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EVALUATION OF STATE BUDGET STRUCTURAL CHANGES BASED ON THE COEFFICIENT METHOD

Abstract

According to the current situation in the world economy connected with the coronavirus pandemic, it is difficult to predict GDP growth. Non-economic factors determine the rate of decline in economies of almost all countries. Accordingly, it is extremely difficult to ensure the stable functioning of financial systems. In this situation, the role of public finance, especially the state budget, significantly increases, given the peculiarities of the formation of different levels' budgets. This research aims to evaluate state budget structural changes on the example of Ukraine. Based on the linear coefficient and the quadratic coefficient of absolute structural changes, the quadratic coefficient of relative structural changes, and integral coefficients of structural changes the authors analyzed the state of public finance in Ukraine since the formation of the state and local budgets and their optimal use to mitigate the effects of the pandemic on the economy can become one of the factors in maintaining financial stability and developing anti-crisis measures. The forecast values of the growth rate of budget revenues and expenditures confirm that the projected revenue gaps are significantly higher than the projected expenditure gaps. The cost structure of the state budget of Ukraine is characterized as a structure with a low level of differences. The Gatev and Ryabtsev coefficients demonstrate unidirectional dynamics. In contrast, Salai coefficient shows the opposite dynamics, which confirms a lack of stability in the cost structure. From 2008 to 2019, the chain rate of change has a significant variation range.

INTRODUCTION

Transparency of the budget process is a prerequisite for the adaptive decision-making process in the public finance sector. It formulates ideas and strategies that promote timely and effective public policy, builds public confidence, and strengthen the government's ability to operate effectively. Moreover, people more and more seek to understand decisions in the field of formation and distribution of the state budget and participate in the discussion of budget priorities. However, the limited transparency of the country's public finance at various levels and the imperfection of budget accounting and control systems, stand in the way of this issue. This indicates gaps in the transparency and accountability of budgets at various levels and certainly requires action to improve this area's norms and practices. Therefore, the analysis of the main indicators of formation and development of public finance as one of the basic elements of the country's financial system is extremely important. Nowadays, the state of the financial system of Ukraine can be characterized as unstable and largely dependent on the influence of external factors. The main areas of the financial system are public finance, business finance, household finance, and the financial market that provides financial flows between them. Traditionally, public finance include state and local finance, and, accordingly, government and local budgets are analyzed. However, if one analyzes

them in terms of institution-building of the economy, public finance can also include finance of public financial and non-financial corporations. In modern finance theory, the theory of "new public finance" is becoming increasingly popular. According to the theory, the very essence of public finance is blurred in the system of public-private partnership. It is impossible to explore public finance only within the framework of a single national financial system since the vast majority of national organizations use financial resources from international financial organizations. In Ukraine, unlike countries with developed financial markets, the role of public finance is a priority in regulating financial flows. Given that the consolidated budget is taken into account to assess and forecast the overall economic situation in the country, the indicators of this budget were analyzed in terms of quality of targets and % of consolidated budget execution in terms of both revenues and expenditures. In Ukraine, the development of public and private partnerships has not yet reached a significant scale and, therefore, is not suitable for analysis. Ukraine's interaction with international financial organizations takes place on an ongoing basis and manifests itself in external public debt formation.

1. LITERATURE REVIEW

As is commonly known, the study of financial relations is associated with the distribution and redistribution of GDP. The structure of the country's GDP characterizes the overall state of the economy and, in terms of finance, reflects the potential at the economic level to stably form financial resources and facilitate the stable filling of the state and local budgets; it largely determines the priority areas for the use of budget funds, especially in the context of stimulating economic activity. According to Korablin (2016), Ukraine has formed a model of "lagging growth" characterized by a steady lag behind more dynamic competitors. One can fully agree with his opinion that the Ukrainian economy can be characterized as small, open, raw materials-based, and having sovereign ratings, indicating signs of speculation.

It should be noted that Fitch credit agency assigned a rating of level B with a stable outlook (2020) (according to the rating scale, Ukraine's liabilities are considered speculative and have a significantly insufficient level of creditworthiness). The same forecast was provided by Standard & Poor's (2019) (this means that Ukraine, in terms of its liabilities in the form of government bonds, is assessed as an issuer that, in principle, is solvent, but the state of solvency is significantly affected by negative trends in the economy, and the likelihood of their occurrence is very high; this forecast is also stable, that is, no changes are expected in the near future). As for Moody's (2019) credit rating is defined as Caa1 with a positive outlook (from the standpoint of this rating, this means that the liabilities are as-

sessed as speculative, have low credit quality and, accordingly, a high level of risk), there is a positive outlook, but the transition to the upper class does not remove the signs of speculative nature.

In some works, Anzuini et al. (2020) and Ardanaz et al. (2020) note that one of the critical tasks of improving the public financial management system's efficiency is to develop new approaches to the management of uncertainty, which is a factor of macroeconomic fluctuations. Thus, it is highlighted that countries with a significant degree of political instability have a much higher tax burden and public debt (Rieth, 2017; Nakagawa et al., 2018). Although public finance development strategies in the vast majority of countries with both developed and transition economies are countercyclical, fiscal policy in many countries is pro-cyclical at this stage (Gootjes & de Haan, 2020). Also, there is a high level of irrationality in applying the monetary policy of the state, which aims to compensate for the distortions of the public financial management system (Leeper et al., 2020). Simultaneously, exceeding a reasonable level of government spending and uncertainty in economic processes may lead to higher inflation (Bretscher et al., 2020). Growing the share of public debt in the state's GDP structure proved that it has an optimal pro-cyclical fiscal policy (Camous & Gimber, 2018).

Comparing the essential features of the public finance sector in Poland and Central and Eastern European countries, the European Union and OECD were made by Sawulski (2016). The author compared the size of the public sector in Poland

and the EU and OECD countries and described the Polish tax and social insurance system's distinctive features compared to other countries. It should be noted that public spending in Poland is significantly higher or lower compared to the other EU member states. Besides, the author provided the outlook for Polish public finance, i.e., an analysis of the 2016 state budget's critical elements and an outline of the essential fiscal policy determinants in the coming years.

As for the methodological approach, on the one hand, Chornovol et al. (2020), based on economic and statistical methods and correlation-regression analysis methods, are used to determine the relationship between the GDP deflator and the share of revenues, expenditures, the general state budget deficit, and public debt in GDP, assessing the features of the public financial management system in Ukraine and EU countries. The authors proclaimed that the mechanism of public financial management in recent years is relatively rigid and restrictive. In the context of institutional change, it expands the tools of public financial management and increases its impact on socio-economic processes. On the other hand, some authors such as Mazaraki and Volosovich (2016), under the conditions of globalization challenges and intentions of European integration of civil society institutional forecasted modernization of the national financial system through overtaking way considering demands of the international community, positive foreign experience, and national interests. The changes of its institutional component lie in transforming individual institutions and the institutional environment as a whole. At the same time, these changes are problematic because Ukraine has to provide stabilization and further economic growth and prevent the destruction of the institutional component in terms of radical reforms. These actions will facilitate the development of entrepreneurial activity and risk management efficiency, uniformity of consumption, overcoming social inequality, improving the households' moral and psychological state, reducing the social burden on public finance, and declining the volume of informal credit markets.

At the same time, Ivanytska (2014) identified the directions of ensuring the openness and accessibility of financial information in different segments of the national financial system following the decisions and documents adopted by international organizations. The author summarized that transparency of the financial and budgetary sphere presupposes the implementation of European principles and standards of state aid to industries and individual enterprises, clarity and consistency of the legislation on tender procurement, and maximum compliance with its norms. In this context, Petlenko and Kotovskyi (2017) proposed a new government model that includes the flexible system of compensation to public officers based on KPIs, decentralization of the budget system, and controlled by the independent auditor. They highlighted that the leading solution for public finance management issues should be implementing the new government model, which is based on using the main principles of corporate financial management in the public area.

The scientific methodological approach to assessing the level of financial decentralization in Ukraine during the decentralization reform (2014–2017) was proposed by Shkolnyk et al. (2018). The universal integral indicator of financial decentralization has been calculated, which has found that local budgets improve public funds management, illustrated by the growth of the integral indicator level in dynamics. Several recommendations are also provided for improving the budget process transparency for each of the components: budget information openness, the state and effectiveness of budgetary supervision, and public participation in the budget process. The idea of the relationship between the budget process transparency and the financial decentralization reform results is proposed.

2. AIMS

The article aims to evaluate state budget structural changes based on integral coefficients on the example of Ukraine.

3. METHODS

For a deeper analysis of the formation of the state budget's revenue side, it is necessary to study structural changes in dynamics for the analyz-

ed period. In scientific publications dealing with structural changes in economic phenomena, indicators of dynamics and variations of structural changes are most often identified. Among all the most common indicators are the linear coefficient and the quadratic coefficient of absolute structural changes, the quadratic coefficient of relative structural changes, and integral coefficients of structural changes (Gatev, Salai, and Ryabtsev indices):

1. The absolute increase in the proportion of the i-th part of the sample:

$$\Delta d_i = d_{ij} - d_{ij-1}, \qquad (1)$$

where d_i is the share of an individual indicator as a whole; j is a time period, +/– signs indicate the direction of change in specific gravity, its increase or decrease.

2. The average absolute increase in the specific weight of $\overline{\Delta d_i}$ of the i-th structural part of the sample for n period:

$$\overline{\Delta d_i} = \frac{d_{in} - d_{i0}}{n - 1}, \qquad (2)$$

where n is the number of periods.

3. The linear coefficient of absolute structural changes (Kazints coefficient) shows the average change in specific gravity:

$$\overline{\Delta d_i} - d_0 = \frac{\sum_{i=1}^{k} \left| d_{ij} - d_{ij-1} \right|}{k}, \qquad (3)$$

where k is the number of elements of the structure under study.

This coefficient characterizes the average value of deviations from specific weights; the greater the value of the indicator, the greater the absolute structural changes (used on the recommendation of the Secretariat of the UN Economic Commission for Europe).

4. The quadratic coefficient of absolute structural changes (Kazints coefficient) with a changeable base of comparison:

$$S_\sigma = \sqrt{\frac{\sum_{i=1}^{k} \left(d_{ij} - d_{ij-1} \right)^2}{k}}. \qquad (4)$$

The quadratic coefficient with greater sensitivity reflects the structure's fluctuations in both priority and insignificant categories.

Both linear and quadratic coefficients allow obtaining and interpreting a consolidated estimate of the rate at which changes in the specific weights of the sample's individual elements occur and make a generalized comparison of the dynamics of structural changes. It is considered that if structural changes account for less than 2%, it is possible to state insignificant shifts; from 2 to 10% – significant shifts; and more than 10 – significant structural shifts. As is commonly known, in terms of financial analysis, the smaller the fluctuations in the behavior of financial indicators, the more stable and reliable is the economic situation, and the more predictable is the financial policy and the state of the country's financial system.

5. The quadratic coefficient of relative structural changes:

$$\delta_\sigma = \sqrt{\sum_{i=1}^{k} \frac{\left(d_{ij} - d_{ij-1} \right)^2}{d_{ij-1}} \cdot 100}. \qquad (5)$$

This indicator has no upper limit and characterizes how, on average, the growth rates of individual elements deviate from their average value, which is 100%.

6. The integral coefficient of structural changes (Gatev index):

$$I_G = \sqrt{\frac{\sum_{i=1}^{k} \left(d_{ij} - d_{ij-1} \right)^2}{\sum_{i=1}^{k} d_{ij-1}^2 + \sum_{i=1}^{k} d_{ij}^2}}. \qquad (6)$$

It takes into account the intensity of changes in individual groups and the share of the group in the compared structures.

7. The integral coefficient of structural differences (Salai coefficient):

$$I_S = \sqrt{\frac{\sum\limits_{i=1}^{k}\left(\left(d_{ij} - d_{ij-1}\right)/\left(d_{ij} + d_{ij-1}\right)\right)^2}{k}}. \quad (7)$$

Unlike the previous one, this index also takes into account the number of groups.

8. The integral index of difference of structures by Ryabtsev:

$$I_R = \sqrt{\frac{\sum\limits_{i=1}^{k}\left(d_{ij} - d_{ij-1}\right)^2}{\sum\limits_{i=1}^{k}\left(d_{ij} + d_{ij-1}\right)^2}}. \quad (8)$$

The popularity of using the latter index is because it does not depend on the number of gradations of the population and has its own scale for assessing structural differences (Table 1).

Table 1. The scale for assessing the index of differences by Ryabtsev

Range of criterion values	Characteristics of structural differences
0.000 – 0.030	Identical structures
0.031 – 0.070	Very low level of differences
0.071 – 0.150	Low level of differences
0.151 – 0.300	Substantial level of differences
0.301 – 0.500	Significant level of differences
0.501 – 0.700	Very significant level of differences
0.701 – 0.900	Opposite type of structures
0.901 – above	Exact opposite of structures

4. RESULTS

As a result of the calculations, the following indicators were obtained (Table 2) for the dynamics and structural changes variations. In general, one can conclude that the formation of state budget revenues is characterized by a significant unevenness of revenues over the years. This is confirmed by the calculated linear and quadratic coefficients of absolute structural shifts, which have twofold deviations in some periods in chain changes. The same is confirmed by the obtained values of the quadratic coefficient of relative structural changes. This indicates that the formation of individual components, such as tax and non-tax revenues and other revenues, in certain periods differ significantly in their share in the revenue structure. This allows concluding that tax policy in Ukraine is in a state of constant changes and reforms and is accompanied by changes in tax legislation. This reduces Ukraine's investment attractiveness since these constant changes do not contribute to creating a transparent business environment and impose certain financial risks on the activities of economic entities.

Meanwhile, the obtained integrated indices, in particular, Gatev and Ryabtsev coefficients, and the comparability of the latter with the rating scale, indicate the presence of very low and low levels of differences in general, which, despite significant fluctuations of individual structural elements in aggregate, namely tax revenues and non-tax rev-

Table 2. Indicators of dynamics and variations of structural changes in the revenue side of the state budget of Ukraine

Source: Authors' calculations.

Year	Linear coefficient of absolute structural changes	Quadratic coefficient of absolute structural changes	Quadratic coefficient of relative structural changes	Integral coefficient of structural changes by		
				Gatev	Ryabtsev	Salai
2008	0.6850	1.2440	4.1260	0.0535	0.0378	0.0846
2009	1.3643	2.3030	7.6382	0.0950	0.0673	0.2809
2010	0.9260	1.4473	4.5768	0.0559	0.0395	0.3185
2011	2.2205	4.0218	12.7180	0.1564	0.1113	1.0818
2012	0.7372	1.4169	4.4808	0.0550	0.0389	0.2339
2013	0.9293	1.4891	4.7090	0.0585	0.0414	0.3104
2014	1.2535	1.7803	5.6298	0.0702	0.0497	0.2880
2015	2.0284	2.8820	9.1136	0.1159	0.0822	24.8402
2016	2.3421	3.5215	11.1359	0.1394	0.0990	0.2586
2017	0.8398	1.3289	4.2025	0.0504	0.0356	0.5856
2018	1.0648	1.6019	5.0657	0.0603	0.0427	8.8957
2019	0.6250	1.0680	3.3772	0.0405	0.0286	1.0174

Figure 1. Execution of expenditures of Ukraine's state budget, %

enues, do not show drastic changes, since taxes constantly prevail in the structure of revenues. In contrast, other structural elements do not change significantly (Figure 1).

It is equally important to study the expenditure side of the state budget.

Calculated indicators of dynamics and variations of structural changes in the expenditures of the state budget of Ukraine indicate the absence of a strategic plan for the development of the country as a whole (Table 3).

In particular, the values of the quadratic coefficient of absolute structural changes indicate a lack of stability in the cost structure since, during the analyzed period, the chain rate of change has a significant range of variation in almost every period. The same applies to the quadratic coefficient

Table 3. Indicators of dynamics and variations of structural changes in expenditure side of the state budget of Ukraine

| Year	Linear coefficient of absolute structural changes	Quadratic coefficient of absolute structural changes	Quadratic coefficient of relative structural changes	Integral coefficient of structural changes by		
				Gatev	Ryabtsev	Salai
2008	0.8301	1.4108	4.6793	0.0833	0.0590	0.1278
2009	0.6765	0.9529	3.1605	0.0556	0.0394	0.0927
2010	0.6038	0.8595	2.8506	0.0498	0.0352	0.1397
2011	1.0603	1.5766	5.2289	0.0905	0.0641	0.1653
2012	0.6153	1.0183	3.3772	0.0572	0.0405	0.0468
2013	0.9418	1.4521	4.8159	0.0809	0.0573	0.1876
2014	1.4188	1.7958	5.9560	0.1006	0.0713	0.1433
2015	0.9597	1.3407	4.4466	0.0745	0.0528	0.2416
2016	0.9465	1.5242	5.0553	0.0838	0.0594	0.1392
2017	1.0066	1.9441	6.4478	0.1056	0.0749	0.0756
2018	0.6621	0.9085	3.0133	0.0498	0.0352	0.2676
2019	1.2936	2.2506	7.4645	0.1285	0.0912	0.1735
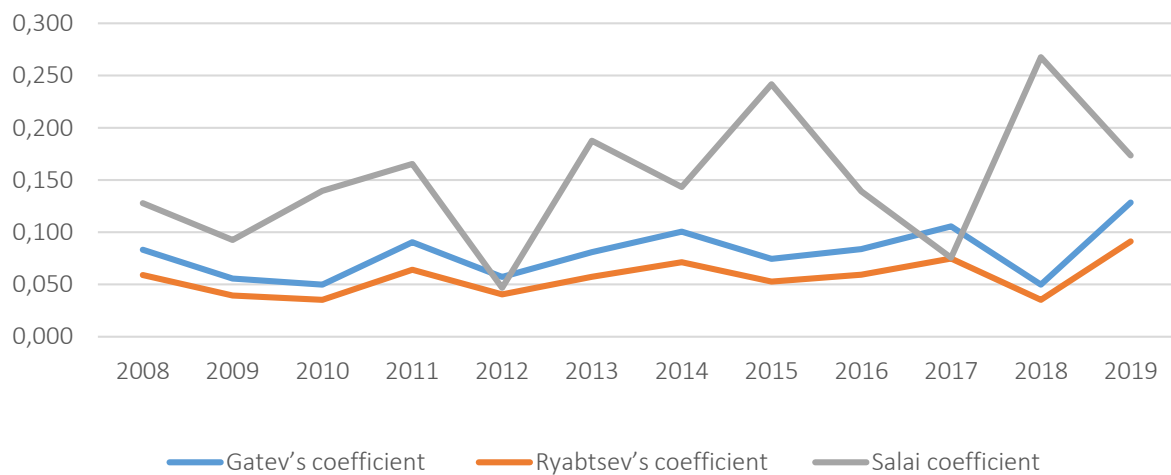
Figure 2. Dynamics of integrated coefficients of structural changes in the expenditure side of the state budget of Ukraine

of relative structural changes. Meanwhile, if one analyzes the dynamics of the integral coefficients of structural changes, in particular, Ryabtsev coefficient, the cost structure of the state budget of Ukraine should be characterized as a structure with a low level of differences.

Graphical representation of the dynamics of the integral coefficients of structural changes (Figure 2) shows that the Gatev and Ryabtsev coefficients demonstrate unidirectional dynamics. In contrast to these two coefficients, Salai coefficient shows completely opposite dynamics and is very unstable, which confirms the above conclusion.

For a long time, the formation of the state budget of Ukraine took place with the excess of expendi-

tures over revenues and a corresponding formation of the government deficit. "The vectors of the impact of the budget deficit on socio-economic processes in society are diverse. Thus, under certain circumstances, the budget deficit can perform an anti-crisis function since the effective use of deficit financing will stimulate socio-economic development. However, the overwhelming majority of the consequences of the budget deficit negatively affect socio-economic development and are associated with the crowding out of private investment".

In itself, government debt cannot be considered a negative phenomenon in the economy, and the main thing is the use of funds for which the debt is used. No less important is the ability to fulfill
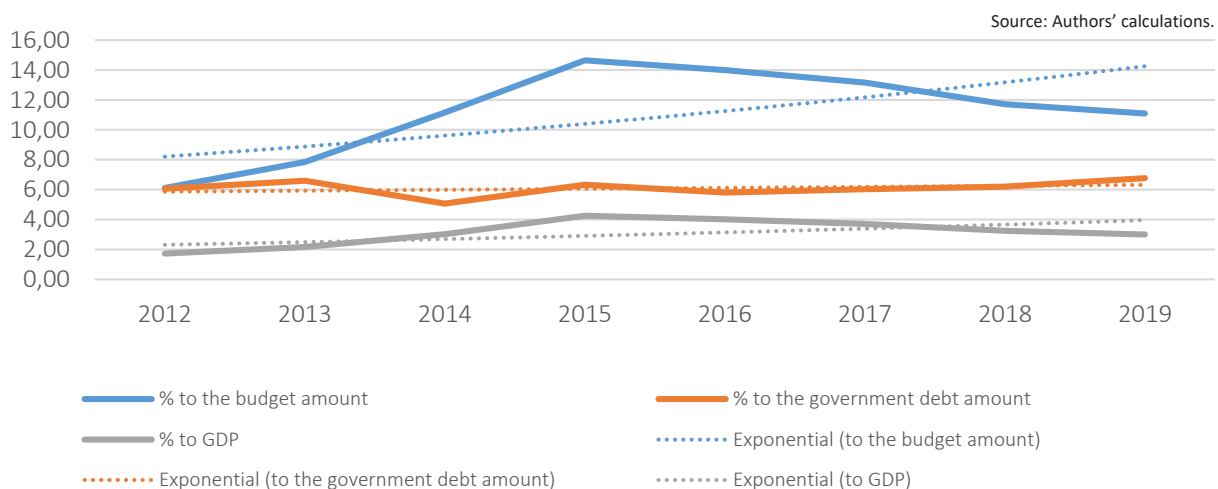
Figure 3. Dynamics of debt service indicators

the obligations assumed on time and in full. The amount of funds for debt service has a steady upward trend. If in 2007, it amounted to UAH 3,349 million, then in 2019, it was UAH 119,248 million. At the same time, the absolute value is not informative enough, so it is worth analyzing the relative indicators, namely, the ratio of debt service costs to the budget amount, the amount of state debt, and the size of the country's GDP (Figure 3).

In general, the trajectory of expenditures to the budget amount and GDP almost completely coincides: gradual growth until 2015 and further gradual but insignificant decrease in indicators.

Meanwhile, the constructed exponential trends with a forecast for a year ahead indicate a general upward trend. This, in turn, requires testing the hypothesis of a correlation between GDP and generated state debt. As a result of calculations, it was determined that the correlation coefficient was 0.858, which indicated a close relationship between the two indicators. In contrast to previous indicators, the dynamics of debt service costs and the debt amount has the opposite trend, but despite some fluctuations, as evidenced by the constructed trend line (exponential), it remains practically unchanged throughout the entire period.

CONCLUSION

This study aimed to evaluate state budget structural changes based on integral coefficients on the example of Ukraine. Having analyzed the formation of state budget revenues in Ukraine, it is established a significant unevenness of revenues over the years, which is confirmed by the coefficients of absolute structural changes. In some periods in the chain, changes have deviations of two times. It indicates that the formation of tax and non-tax revenues and other income in specific periods differ significantly in their share in income structure. Thus, tax policy in Ukraine is in a state of reform and is accompanied by changes in tax legislation. This fact reduces the investment attractiveness of Ukraine, as such changes do not contribute to the creation of a transparent business environment and create financial risks for businesses. Simultaneously, the obtained integrated indicators (Gatev coefficient and Ryabtsev coefficient) indicate a low level of general differences, despite significant fluctuations of individual structural elements in aggregate form (tax revenues and non-tax revenues), do not show sharp changes. Taxes, other structural components do not fluctuate significantly. Regarding the implementation of the plan for state budget expenditures, there is a lack of long-term development strategy of the country and situational solution of specific tasks in the conditions of the permanence of crisis phenomena in the economy of Ukraine. Regarding the structure of state budget expenditures, it should be noted that it changed quite often during the analyzed period. Therefore, as in the case of state budget revenues, an analysis of structural changes was conducted to determine how consistent the country's financial policy is as a whole. And it's budget component in particular. The leading indicators of the formation and development of public finance of Ukraine, as one of the essential elements of the financial system of Ukraine, is unbalanced and structurally unstable due to the lack of a long-term strategy for the formation and development of not only public finance but also the financial system as a whole. Both economic and political factors significantly influence them. It leads to a significant amount of state debt and an increase in the cost for its maintenance, which can cause not only a financial but also an economic crisis. Moreover, based on the ratings of the world's leading rating agencies, Ukraine's government bonds are rated speculative with a high credit risk level and, accordingly, with a high probability of default.

AUTHOR CONTRIBUTIONS

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