RAB REGULATION OF TARIFF FORMATION ON RAILWAY TRANSPORT

Kateryna Andriushchenko[1], Oleksandr Rozhko[2], Oksana Lavruk[3], Kateryna Teteruk[4], Natalya Ushenko [5]

ABSTRACT The transport complex operation in freight transport is closely interlinked to the state of country's economy. The peculiarity of RAB mechanism is investments volume being determined by the needs for the rolling stock's development and update. RAB-regulation is designed to encourage companies to modernize the infrastructure and improve the expenses efficiency. The main principle of tariffs RAB-regulation is the following: the capital invested in a regulated infrastructure company should at least have impact, which would be enough to attract new investments and enterprise development, as well as comply with the investment risk level. The goal of this work is to develop an algorithm for determining the economic feasibility of introducing RAB regulation of tariff setting at railway enterprises. The methodological approach to assessing the economic feasibility of price liberalization is offered to assess the feasibility of changes implemented in the studied sectors of activity, which is based on identifying the need for fixed assets, estimating the allowed limits for tariff growth, calculating baseline parameters for baseline strategies.

KEYWORDS rate-setting, railway service restructuring, competitive conditions

1 INTRODUCTION

In any country, transport can be characterized as an element of a unified territorial-production complex which provides services to the national economy. It aims to take care of cargo and passengers movement. The transport complex operation in freight transport is closely interlinked to the state of country's economy. The prevailing economy specificities, as well as industry and agricultural development with promising trends are influencing the cargo formation, its nomenclature structure, rail freight transport direction [17]. The company is forced to redistribute the resources only for the vitally importnat projects diu to the lack of investment resources. The projects that receive these resources provide the needed level of plan execution on absorbing main transportation volume [12]. At the same time the number of less priority activities are financed under the principle if there is some budget left. This does not let improve the quality and competitiveness of railway transport.

At the same time, within a long period of time, the insufficient reconstruction volume of infrastructure objects led to lots of 'bottle necks' appearing in the chain (meaning infrastructure sections with limited capacity) [3]. It also led to a significant pressure increase on the infrastructure, though there are no improvements in its quality and capacity. This is the major constraint to the volume growth factor, as well as transportation quality.

Nowadays, the railway transport faces the following tasks: significantly increase the customer-orientation and services quality, at the same time considering the consumers' real needs in conditions of a complicated macroeconomic and geopolitical situation [9].

Though, there is a way to solve the issue of investment attraction in the system of stimulating regulation based on marginal tariff (revenue) in case taking into account and including incomes on investment capital according to RAB-regulation of pricing in needed gross revenue (NGR).

RAB (Regulatory Asset Base – a regulated base of invested capital) is a system of long-term pricing, concentrated on getting a double effect: investments attraction for chain infrastructures' construction and modernization, as well as infrastructure companies' efficiency stimulation (Fig.1). The peculiarity of RAB mechanism is investments volume being determined by the needs for the rolling stock's development and update.

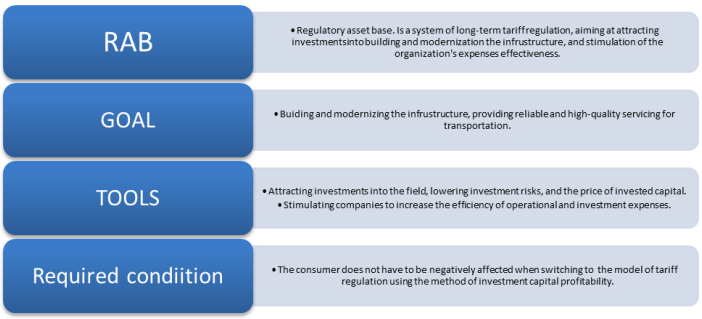


Figure - 1 Tariffs RAB-regulation– the system of long-term pricing

Back in 90s, Britain and then other European countries refused from the "expenses+" system and switched to RAB-regulation, which is designed to encourage companies to modernize the infrastructure and improve the expenses efficiency.

As per the chart that shows management cumulative efficiency increase per control periods (Fig. 2), (in case of implementing the RAB-regulation method, the company's activities are divided into 5-year periods) the overall efficiency has approximately increased on 35-40% within the first two control periods. It proves that the company is responsible for the national railway infrastructure development. The reason of a small deviation in business plan chart is global crisis phenomenon happening worldwide and influencing UK economy as well [23].

- *Kateryna Andriushchenko1, Oleksandr Rozhko2, Oksana Lavruk3, Kateryna Teteruk4, Natalya Ushenko 5*
- *1 SHEE «Kyiv National Economic University named after Vadym Hetman», Department of Economics and Entrepreneurship, Kyiv, Ukraine*
- *2Taras Shevchenko National University of Kyiv, Vice-rector for scientific and pedagogical work, Kyiv, Ukraine,*
- *3State Agrarian and Engineering University in Podilya, Department of Management, Public Management and Administration, Kamianets-Podilskyi, Khmelnytskyi region, Ukraine*
- *4SHEE «Kyiv National Economic University named after Vadym Hetman», Department of Economics and Entrepreneurship, Kyiv, Ukraine*
- *5SHEE «Technologies National Aviation University», Department of Economics and Business, Kyiv, Ukraine*
  e-mail: katya373@i.ua

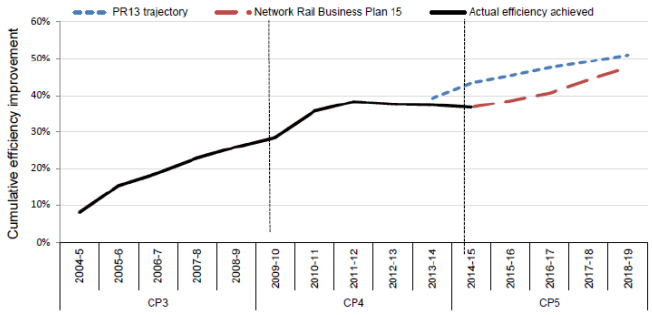


Figure - 2 The results of tariffs RAB-regulation used in Great Britain railway transport management

The RAB model consists of two parts: the initial RAB and new RAB. The initial RAB is calculated based on net value of capital assets and capital input, as well as company's balance sheet of the time of the system implementation. The new RAB is the volume of capital investments planned by the company by the time of regulation.
Shifting to tariff RAB-regulation is shifting to a new investment strategy. The long-term tariff will allow planning the resources and allocate the company's abilities in a rational way.
The main principle of tariffs RAB-regulation is the following: the capital invested in a regulated infrastructure company should at least have impact, which would be enough to attract new investments and enterprise development, as well as comply with the investment risk level. The incomes the investor may receive for the invested capital is defined by the norm set by the market participants as a fair one, and then return the invested capital amount by the end of the investment period [1].

2. LITERATURE SURVEY

The reformation of the railway sector within the EU started back in 1991, after the adoption of the EU Directive # 91/440 [13]. The Directive contained the main goals of the. reformation: state's railway transport enterprises restructuring and privatization, providing the access to the carriers' infrastructure and introducing fees for getting this access, directions specialization depending on transportation type. We need to take into consideration that railway transport reformation in EU countries was completed taking into account national and regional specificities, as well as the changes in EU members.
In his research commissioned by the IBM worldwide business support center, Lowry M.N. mentions unevenness of reformation processes, as well as "leading" countries, countries "as per schedule" and "lagging behind" ones. As well, there is a fourth category – countries that are just starting their railway transport reformation [14]. In USA, the gradual move away from the general regulation was adoption of the Rail road Revitalization and Regulatory Reform Act, 4-R Act, as well as the Rail Transportation Improvement Act which provided the financing of AMTRAK and CONTRAIL at the regulatory level, as well as gave the carriers some freedom within pricing. The Staggers Rail Act entered into force in 1980 and brought about crucial changes in the regulation system of the railway transport [6].
The Staggers Rail Act has significantly increased the railroads capacity, which led to some expenses optimization and unemployment level improvement. The amendments to the legislation led to new carriers appearing on the market. They could introduce flexible tariffs, develop goods delivery infrastructure and cut expenses due to production optimization as well. So, the Staggers Rail Act had a significant influence on railway transport efficiency indicators from the beginning of 1980still the end of 1990th: the operational length was decreased by 35%, the total number of locomotives decreased by 32% and wagons by 27%, reduction of stuff by 60% and the tariffs annual decrease for an average of 1.2% [7]. Some carriers have gone further with the tariffs decrease, which finally led to their bankruptcy; other ones focused on reorganization that would comply with market requirements. There were also cases with the merger of railway companies with the carrier companies that use other transport, aiming at creating a powerful intermodal system on transport with high incomes and flexible tariff regulation.
Nowadays, these are the main participants in the UK rail transportation market: Network Rail– infrastructure owner and operator, Department for transport, Office of the Rail Regulator, and a number of large companies. For more than 10 years, passenger transportation has been carried out by franchise companies. This mechanism works successfully; the proof is the growth of passenger traffic by 50% over the past ten years [27]. There are 19 passenger franchises in the UK with ten different ownership groups.
The Japanese reformation model in the transport market aims at creating a significant number of vertically integrated operators of various sizes and specializations. At the same time, rail transportation is mainly focused on servicing passenger traffic. There are three large privately owned vertically integrated companies in the country with a predominant share of passenger traffic, which through lease agreements are associated with the national freight company, which mirrors the American system. In addition, in Japan there are also three small state vertically integrated (including both transport and infrastructure) passenger companies operating on individual islands and about 30 private vertically integrated companies of various sizes and specializations. Thus, during the Japanese reform, transportation pricing became completely free [24].
As noted in the article [29] technically, using the methodology of tariffs RAB-regulation, a regulated company can plan a likely increase in its value and income. In fact, however, the calculation does not make sense without the formation of the regulatory process itself as an optimization process with the close interaction of all "players". As a result, the regulator can separate the reference points of its tariff policy in an arbitrary specific case - either the regulator provides incentives to consumer enterprises, or creates conditioned parametric calculation models for the purpose of stimulating investors (by changing the rate of return, etc.).
The authors [5] emphasizes that the transition to RAB regulation is a win-win for all process participants: the consumers will receive improvement of service quality, reliability, infrastructure readiness and guarantees of infrastructure provision of required volumes of services while keeping the tariff at an acceptable level. Experts compare the new tariff configuration with the mortgage. It is always rather difficult to make one-time investments in improving the process and maintenance of the infrastructure of a regulated company, ensuring reliability. With this tariffing method, the regulated infrastructure organization accumulates the

necessary funds for the development of the company. This way, consumers receive acceptable tariffs.

The main feature of transport is its specific role in the economy: transport is its integral link that completes the production process in the circulation process, meaning it differs from other industries by being "a continuation of the production process within the circulation process and for the circulation process ..." [16]. Transport provides economic interconnections between different sectors and the continuity of the products production and circulation processes; with the help of transport infrastructure, what was produced and will be consumed in the national economy moves. Thus, the structure and volume of freight flows, their distribution throughout the country, by directions and by season, as well as the associated cash flows, are determined not by the industry or by the transport enterprises themselves, but by the enterprises and organizations that own the goods [26]. This is also true for passengers and their luggage. At the same time, the level of transport development affects the speed of products circulation, as well as their safety and final cost.

Transport products themselves are transport services for the movement (transportation) of goods and passengers and are not a new product that can be separated from the production process and participate in economic circulation in material form as a commodity. Transport products appear in the form of a beneficial effect from the transport operation, which can be consumed only during the production process and does not exist as a commodity separated from this process [25]. Therefore, transport products are usually measured in physical terms characterizing the final economic effect and reflecting the number of goods or passengers transported over a certain distance.

- The existing theoretical, methodological and regulatory framework on RAB pricing regulation at railway undertakings does not fully open up opportunities that create conditions for the efficient operation of railway undertakings [30]. Even more - it is a barrier to attracting investment and innovation in the industry. Because of this, it became necessary to carry out the economic feasibility of RAB pricing regulation for railway transport enterprises.

3. METHODS

It is offered to use the following sequence of steps to evaluate the economic feasibility of implementing the RAB regulation of tariff setting at railway transport enterprises, Fig. 3.

In the long terms, the tariff is reduced due to a reduction in operating costs, as after five years the regulator reduces its regulatory level by the amount of saved costs and the cost of attracted capital, since the investment risks decrease with long-term tariffing conditions and annual indexation with taking into account macroeconomic factors [8].

It follows that two of the three tariff components in the new regulatory system tend to decline.[11]. The third component - capital, which is allocated for investment purposes - can increase, at the same time the tariff will not rise, and, as the needs of the company for investment will meet, it will start decreasing.

A new pricing system is needed to attract large-scale investment in distribution networks while avoiding the sharp rise in tariffs for network services. RAB regulation allows companies to raise capital in the required volume and return it not at the moment (within a year), as it is now, but over a long period [4].

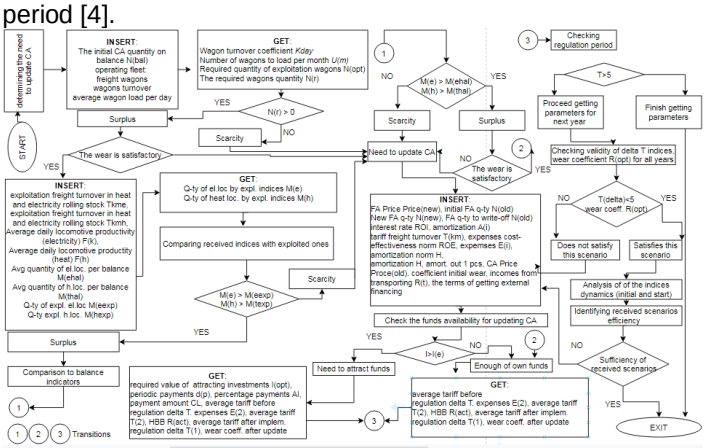


Figure-3 Algorithm flowchart for determining the economic feasibility of implementing RAB-regulation in railway transport

These conditions are extremely beneficial to network organizations, because otherwise they are unable to seek a significant amount of funds under such conditions [21].

From the above it follows that the introduction of a tariff-setting system based on the RAB principles has several advantages:

- Appearing incentives to reduce costs and improve the reliability and quality of energy supply;
- Ensuring the return on equity and borrowed capital at the level of market profitability in industries with a similar risk level;
- Setting long-term tariffs with annual indexation depending on the magnitude of inflation and taking into account other objective reasons, which contribute to the transparency and predictability of companies cash flows [20].

4. RESULTS

According to the information provided by JSC "Ukrzaliznytsya" (as of 2015, balance data) there were 109596 freight wagons. Of these, 69,800 wagons were operating fleet, 3475 wagons were to be cancelled. The depreciation of the park was 91.0%, Tab. 1.

Table -1 Railway (wagons) volume and quality indices

Railway volume and quality indices	Index dimension	Index value
Freight wagons quantity, N(bal)	pcs	109596
Containers quantity	pcs	4475
Passenger cars quantity	pcs	5210
Freight wagons operating fleet	pcs	69800
Freight wagons wear	%	91

As can be seen from the indicators above, the wagons are worn to a critical condition. The further delay in their restoration may lead to a complete decline of Ukrainian railway transport in. In this regard, there is a need to move to the regulation of the natural monopoly, which will make it possible to update the railway rolling stock.

Except but updating the rolling stock when changing regulatory approaches, it is important to take into consideration the issue of the sufficient or insufficient number of freight wagons [32].

In order to verify the claim about the need to increase (or decrease) the number of freight wagons in the current

transportation market conjuncture, one can use the approach, but improving it in accordance with the characteristics of the Ukrainian railway. The following equation can be used:

$$N(r) = N(bal) - N(opt) \quad (1)$$

where *N(r)* stands for the required number of freight wagons, pcs.
N(bal) - the number of wagons used for freight according to data from
company balance sheet;
N(opt) - required number of freight wagons, pcs.
The negative result of the calculation speaks of the lack of cars existing number, as well as of the need to increase operating fleet. The positive value calculation result indicates the surplus of the wagon fleet. It is accepted that the monthly load during the year will be balanced, and the wagons do not get into repair [31].
The required number of freight wagons *(N(opt))* can be found with the help of the equation

$$N(opt) = 1 + \frac{U(n)}{KDay} \quad (2)$$

where Un is the number of wagons loaded per month, pcs .;
KDay - wagon turnover coefficient.
Un, the component of the previous equation - the number of wagons loaded per month can be found with the help of the formula:

$$U(n) = UDay \cdot 30.4 \quad (3)$$

where *UDay* is the average wagons load a day, pcs .;
30.4 - the average number of days in one month.
The Wagon Ratio (*UDay*) can be found with the help of the following equation:

$$KDay = \frac{30.4}{k} \quad (4)$$

where *k* stands for the turnover of the freight wagon, days.
According to Ukrzaliznytsya (2015), the freight wagons turnover was 9.6 days, and the average load of wagons per day was 12.559 thousand wagons.
So, with the formula (4) we get *UDay* = 3,2. The number of wagons being loaded per month Un = 381.8 thousand wagons.
Now we find the required number of wagons as: *N(opt)* = 381.8/3.2 = 119.313 thousand wagons.
At the same time, the required number of freight wagons is: *N(r)* = 109.596 – 119.313 = −9.9171 thousand wagons.
The result suggests that today there is a shortage of rolling stock for cars of about 10 thousand cars [18].
In case we put the number of operating fleet of wagons instead of the balance wagons numbers, the required number of wagons would be: Nr = 69.800 – 119.313 = −49.5131 thousand wagons. The results of the calculations are presented in **Tab.2**.

Table 2. The calculated railway indices

Calculated railway indices	**Index dimension**	**Index value**
Freight wagon turnover, *k*	days	9.6
Average daily wagons load, *U(Day)*	pcs	12.559 thousand
Wagon turnover coefficient, *K(Day)*		
Number of wagons, loaded per month, *U(n)*	pcs	381.8 thousand
Required quantity of freight wagons, *N(opt)*	pcs	119.313 thousand
Required quantity of freight wagons, *N(r)*	Pcs	-9.917 thousand
Required quantity of freight wagons for operating fleet, *N(r)*	pcs	-49.513 thousand

Therefore, with the existing demolition of freight wagons and basing on the calculations made, it is necessary to talk about the need of increasing and updating the operating fleet of freight wagons.
The following formulas should be used to verify the locomotive sufficiency statement. According to the formulas, you can find the required number of freight locomotives by the traction types (separately for heat and electricity locomotives) [10].
The required number of train locomotives M operated (in freight traffic) can be found with the help of the following equasion:

$$M = \frac{Tkm}{F(t)} \quad (5)$$

where Tkm is the gross tonne-kilometers per day, tkm;
Ft – the operated park's locomotive performance, tkm / day.
According to the data from JSC Ukrzaliznytsya, operational performance indicators are presented in Tab. 3 (for 2015).

Table 3. Volume and quality railways (locomotives) indices

Volume and quality railway indices	**Index dimension**	**Index value**
Exploitation freight turnover of freight wagons, electr. locomotives, T(kme)	Mln tkm gross	278383.4
Exploitation freight turnover of freight wagons, heat locomotives, T(kme)	Mln tkm gross	32491.3
Tariff freight turnover	Mln tkm	195054.4
Daily average locomotive productivity	thousand tkm gross	1376
Daily average locomotive productivity, (electricity), F(le)	thousand tkm gross	1456
Daily average locomotive productivity, (heat), F(lt)	thousand tkm gross	934

Then, based on Tab. 3 data and formulas (5) we obtain the number of electric locomotives and heat locomotives (in cargo movement):
M(e) = (278383.4*100) / 1456.365 = 523.83 pcs, M(t) = 32491.3*100 / 943*365 = 95.31 pcs
The result obtained is almost exactly the same as the performance of the locomotive fleet in Tab. 4.
Therefore, we can conclude that by the time of the calculations, the railway has a sufficient number of the locomotives, taking into account the volume and quality indicators of the railway.
While the wear of the locomotives amounts to the following indicators (Tab. 6).
When comparing the indicators for locomotives to the performance indicators (volume and quality), as well as with the source data (Tab.5), we can see that for the existing indicators there is no detail of the locomotives number by

types of traffic. This does not let us make any comparison between the calculated, operational and quantitative indicators of the financial statements [2].

Table 4. The indices of the locomotives operating fleet

Volume and quality railway indices	Index dimension	Index value
Exploitated electr. locomotives operating fleet	Daily avg pcs	921.62
Exploited freight electr. locomotives operating fleet	Daily avg pcs	523.87
Exploited manoeuvrable electr. operating fleet	Daily avg pcs	47.18
Exploitated heat locomotives operating fleet	Daily avg pcs	1002.51
Exploitated freight heat locomotives operating fleet	Daily avg pcs	95.31
Exploitated manoevurable heat locomotives operating fleet	Daily avg pcs	516.95

Table 5. Quantity indices (locomotives)

Quantity railway indices	Index dimension	Index value
Locomotives quantity	Pcs	3872
Electricity locomotives (op.fleet)	Pcs	1720
Electricity locomotives (exploitation)	Pcs	1080
Electricity locomotives (invalid)	Pcs	461
Electricity locomotives (stock)	Pcs	179
Heat locomotives (op.fleet)	Pcs	2152
Heat locomotives (exploitation)	Pcs	1121
Heat locomotives (invalid)	Pcs	868
Heat locomotives (stock)	Pcs	163
Locomotives (wear)	%	95.7

So, as a result, there is a shortage (in terms of quantity and demolition) for wagons, though there is no shortage for locomotives (in terms of quantity, the wear is unsatisfactory), and, given the limited information available, it is impossible to point out a surplus or scarcity by movement types. The forecast used for calculating scenario modeling is represented in Tab.6 and is visualized on Fig.4.

Table 6. The turnover forecast used for calculating scenario modeling

Years	Freight turnover, mln tkm	Forecast (freight turnover, mln tkm)	Binding to low probability (freight turnover, mln tkm)	Binding to high probability (freight turnover, mln tkm)	Statistics	Value
2011	243 865.70				Alpha	0.90
2012	237 722.30				Beta	0.00
2013	224 433.90				Gamma	0.00
2014	211 233.10				MASE	0.50
2015	195 054.40				SMAPE	0.02
2016	187 557.00				MAE	4 762.06
2017	191 914. 10				RMSE	6 205.92
2018	186 344.00	186 344.00	186 344.00	186 344.00		
2019		176 839.38	164 676.00	189 002.76		
2020		167 815.41	151 443.11	184 187.70		
2021		158 791 43	139 082. 98	178 499.89		
2022		149 767.46	127 205.08	172 329.84		
2023		140 743. 49	115 644.35	165 842.62		

Note. The annual freight turnover growth is forecasted for the revival scenery

The data taken from the forecast is taken for the period 2011-2018, since there is a blank for 2009 influencing the correspondence of the forecast model.

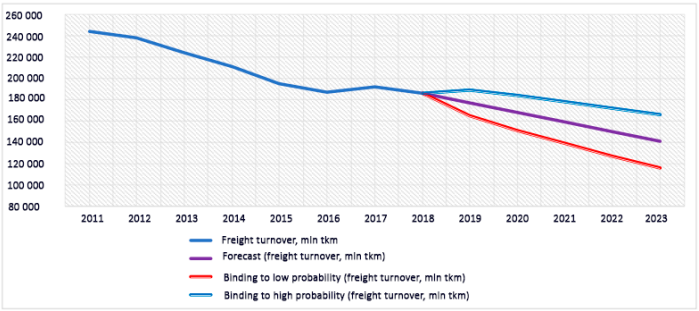


Figure - 4. Freight turnover forecast

5. DISCUSSION

The methodological approach to assessing the economic feasibility of price liberalization is offered to assess the feasibility of changes implemented in the studied sectors of activity, which is based on identifying the need for fixed assets, estimating the allowed limits for tariff growth, calculating baseline parameters for baseline strategies, basing strategies choice of developed scenarios on the basis of comparing the scenario values of tariff level change to their allowed growth limit, choice of arbitrary scripting by comparing the change of tariffs projected rates [15]. Scenario planning and forecasting were applied in the development of railway transport development scenarios (Current, Evolutionary, Pessimistic, Revival). These approaches prevent unjustified cost and capacities increases, as well as take into account

liberalization incentives and previously developed recommendations [28].

After calculating the developed scenarios, we present the results of calculations below. The capital assets growing result, investment program and the need for credit resources per scenarios is represented on Fig.5.

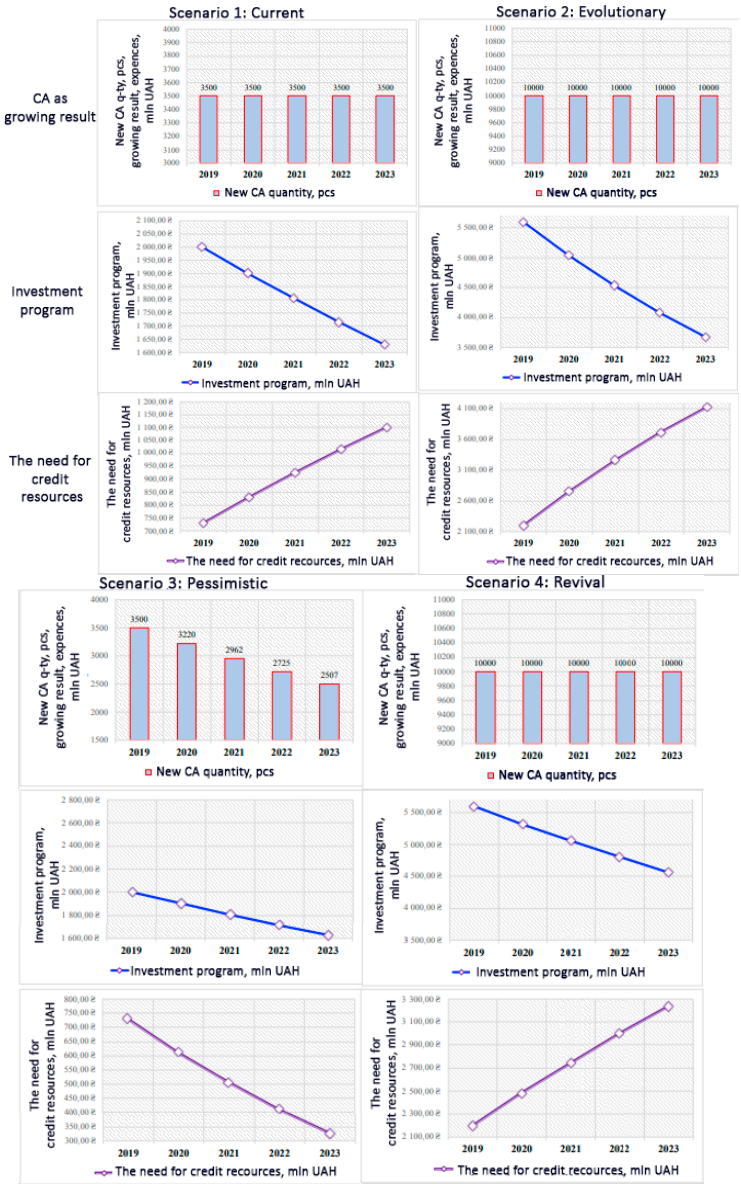


Figure - 5. Scenario calculation results for CA, investment program, credit resources

Also, the calculations have been performed for four scenarios within the wear condition. The results of the calculation for the wear condition per scenarios are represented on the Fig. 6.

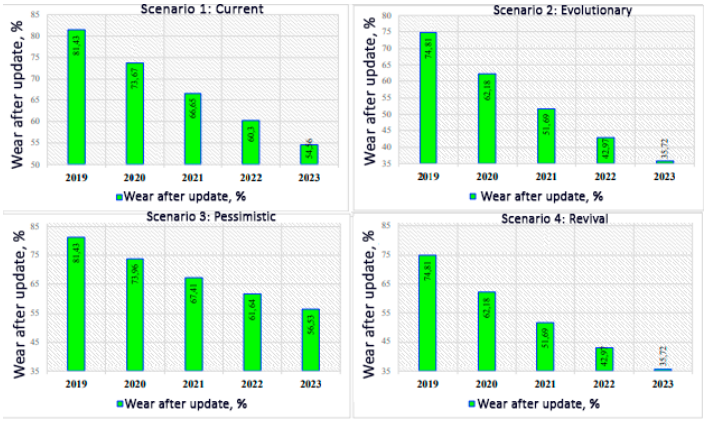


Figure - 6. The calculation results for wear condition per scenarios

Another important calculation was performed for TRR, and has been done per scenarios. The results of these calculations are presented on Fig. 7.

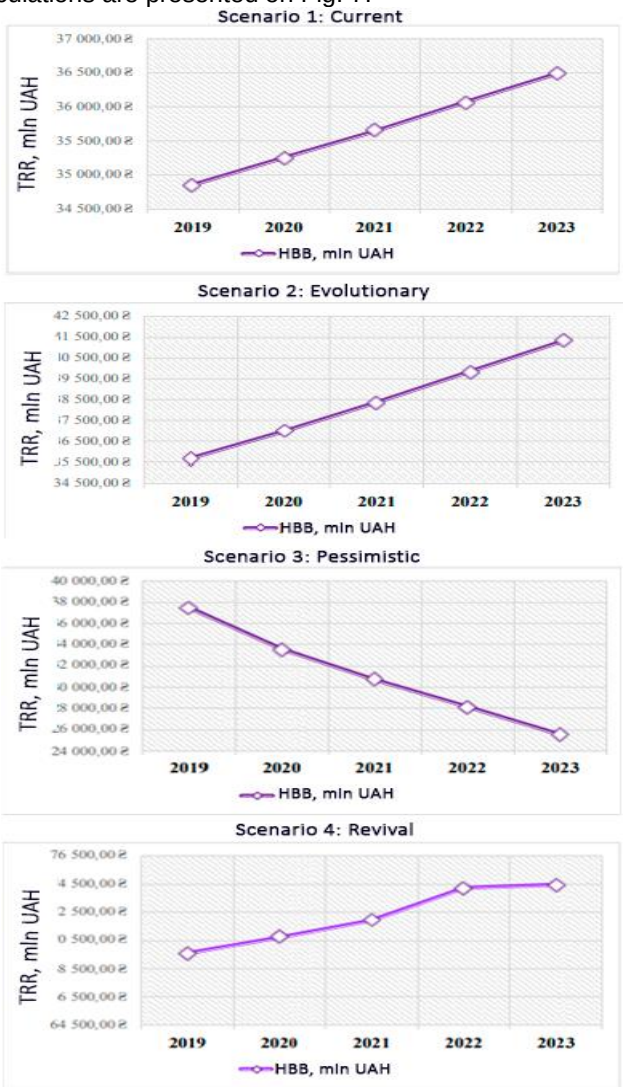


Figure - 7. Calculation results for TRR per scenarios

Calculation results of average tariffs, as well as tariff changes have also been completed. The results of these calculation are represented on Fig. 8.

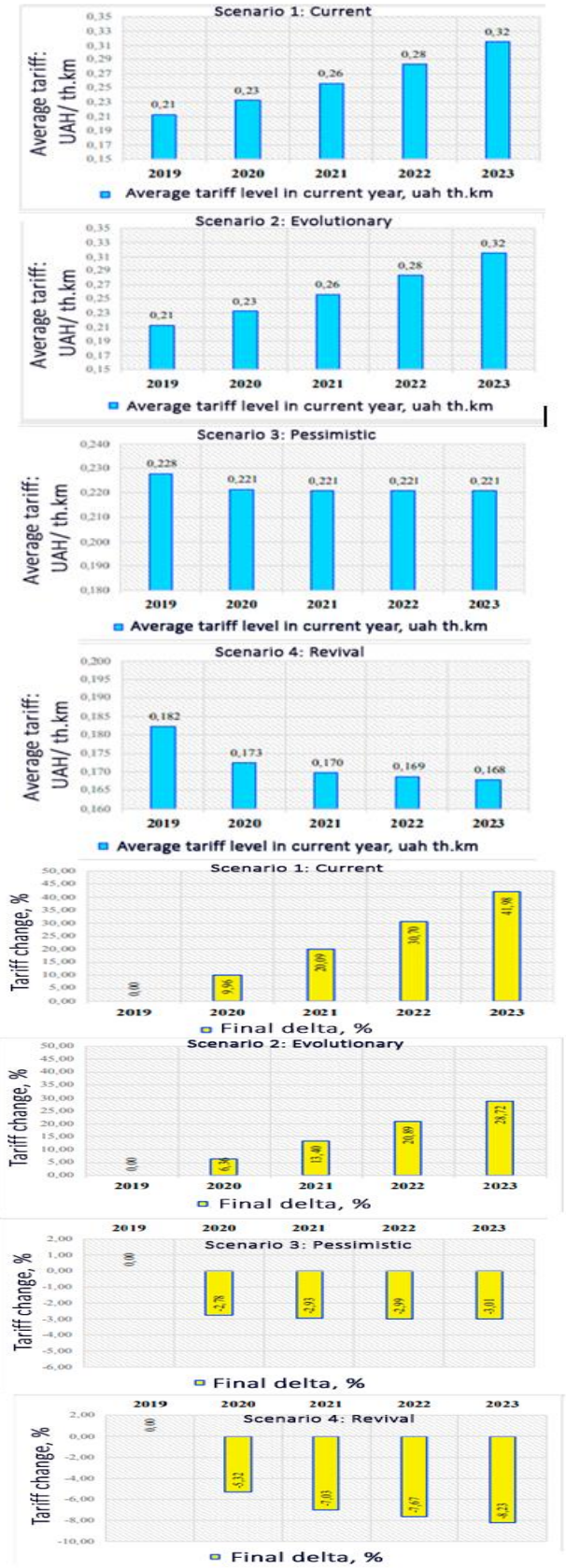
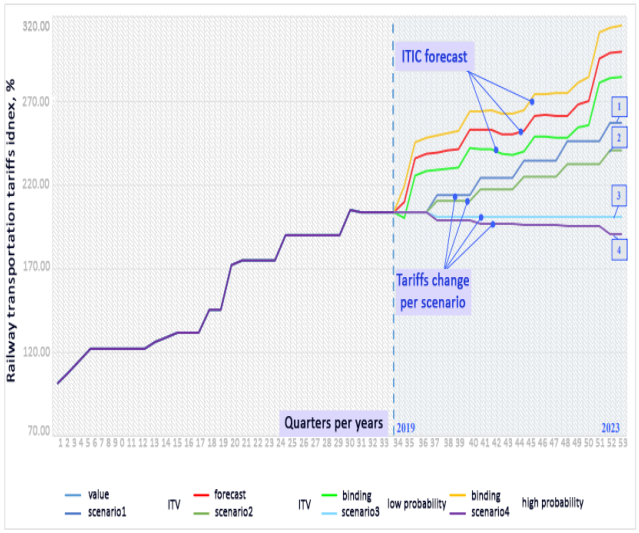


Figure - 8 Scenario calculation results

Also, we will conduct the comparison of the results of changes made in tariffs level to the existing index of tariffs for rail transportation by comparing the calculated series changes dynamics and the forecast series with the boundaries corresponding to the pessimistic and optimistic scenarios of its implementation [19].

In case we compare the level of the tariff changes in the developed scenarios to the estimated values of the tariff changes, which correspond to the revision of the freight rail freight tariff index for the time period for which the scenario was developed, we will be able to say that the results obtained for the 4 scenarios are below all other forecast variants of the mentioned indices [22].

The sum of all developments allowed us to offer a conceptual approach to the liberalization of pricing in potentially competitive sectors of railway transport enterprises, which is based on competition advocacy, scenario development, and tariff menu formation.



Note. The significance level in predicting is 0.05 (95%). One interval of the abscissa axis corresponds to the period of 1st quarter (1 period - 1 quarter of 2011). The value is represented by a growing result. The latest Index Tariff value (ITV) is the basis for changing tariffs. The method used is the method if basic substitution

Figure - 9 Scenario calculation results

6.CONCLUSIONS

The analysis of RAB regulation of natural monopolies in Ukraine and abroad has been carried out. The world experience analysis shows that currently regulated European infrastructure companies choose the mechanism of RAB regulation as the most convenient way for all market participants to predict and control the level of tariffs, revenue, expenses of infrastructure companies.

It is established that the relationship of long-term tariff policy with the indicators of efficiency, reliability and quality in terms of provision of infrastructure services can be made within the network contract implementation mechanism in railway transport, which is concluded between the state and a business entity on railway transport and providing a long-term investment program, the model of long-term tariff regulation, as well as the target quality level of services and associated operating items indices.

The methodological approach development should aim at introducing incentive pricing regulation (RAB) methods, as well as offsetting the shortcomings and imperfections of existing pricing methods (change in tariffs for the index value, lack of motivation to optimize the resources used, multivariate

macroeconomic development). The offered methodological approach is stimulating (RAB), takes into account the level of expenses, the gross income required, the change in the tariffs level (price corridors), allows to take into account the investment component in the structure of the tariff, provides the possibility of returning the raised funds and obtaining income on equity, etc. It may be extended to tariff components, to certain areas, sectors, segments of services provided (to be provided) by railway undertakings. The framework for pricing in the studied sectors of railway enterprises is presented to implement the methodological approach, which serves the development speed and the offered approaches implementation.

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CONTACTS:

Kateryna Andriushchenko
Doctor of Economic Sciences Professor
Department of Economics and Entrepreneurship
SHEE «Kyiv National Economic University named after Vadym Hetman»
Peremogy ave., 54/1, Kyiv, Ukraine, 03057
E-mail: katya373@i.ua,
Contact tel.: +380677983314
ORCID: https://orcid.org/0000-0002-6274-5310

Oleksandr Rozhko
Doctor of Economic Sciences, Professor
Vice-rector for scientific and pedagogical work (prospective development)
Taras Shevchenko National University of Kyiv
Vasylkivska street, 90 A, Kyiv, Ukraine, 03022
E-mail: rozhko_od@ukr.net
Contact tel.: +38067737095
ORCID: http://orcid.org/0000-0001-8415-2084

Oksana Lavruk
Candidate of Economic Sciences (Ph. D.), Associate Professor
State Agrarian and Engineering University in Podilya, Department of Management, Public Management and Administration,
Schevchenko Str., 13, Kamianets-Podilskyi, Khmelnytskyi region, Ukraine, 32300
E-mail: vvlavruk@ukr.net
Contact tel.: +380985908757
Number ORCID: https://orcid.org/0000-0001-9089-237X

Kateryna Teteruk
PhD student at Economics and Management Faculty,
Department of Economics and Entrepreneurship
SHEE «Kyiv National Economic University named after Vadym Hetman»
Peremogy ave., 54/1, Kyiv, Ukraine, 03057
E-mail: k_teteruk@ukr.net,
Contact tel.: +380930223810
ORCID: https://orcid.org/0000-0002-6274-5310

Natalya Ushenko
Doctor of Economic Sciences, Professor, Professor Department of Economics and Business, SHEE «Technologies National Aviation University»
Kosmonavta Komarova Ave, 1, Kyiv, Ukraine, 03058
E-mail: ushenko_nv@ukr.net,
Contact tel.: +380509754602
ORCID: https://orcid.org/0000-0002-3158-4497