that depreciation policy and the cost structure of railway operations, rather than traffic volume alone, are central to understanding asset-utilization efficiency in transition-economy railway systems. The present study builds on this framework by applying it to the case of "Uzbekistan Railways" JSC over an eleven-year period.

RESEARCH METHODOLOGY

This study employs an annual time series of financial and operational data for "Uzbekistan Railways" JSC (UTY) covering the period 2014–2024, while rolling-stock productivity data cover 2014–2023. The data were obtained from the company's financial statements and official statistics published by the State Statistics Agency of the Republic of Uzbekistan.

In accordance with the ITF/OECD methodological framework, four groups of indicators were constructed and analyzed:

(1) Depreciation intensity — the ratio of accrued depreciation of fixed assets to total operating costs, used as a proxy indicator of the rate at which fixed assets are renewed through internal financial resources;

(2) Operating ratio — the ratio of total operating costs to net revenue, expressed as a percentage, following the methodology proposed by Thompson and Bente (2014);

(3) Gross profitability — the ratio of gross profit (net revenue minus cost of sales) to net revenue, calculated both for the company as a whole and separately for freight transportation operations;

(4) Rolling-stock productivity indicators — including locomotive productivity (gross tonne-kilometres per locomotive-day), wagon productivity (net tonne-kilometres per wagon-day), static load (tonnes per wagon), wagon turnaround time (days), and average train speed.

In addition, the cost structure of freight transportation operations was disaggregated into six categories: materials, electricity, fuel, payroll, social-fund contributions, and other operating costs for the period 2019–2023. This made it possible to compare the growth rates of individual cost components with the growth rates of revenue and physical traffic indicators.

Given the relatively limited number of annual observations (approximately 10–11), the analysis was conducted using descriptive statistics, growth-rate analysis, and ratio analysis rather than multivariate econometric estimation. This approach is consistent with similar single-country case studies in the railway-efficiency literature, where short annual time series do not provide a sufficient basis for robust regression-based inference.

ANALYSIS AND RESULTS

Table 1 summarizes the dynamics of depreciation intensity and the operating ratio of "Uzbekistan Railways" JSC (UTY) for selected years over the period 2014–2024 (Table 1).

Table 1
Depreciation intensity and operating ratio of UTY, 2014–2024 (%)

Year	Depreciation intensity (%)	Operating ratio (%)	Gross profitability (%)
2015	—	96.6	24.2
2018	13.7	91.6	26.3
2020	13.4	101.1	30.2
2022	19.6	128.4	9.8
2023	16.8	126.8	11.5
2024	9.1	103.8	7.7

Source: Author's calculations based on UTY financial statements, 2014–2024.

Two distinct periods can be observed. From 2015 to 2018, the operating ratio remained close to or below 100 percent, ranging from 91.6 percent to 96.6 percent. During this period, gross profitability was between 24 percent and 26 percent, which was broadly comparable to the EU-15 average operating ratio of 89.3 percent reported by Thompson and Bente (2014) for 2011.

From 2019 onward, the operating ratio remained consistently above 100 percent, ranging from 101.1 percent to 128.4 percent, while gross profitability declined to 7.7–11.5 percent in 2022–2024. This represents a decrease of more than two-thirds compared with the 2018–2020 levels.

It is important to note that depreciation intensity did not follow the same pattern. This indicator peaked at 19.6 percent in 2022 and then declined sharply to 9.1 percent in 2024, the lowest level observed during the period under review. This suggests that the deterioration in financial efficiency after 2019 was not primarily driven by depreciation charges, but rather by other cost components.

Table 2 summarizes the key indicators of locomotive and freight wagon productivity in “Uzbekistan Railways” JSC (UTY) during the period 2014–2023 (Table 2).

Table 2
Rolling-stock productivity indicators, UTY, 2014 vs 2023

Indicator	2014	**2023**	**Change, %**
Locomotive productivity (thousand gross tonne-km/day)	1,078	1,288	+19.5
Average daily locomotive run, km	429.1	503.8	+17.4
Wagon productivity (net tonne-km/day)	2,418	3,167	+31.0
Wagon static load, tonnes/wagon	51.14	49.92	−2.4
Average wagon turnaround time, days	4.50	3.85	−14.4
Average freight train technical speed, km/h	39.1	43.8	+12.0

Source: Author’s calculations based on UTY operational statistics, 2014–2023.

All physical productivity indicators of rolling stock improved during the period under review. The most significant increase was observed in wagon productivity, which rose by 31.0 percent. This improvement was driven primarily by faster wagon turnaround, which decreased by 14.4 percent, and higher train speeds, which increased by 12.0 percent, rather than by improvements in wagon loading, as the static load remained almost unchanged and declined slightly by 2.4 percent.

This indicates that efficiency gains were achieved mainly through more intensive use of the existing fleet, representing an intensive form of fixed asset reproduction, rather than through substantial changes in the technical characteristics of the wagon fleet itself.

Table 3 presents the structure and growth dynamics of operating costs in freight transportation during 2019–2023 (Table 3).

Table 3
Structure of freight transport operating costs, UTY, 2019–2023

Cost category	**2019 (bln UZS)**	**2023 (bln UZS)**	**Growth 2019–2023 (%)**	**Share 2023 (%)**
Materials	258.8	458.4	+77.1	5.4
Electricity	139.0	290.0	+108.7	3.4
Fuel	303.6	641.1	+111.2	7.6
Payroll	900.3	2,583.4	+187.0	30.6
Social fund contributions	108.0	310.0	+186.9	3.7
Other costs	1,985.9	4,171.7	+110.1	49.3
Total costs	3,695.5	8,454.6	+128.8	100.0

Source: Author’s calculations based on UTY freight transport cost reports, 2019–2023.

Total freight transportation costs increased by 128.8 percent during 2019–2023, while revenue grew by only 50.8 percent over the same period. This cost–revenue imbalance was the main factor behind the decline in freight profitability shown in Table 1, from 47.2 percent in 2019 and a peak of 52.8 percent in 2020 to −0.6 percent in 2022 and 0.6 percent in 2023.

The fastest-growing cost categories were payroll, which increased by 187.0 percent, and social fund contributions, which rose by 186.9 percent. This occurred despite an approximately 18 percent reduction in the enterprise’s workforce during the same period, indicating a significant increase in average labour costs.

Energy-related costs also increased considerably. Electricity costs rose by 108.7 percent, while fuel costs increased by 111.2 percent, both exceeding the growth rate of revenue. This trend may be associated with the ageing of the traction fleet and the resulting increase in energy and maintenance requirements relative to the volume of traffic handled.

CONCLUSION AND RECOMMENDATIONS

The results indicate a structural mismatch between physical asset-utilization efficiency, which improved steadily during the study period, and financial efficiency, which declined noticeably after 2018. This finding is consistent with the conclusion of Thompson and Bente (2014) that improvements in labour or asset productivity achieved through workforce reduction or traffic intensification may mask underlying deterioration in the condition of fixed assets, which later becomes reflected in rising maintenance and energy costs.

For “Uzbekistan Railways” JSC (UTY), the evidence suggests that the post-2019 decline in profitability was not primarily caused by depreciation, as depreciation intensity fell to its lowest level in 2024. Rather, it was mainly associated with two factors: first, energy costs increased faster than traffic volumes, which may reflect declining fuel efficiency due to the ageing of the locomotive fleet; second, payroll costs grew faster than both workforce reduction and revenue growth. In addition, the “other costs” category, which includes repair and maintenance expenditures and accounts for approximately half of total costs, increased by 110.1 percent, broadly in line with overall cost growth. This is consistent with the growing maintenance requirements associated with asset ageing.

From a policy perspective, the study concludes that assessing the efficiency of fixed asset utilization in railway enterprises requires a combined monitoring framework that links physical productivity indicators, such as rolling-stock productivity, traffic density, and turnaround time, with financial sustainability indicators, including the operating ratio, gross profitability, and depreciation intensity. This assessment should be conducted at the level of individual asset groups or responsibility centres rather than only at the enterprise level.

Such a framework would allow management to distinguish genuine efficiency gains from cost-shifting effects and to target investment and modernization programs more effectively. Particular attention should be given to traction equipment renewal and infrastructure rehabilitation, as these areas may have the greatest impact on restoring and strengthening financial sustainability.

Future research based on panel data across regional divisions or asset categories could extend this analysis through formal econometric estimation of the relationship between fleet age, energy consumption, and operating costs.

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