



Article

Econometric Modeling and Forecasting of Development Indicators of Tourism Enterprises in Uzbekistan

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Abstract: This study aims to develop a comprehensive multivariate econometric model for analyzing and forecasting tourism revenue in Uzbekistan. Given the sector's growing role in the national economy, an evidence-based understanding of key drivers such as tourism value-added, inbound tourist arrivals, investment volume, and the number of tourism-related enterprises is essential. Annual data from 2014 to 2024 were used to construct a log-linear regression model in EVIEWS 12. The model addresses scale heterogeneity among explanatory variables and ensures statistical robustness. The selected predictors include tourism gross value added, number of inbound tourists, investment volume, and active tourism enterprises. The model demonstrates strong explanatory power with an R^2 of 0.9554 and a Durbin-Watson statistic close to 2, indicating minimal autocorrelation. Forecasts for 2025–2029 suggest steady tourism revenue growth, driven by synchronized increases in investment and entrepreneurial activity within the sector. The findings provide a reliable basis for medium-term tourism policy design and resource allocation. The proposed modeling framework also offers a replicable approach for other emerging economies aiming to strengthen tourism-led economic development and enrich empirical literature on tourism economics.

Keywords: Tourism Revenue, Econometric Modeling, Entrepreneurship, Uzbekistan, Forecasting, Log-Linear Regression, Trend

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1. Introduction

Tourism has become a significant element emerged as an important factor in economic diversification and sustainable development in many numerous developing nations, including Uzbekistan [1]. As a labor-intensive industry with substantial backward and forward connections, significantly contributes to entrepreneurship, attracting investment, and generating foreign currency generation. Uzbekistan has recently enacted changes to liberalize the tourism sector, enhance infrastructure, and establish itself as a global cultural and historical destination [2], [3].

Notwithstanding these accomplishments the tourist sector continuous vulnerable to external shocks and requires systematic monitoring and forecasting to support evidence-based decision-making. From this perspective, econometric modeling serves as a valuable tool for analyzing the relationships between key economic indicators and tourism outcomes. By understanding how factors such as gross value added, tourist arrivals, investment flows, and the number of active enterprises impact tourism revenues, policymakers can design more targeted strategies to enhance growth and sustainability in the sector [4].

This work seeks to create a comprehensive econometric model that captures the dynamic relationships between tourism revenues and their primary factors in Uzbekistan from 2014 to 2024 [5]. Using a log-linear regression approach, the research not only quantifies these relationships but also provides forecasts for the years 2025–2029. The ultimate objective is to create a data-driven framework for medium- and long-term policy planning, with a focus on boosting investment and entrepreneurship efficiency in the travel and tourist industry [6].

Literature Review

As nations look to quantify the industry's contribution to economic growth and pinpoint its drivers, the use of econometric modeling in tourist research is becoming more and more important. Numerous studies have emphasized the catalytic role of tourism in entrepreneurship, job creation, and regional development, particularly in emerging economies [7], [8].

For instance, Dritsakis (1), in his study on Greece, explores the long-term relationship between tourism revenues and economic growth using cointegration and Granger causality analyses. Based on quarterly data from 1960 to 2000, the study examines the relationship among real GDP, the real effective exchange rate, and international tourism revenues. Similarly, Proença and Soukiazis (2) analyzed the impact of tourism on economic growth in Portugal's NUTS II and NUTS III regions using panel data analysis. Barro and Sala-i-Martin's conditional convergence theory led them to conclude that the tourist industry, and in particular hotel capacity, has a beneficial impact on regional income growth [9].

Their results demonstrate that by increasing employment and economic activity, tourism considerably boosts economic growth in Portuguese regions. In the context of econometric modeling, Song and Li (3) conducted a comprehensive review of tourism demand forecasting methods, highlighting the effectiveness of multivariate regression and time series models in predicting tourism flows [10]. Their study emphasizes the importance of incorporating macroeconomic variables and exogenous shocks to improve model accuracy.

From a policy perspective, Seetanah (4) utilized panel data from 19 island economies between 1990 and 2007 to examine tourism's potential contribution to economic growth and development within the framework of the traditional augmented Solow growth model [11].

In a study by Bahodirhon Safarov, Hisham Al Smadi, Makhina Buzrukova, and Bekzot Janzakov (5), ARIMA and ARDL models were employed to forecast the volume of tourism services in Uzbekistan. The analysis revealed that safety and well-being factors significantly influence the inflow of foreign tourists into the country. The impact of the COVID-19 pandemic was found to potentially persist until 2026 [12].

Most of the reviewed literature (6–18) examines the effects of tourism on economic growth. Relatively few of these studies have examined the relationship between tourism and revenue in the context of Central Asia, especially Uzbekistan, despite the fact that many of them concentrate on developed or tourism-intensive countries.

However, recent domestic research efforts have begun addressing this gap by applying econometric tools to assess tourism potential and evaluate the impact of policy reforms [13]. These studies typically rely on macro-level indicators and expert-driven variable selection to model sector trends, yet still lack standardized methodologies and long-term forecasting frameworks.

By creating a multi-dimensional log-linear econometric model specifically for the tourism industry in Uzbekistan, this study adds to the body of current literature. The study intends to close a gap in empirical forecasting tools for tourism entrepreneurship in transitional economies by combining historical data with variables chosen by experts.

2. Materials and Methods

In order to examine and forecast the important development indicators of Uzbek tourist firms for the years 2014–2024, with forecasts going through 2029, this study uses an econometric modeling technique. The analysis is based on secondary data collected from the State Committee of the Republic of Uzbekistan on Statistics, covering variables such as the number of tourists (X_1), tourism investments (X_2), number of tourism enterprises (X_3), and tourism revenue (Y). The Ordinary Least Squares (OLS) method was applied to construct the multiple linear regression models. To assess long-term patterns, deterministic trend models—linear, quadratic (parabolic), and exponential—were estimated for each variable.

The most optimal trend equation was selected based on the highest R^2 , significance of coefficients (t-statistics), and Akaike Information Criterion (AIC) values. Forecasting for 2025–2029 was conducted using the best-fit trend models. Diagnostic tests were conducted to ensure the reliability of the estimated models. All analyses and forecasts were carried out using EViews 12 software, which enabled robust econometric estimation, time series decomposition, and dynamic forecasting procedures. The study's goal of assessing temporal dynamics and projecting future developments in the tourism industry justifies the use of time series econometric modeling. The logarithmic transformation improves model stability, while the trend models provide a practical basis for future planning. The approach adheres to international standards of empirical economic research and supports data-driven policy recommendations.

3. Results

In the econometric analysis of socio-economic development processes, considering the widespread use of the multi-factor production functions discussed above and their derived functions, we define econometric models in the form of a production function based on multi-factor relationships to estimate the volume of income generated from tourism activities. Once built, these models will assist in identifying the macro-level management strategies for the elements influencing tourism revenues, identifying medium- and long-term forecast indicators, and directing the appropriate actions to meet these indicators.

A multi-factor analysis was conducted to investigate how the amount of tourism revenue, an endogenous variable, varies in response to key factors (resources) [14], [15].

Treating the volume of income from tourism as the output (resultant) factor of a function, and based on expert analysis conducted with leading experts from the

Ministry of Tourism and Cultural Heritage of the Republic of Uzbekistan, the following indicators were selected as influencing factors (Table 1):

- X_1 – Gross value added generated in the tourism sector
- X_2 – Number of tourists entering Uzbekistan
- X_3 – Volume of investments in the tourism sector
- X_4 – Number of business entities in the tourism sector

When examining the nature of the endogenous variable and its influencing exogenous indicators, it becomes clear that the influencing factors—expressed through capital, resources, and real gross income per capita—have a significant impact and form a relationship similar to that of a production function. Based on the linkage between the key identified endogenous and exogenous variables, the trends in changes in tourism revenue were analyzed using time series data with the help of EViews 12 software. The analysis was developed by the author using data from the State Committee of the Republic of Uzbekistan on Statistics, see Table 1.

Table 1. Indicators of the volume of income from the tourism sector and the factors influencing its changes.

Years	Volume of Income from the Tourism Sector, billion UZS (Y)	Gross Value Added Generated in the Tourism Sector, billion UZS (X1)	Number of Incoming Tourists to Uzbekistan, thousand persons (X2)	Volume of Investments in the Tourism Sector, billion UZS (X3)	Number of Business Entities in the Tourism Sector, units (X4)
2014	1052,0	4066,4	1862,0	18,7	1200
2015	1187,5	4219,5	1917,0	18,5	1250
2016	1252,5	4253,3	2070,0	35,2	1326
2017	1546,9	4631,8	2691,0	31,7	1452
2018	1041,1	5085,7	5346,0	44,9	1634
2019	1313,0	6169,0	6748,0	87,5	1875
2020	255,8	1240,0	1504,0	101,7	1512
2021	422,1	1680,2	1885,0	580,2	1736
2022	875,3	3778,2	5233,0	730,5	2125
2023	896,3	4178,5	6626,0	947,3	2649
2024	949,2	4847,1	8624,0	1258,2	3581

Due to the fact that the measurement units of the dependent and independent variables presented in the table above are not uniform – that is, the factor indicators are not homogeneous – the main trend model is determined in the form of a linear-logarithmic relationship. All factor indicators are converted into natural logarithmic numbers in order to do this, see Table 2.

During the regression analysis conducted using the EViews12 software package, the parameters identified and the significance of the model were evaluated based on the main diagnostic indicators calculated by the software. The linear-logarithmic trend model is built using the regression model's coefficients, which are taken from the regression analysis findings.

Table 2. Logarithmic values of the volume of income from the tourism sector and the factors influencing its changes.

t	LnY	LnX_1	LnX_2	LnX_3	LnX_4
2014	6,95844839	8,310513	7,529406	2,928524	5,83773
2015	7,07960554	8,347472	7,558517	2,917771	5,986452
2016	7,13289683	8,35545	7,635304	3,561046	6,070738
2017	7,34400821	8,440701	7,897668	3,456317	6,212606
2018	6,94803313	8,534188	8,584104	3,804438	6,890609
2019	7,18006987	8,727292	8,817001	4,471639	7,05445

2020	5,54439589	7,122867	7,315884	4,622027	7,198184
2021	6,04524225	7,426668	7,541683	6,363373	7,301822
2022	6,77456668	8,237003	8,56274	6,593729	7,327781
2023	6,79827518	8,337708	8,798757	6,853616	7,379632
2024	6,85561952	8,486136	8,925853	7,137437	7,633854

Using the identified data, a multi-factor econometric model was developed to represent the changes in the volume of income from the tourism sector under the influence of various factors. Accordingly, the following regression equation was formulated to describe this process:

$$\ln Y = 1,365 \cdot \ln X_1 - 0,389 \cdot \ln X_2 + 0,071 \cdot \ln X_3 - 0,079 \cdot \ln X_4 - 1,072$$

Table 3 presents the expected indicators of changes in the volume of tourism-related revenue for 2025–2029, together with the best models for calculating them, based on the trend models found using the software package.

$$Y_1 = \frac{X_1^{1,365} \cdot X_3^{0,071}}{X_2^{0,389} \cdot X_4^{0,079} \cdot e^{1,072}}$$

The following non-linear econometric model, which represents the amount of revenue generated by the tourism industry, is produced by exponentiating the identified linear-logarithmic model:

Table 3. Trend Models and Forecast Indicators of the Volume of Income from the Tourism Sector and Its Influencing Factors for the Years 2024–2028.

Indicators and Their Factor-Based Models	Forecast Indicators				
	2025	2026	2027	2028	2029
Volume of Income from the Tourism Sector, billion UZS	865,63	925,44	1003,5	1099,8	1214,33
$Y_1 = \frac{X_1^{1,365} \cdot X_3^{0,071}}{X_2^{0,389} \cdot X_4^{0,079} \cdot e^{1,072}}$					
Gross Value Added Generated in the Tourism Sector, billion UZS	4133,73	4463,30	4808,68	5169,87	5546,88
$x_1 = 4066,4 + 159,82 \cdot t - 4,95 \cdot t^2$					
Number of Tourists Arriving in Uzbekistan, thousand persons	8491,0	9683,0	10978,0	12379,0	13883,3
$x_2 = 2250,30 - 5,22 \cdot t + 52,05 \cdot t^2$					
Volume of Investments in the Tourism Sector, billion UZS	1622,86	2019,95	2459,74	2942,23	3467,42
$x_3 = -20,1 + 41,38 \cdot t + 9,7 \cdot t^2$					
Number of Business Entities in the Tourism Sector, units	3730,46	4301,25	4931,41	5620,93	6369,8
$x_4 = 1369,57 - 111,86 \cdot t + 29,68 \cdot t^2$					

Using the multi-factor econometric model, the medium-term changes in the volume of income from the tourism sector for the years 2014–2029 were illustrated in a graphical format, see Figure 1.

Based on the above factor relationships, a development scenario was formulated by us to reflect the influence of key indicators—considered the most important for the development of the tourism sector—on the resulting indicator: the volume of income from the tourism sector. Utilizing the identified trends enables the optimal allocation of resource volumes invested in the sector and enhances the efficiency gained per unit of resource.

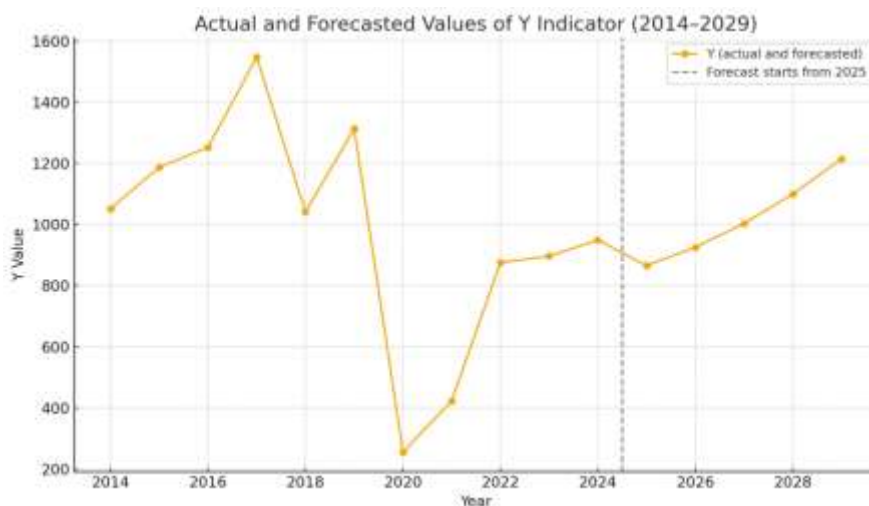


Figure 1. Changes in the Volume of Income from the Tourism Sector in 2014–2029, billion UZS (Forecast Indicators for 2025–2029).

The trend models identified based on multi-factor relationships allow for the forecasting of changes in the key performance indicators of the sector in the future, under the influence of selected factors, while taking into account a certain margin of error. During the research process, changes in the volume of income from the tourism sector, influenced by four key factors, were used to determine forecast values for the coming period.

The significance of the developed model and its parameters under the influence of particular factors is evaluated in four directions during the econometric modeling verification stage:

- The quality of the model is evaluated using the multiple correlation coefficient and the coefficient of determination;
- The overall significance of the model is assessed using the approximation error and the Fisher criterion;
- The reliability of the model parameters is evaluated using the Student’s t-test;
- The fulfillment of the “ordinary least squares method” assumptions is checked using the Durbin-Watson statistic, which helps assess the presence of autocorrelation or multicollinearity in the constructed trend model.

The dynamics of the analyzed time series always represent a sample of significantly longer sequences; for the econometric model we developed, an 11-year time series was used. Therefore, it is necessary to thoroughly verify and assess the reliability of the econometric models obtained through correlation-regression analysis.

The significance, reliability, and practical applicability of the constructed econometric model for forecasting are evaluated based on the following criteria:

1. Assessment of the significance of econometric models using the Fisher criterion and approximation error.

2. Evaluation of model quality through the multiple correlation coefficient and the coefficient of determination.
3. Evaluation of model parameters using the Student's t-test.
4. The Durbin-Watson statistic is used to evaluate the series' residual autocorrelation.

Using the econometric model in practice without first evaluating its significance and the quality of its parameters, based on the above calculations, may lead to major forecasting errors. Therefore, taking this into account, we evaluate the model for changes in the volume of income from the tourism sector based on its significance and the quality of its parameters.

The primary assessment indicators determined by the program were used to evaluate the model's relevance and the parameters found during the regression analysis, which was carried out using the EViews12 software package, see Table 4.

Table 4. Relationship characteristics of the selected factors affecting the volume of income from the tourism sector and key indicators of the quality of the constructed multi-factor model.

Dependent Variable: ...		LnY		
Method: Least Squares				
Date: 04/11/25 Time: 15:39				
Sample: 2014 2024				
Included observations: 11				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LnX1	1.364924	0.507066	2.691807	0.0360
LnX2	-0.389096	0.470438	-0.827092	0.4398
LnX3	0.070962	0.051848	1.368653	0.2201
LnX4	-0.078484	0.408716	-0.192025	0.8541
C	-1.072271	3.058493	-0.350588	0.7379
R-squared	0.973293	Mean dependent var	6.787378	
Adjusted R-squared	0.955488	S.D. dependent var	0.531471	
S.E. of regression	0.112129	Akaike info criterion	-1.235379	
Sum squared resid	0.075437	Schwarz criterion	-1.054518	
Log likelihood	11.79458	Hannan-Quinn criter.	-1.349387	
F-statistic	54.66461	Durbin-Watson stat	1.641963	
Prob(F-statistic)	0.000075			

The analysis performed using the software package shows that the multiple correlation coefficient between the dependent variable and the influencing factors is $r = 0.9732$, and the coefficient of determination is $R^2 = 0.9554$. This indicates a strong correlation between the dependent variable and the influencing factors, as well as a close relationship between the calculated and actual values, as reflected in the residuals.

The significance and parameter quality of the built econometric model are assessed using the values shown in the table. With a significance level of 0.000075, the endogenous variable in the identified model has a Fisher criteria of 54.66. This amply illustrates the trend model's statistical significance and suitability for real-world use.

The quality of the model is further assessed using the Akaike Information Criterion (AIC = -1.24), the Schwarz Criterion (SC = -1.05), and the Hannan-Quinn Criterion (HQC = -1.35). The values of these criteria also support the practical applicability of the trend model.

The Durbin-Watson (DW) statistic, which helps determine the presence of autocorrelation or multicollinearity in the model, is 1.64. Given that the optimal threshold is around 2.0, it can be concluded that the model exhibits almost no autocorrelation.

Using the EViews12 software package, we construct a trend of changes in the volume of income from the tourism sector—considered the main supporting indicator for the

sector’s development—within a statistical error margin of ± 2 . We also evaluate the indicators that reflect the significance of this trend, see Figure 2.

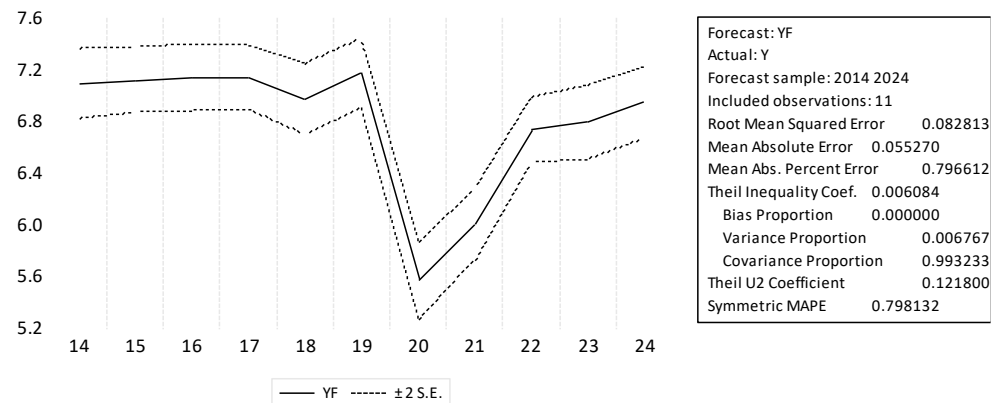


Figure 2. Changes in the volume of income from the tourism sector in 2014–2024 within the ± 2 statistical error margin of the net profit.

The indicators presented in Figure 2 reflect the significance and adequacy of the constructed model. Specifically, the Theil inequality coefficient is 0.006, the Theil U2 coefficient is 0.122, the bias proportion is 0, the variance proportion is 0.0068, the covariance proportion is 0.9932, and the symmetric MAPE is 0.798, indicating that the model lies within acceptable ranges. In particular, considering that the threshold for symmetric MAPE is 10, the level of forecast error is well below this limit, i.e., $MAPE: 0.798 < 10$.

In addition to the aforementioned, the graph of residuals, actual values, and fitted model values in Figure 3 should be used to assess the model of changes in the volume of income from the tourism sector, which is regarded as one of the most significant indicators in the sector's development under the influence of various factors.

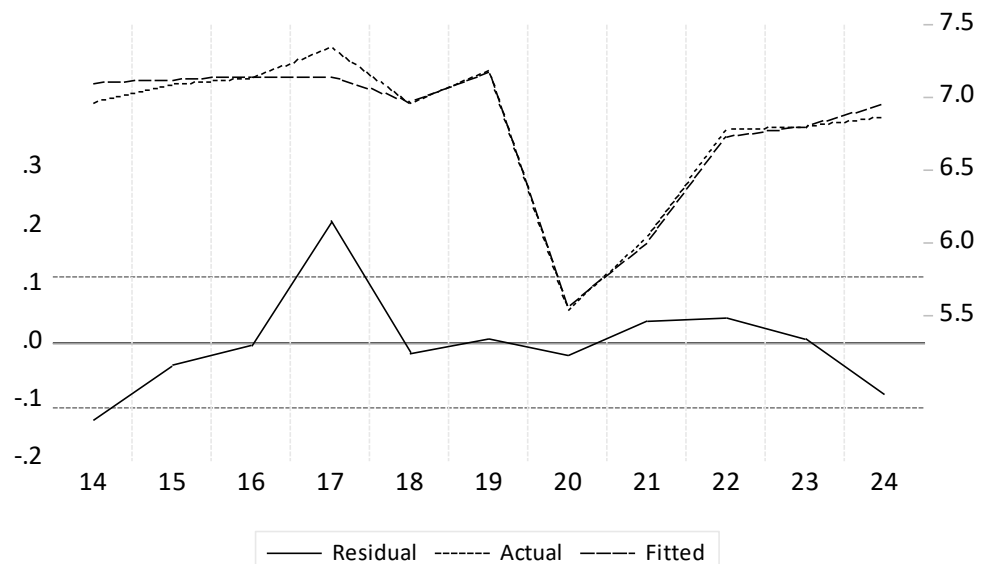


Figure 3. Graph of residuals, actual values, and fitted model values of the volume of income from the tourism sector.

In the graph presented in Figure 3, the difference between the actual values and the values calculated using the constructed model seems to be insignificant, despite the fact

that the fluctuation level between the residual indicators calculated using the residual model and the actual values is rather high.

4. Discussion

Based on the above analytical information and the evaluation of indicator values, the following trend model—which takes into account the volume of income from the tourism sector and the impact of influencing factors, identified as the most important in the development of the tourism industry—can be used in the process of developing future development strategies for the sector.

The model and forecast indicators developed using the EViews 12 software serve as a foundation for formulating alternative scenarios aimed at planning and strategizing the development of the tourism sector, particularly in advancing the activities of entrepreneurial entities in the short and medium term. If tourism-related business entities base their plans and programs on the outcome variable and the influencing indicators used in this model, it has been determined that the results—verified against the set forecasting criteria—will yield high effectiveness.

When using the constructed trend models, determining the volume of resources (exogenous factors) to be invested in tourism enterprises operating in the tourism services market—based on the efficiency gained from each additional unit of resource—makes it possible to ensure the optimal effectiveness of tourism income generation. It also supports the balanced and sustainable development of tourism enterprises' activities.

5. Conclusion

Based on the results of using investment mechanisms, the following actions should be taken to support the operations of tourism businesses.

The organizational and economic mechanism for supporting investments in tourism enterprises is reflected in a set of organizational structures, legal norms, economic tools, and other measures implemented by the state to promote investment incentives. The key components of the investment support mechanism for tourism enterprises include regulatory, organizational, methodological (methodological support), human resource, informational, and financial aspects.

In the development of entrepreneurial activity within tourism enterprises, financing investment projects and providing investment support serve as financial tools in the formulation of measures aimed at ensuring the stable operation of newly established tourism enterprises, mitigating the effects of internal and external factors, gaining competitive advantage within entrepreneurial structures, and reducing potential risks in the sector.

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