

ANALYSIS AND FORECASTING OF SEASONAL FLUCTUATIONS IN BUDGET REVENUES OF DIFFERENT LEVELS UNDER MARTIAL LAW AS A COMPONENT OF EFFECTIVE PUBLIC FINANCE MANAGEMENT IN UKRAINE

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Introduction. Analysing and forecasting seasonal fluctuations in budget revenues at various levels is an important component of effective public finance management. In today's environment of war and economic instability, the government and local authorities face the need to accurately plan their revenues and expenditures, which must be preceded by detailed analysis and forecasting. Seasonal fluctuations in budget revenues can arise from a variety of factors, such as changes in consumer activity, tax revenues, economic cycles, changes in legislation, the course of hostilities, and specific sectoral influences. Understanding and predicting these fluctuations allows prepare in advance for possible financial challenges, ensure uninterrupted financing of important expenditures at the state and local levels, and maintain financial stability. Tools and methods of analysis, including statistical models and econometric approaches, help to anticipate seasonal trends and make informed decisions on budget planning. In particular, budget revenues can be forecasted using extrapolation based on seasonality indices.

Analysis of recent research and publications. The analysis and forecasting of revenues to the budgets of different levels of Ukraine has been the subject of study by a number of domestic scholars. In particular, they conducted the following studies: O.Z. Hirska and G.G. Tsehelyk – the use of time trends for analysing and forecasting tax revenues to the State Budget of Ukraine [1]; O.F. Zaporozhets – analysis and forecasting of customs payments to the state budget [2]; H.Yu. Kucherova – trend analysis of tax revenues of the consolidated budget of Ukraine [3]; S.L. Londar and L.O. Melnykova – medium-term forecasting of consolidated budget revenues from corporate income tax [4]; V. V. Malikov and O.A. Diehtiar – features of using economic and mathematical models for forecasting budget revenues [5]; V.P. Martyniuk – forecasting the receipt of tax payments to the state budget by using the ARIMA model [6]; A. Yu. Polchanov – forecasting tax revenues of the consolidated budget of Ukraine based on time series analysis [7]; N.S. Sytnyk and O.Ya. Ivaneiko – analysis of revenues to local budgets during the war [8]; O. Totska and I. Dmytruk – analysis of personal income tax revenues in Ukraine at the national and regional levels [9]; A. Khomutenko and Yu. Bzova – forecasting the volume of corporate income tax revenues to the State Budget of Ukraine by the method of correlation and regression analysis [10]; L.V. Shirinian et al. – analysis and forecasting of revenues to the State Budget of Ukraine from the income tax of insurance companies [11].

Foreign scholars have studied budget revenues in other countries: M. Ademmer and J. Boysen-Hogrefe – the impact of errors in medium-term tax revenue forecasts on the final budget balance based on fiscal data for all German states [12]; J.T. Jalles – fiscal forecasts of the European Commission for a sample of 10 countries in Central and Eastern Europe [13]; S. Jorge et al. – the factors that influence the excess of revenues in local

government based on data from Portuguese municipalities [14]; E. Pamplona et al. – the effectiveness of the Autoregressive-Moving Average model (ARMA) in forecasting the budget revenues of municipalities of Paraná state (Brazil) compared to the model proposed by the Federal Budget Secretary [15]; C. Szydłowski – the level of budget revenues of selected municipalities in Poland from the vehicle tax and its share in total municipal revenues [16].

In the analysed publications, domestic authors focused their attention mainly on revenues to the budgets of one level: state, local or consolidated. Foreign authors studied budget revenues in other countries.

Objectives of the article. Unlike the aforementioned publications, the purpose of this study is to analyse and forecast seasonal fluctuations in tax revenues to the State Budget of Ukraine from the Volyn region and to local budgets of Volyn region under martial law.

The main material of the study. Volyn region is located in north-western Ukraine and borders Poland. As part of the relocation process, a number of businesses from the active hostilities zone moved here.

To analyse the indicators of budget revenues for 2022–2023, Table 1 and Table 2 are constructed, where data on the largest budget-forming taxes are selected only.

Table 1

Revenues of the largest budget-forming taxes to the state budget in the Volyn region in 2022–2023, UAH million

Year	Month	VAT on goods imported into the customs territory of Ukraine (KBCI 14070100)	Customs duty on goods imported by business entities (KBCI 15010100)	Personal income tax paid by tax agents on taxpayer's income in the form of wages (KBCI 11010100)	Personal income tax on allowances, remuneration and other payments received by military personnel, police officers and persons holding the rank of private or commander, paid by tax agents (KBCI 11010200)	Excise tax on excisable goods imported into the customs territory of Ukraine – Vehicles (KBCI 14030800)
2022	January	940.755	78.291	72.704	5.470	180.713
	February	1,075.194	92.435	97.583	6.533	214.639
	March	299.073	21.180	73.657	32.018	8.412
	April	477.358	17.601	76.724	35.458	2.819
	May	530.986	3.654	77.546	55.327	0.954
	June	733.429	3.575	95.200	56.800	1.396
	July	1,534.213	115.900	87.317	51.148	42.253
	August	1,488.222	132.485	83.221	58.063	100.199
	September	1,969.725	155.821	85.439	58.461	138.916
	October	1,781.008	183.259	87.996	68.876	169.351
	November	2,011.259	192.234	92.416	81.951	167.616
	December	1,951.088	145.649	123.585	99.472	145.784
	Total	14,792.310	1,142.084	1,053.388	609.577	1,173.052
2023	January	1,640.082	129.888	78.015	54.542	136.674
	February	2,192.776	166.993	86.649	77.835	151.847
	March	2,386.274	178.244	99.718	43.461	226.509
	April	2,060.059	149.399	90.178	84.077	214.062
	May	1,788.248	163.582	95.322	72.737	236.611
	June	1,987.640	167.993	119.531	26.604	229.276
	July	2,163.156	151.220	93.207	52.163	236.570
	August	2,292.928	188.342	98.100	67.033	251.076
	September	2,341.036	213.367	99.992	86.259	267.986
	October	2,530.919	215.948	103.527	0.000	325.613
	November	1,512.141	116.922	112.268	612.417	285.999
	December	1,956.077	131.035	138.740	334.666	261.211
	Total	24,851.336	1,972.933	1,215.247	1,511.794	2,823.434

Notes. KBCI is a code of budgetary classification of income.

Source: data from the automated system "E-Kazna Dokhody"

Table 1 shows that in the structure of state budget revenues in 2022–2023, value added tax on goods imported into the customs territory of Ukraine (hereinafter – VAT) accounts for the largest share. A significant decrease in this tax in March-June 2022 is explained by the fact that the Verkhovna Rada of Ukraine (hereinafter – VRU), at the beginning of the full-scale invasion, exempted vehicles imported into the country from customs

duties, including VAT. However, on 1 July 2022, the VRU adopted a government bill that reintroduced duties and VAT on imported goods and customs clearance of vehicles. As a result, revenues from this tax have increased significantly, driven by consumption growth and inflation, as well as Ukraine's heavy dependence on imports during the war.

Table 2

Revenues of the largest budget-forming taxes to local budgets of the Volyn region in 2022–2023, UAH million

Year	Month	PIT (KBCI 11010100)	Military PIT (KBCI 11010200)	Single tax on individuals (KBCI 18050400)	Land tax from legal entities (KBCI 18010500)	Rent from legal entities (KBCI 18010600)
2022	January	273.504	20.577	65.471	17.832	15.637
	February	367.099	24.576	87.797	23.130	15.330
	March	277.090	120.447	22.746	22.574	15.904
	April	288.629	133.389	50.387	20.272	15.439
	May	291.721	208.135	63.074	21.309	17.472
	June	358.133	213.677	33.042	21.290	16.423
	July	328.478	192.415	53.607	25.946	17.241
	August	313.071	218.428	57.093	23.070	19.728
	September	321.415	219.923	37.956	21.622	18.443
	October	331.034	259.107	62.502	22.269	18.210
	November	347.659	308.293	66.301	19.539	20.325
	December	464.915	374.205	45.380	19.431	21.891
	Total	3,962.748	2,293.172	645.356	258.284	212.043
2023	January	293.486	205.180	74.480	12.690	17.314
	February	325.965	292.808	66.951	17.955	20.561
	March	375.130	163.495	43.783	17.139	22.153
	April	339.239	316.291	63.130	13.604	21.702
	May	358.592	273.631	62.725	18.231	21.634
	June	449.662	100.082	44.396	16.235	21.433
	July	350.636	196.233	69.154	16.489	21.923
	August	369.042	252.170	80.899	15.515	21.799
	September	376.159	324.497	40.619	16.088	20.652
	October	389.459	284.343	93.066	18.697	21.625
	November	422.343	-284.343	99.865	17.393	22.047
	December	521.926	0.000	46.606	16.983	23.840
	Total	4,571.639	2,124.387	785.674	197.019	256.683

Source: data from the automated system "E-Kazna Dokhody"

A similar trend was observed with other revenues controlled by the State Customs Service of Ukraine, including customs duties on goods imported by business entities and excise tax on vehicles imported into the customs territory of Ukraine. Overall, customs revenues to the state budget in 2023 increased by 74% or UAH 13.07 billion compared to 2022.

In the fourth quarter of 2023, state budget revenues from the personal income tax on allowances, remuneration and other payments received by military personnel, police officers and persons holding the rank of private or commander, paid by tax agents (hereinafter – military PIT) increased significantly. This is due to changes in legislation – the VRU passed a bill that completely removed military personal income tax revenues from local budgets. From now on, 100% of the tax is credited to the state budget, including 25% to the general fund and 75% to the special fund of the state budget. These revenues finance the purchase of drones and artillery systems. Revenues from personal income tax paid by tax agents on taxpayer's income in the form of wages (hereinafter – PIT), also increased. All five types of taxes grew year-on-year.

Table 2 shows that in the structure of local budget revenues in 2022–2023, PIT and military PIT account for the largest share. In particular, from March 2022 to October 2023, local budgets received significant revenues from military PIT, which significantly strengthened territorial communities (hereinafter – TCs), especially the regional centre and TCs with military units. Even taking into account the financial and material assistance to the Ukrainian defence forces from the TCs, a significant amount of the funds received from the military PIT was spent locally, which allowed not only to meet the basic needs of the TCs but also to develop the general infrastructure during the war. However, since 1 October 2023, local budgets have been deprived of these revenues, forcing local authorities to reconsider the sources of budget revenues and their own expenditures.

There was also an increase in PIT and single tax on individuals revenues. This can be explained by the increase in the average salary in Ukraine and internally displaced persons who either found jobs or started business in the TG region.

Revenues from land tax and rent from legal entities are also an important component of local budget revenues and a sign that local governments are making effective use of communal land and property. Annual figures have increased for all types of taxes, except military PIT and land tax.

Seasonality indices are calculated by the formula:

$$i_s = \frac{\bar{y}_i}{\bar{y}} \times 100, \tag{1}$$

where $\bar{y}_i = \frac{\sum_i y_i}{k}$ – is the average value of the budget revenues indicator for the i -th month;

y_i – is the value of the budget revenue indicator for the i -th month;

k – number of years ($k = 2$);

$\bar{y} = \frac{\sum_{i=1}^{12} \bar{y}_i}{n}$ – the average value of the budget revenues indicator for the entire analysed period;

n – number of months ($n = 12$).

The results are presented in Table 3 and Table 4. They do not calculate the indicators for military PIT revenues, as they are credited to the state budget from 1 October 2023.

Table 3 shows that in 2022–2023, the State Budget of Ukraine received on average UAH 1,651.819 million from VAT on goods imported into the customs territory of Ukraine, UAH 129.792 million – customs duties on goods imported by business entities, UAH 94.526 million – personal income tax, and UAH 166.520 million – excise tax on imported vehicles from the Volyn region. At the same time, the local budgets of Volyn region received on average UAH 355.599 million from personal income tax, UAH 59.626 million – single tax on individuals, UAH 18.971 million – land tax on legal entities, and UAH 19.530 million – rent on legal entities.

Table 3

Average values of the largest budget-forming taxes for 2022–2023, UAH million

Month	Revenues to the state budget in the Volyn region			
	KBCI 14070100	KBCI 15010100	KBCI 11010100	KBCI 14030800
January	1,290.419	104.090	75.360	158.694
February	1,633.985	129.714	92.116	183.243
March	1,342.674	99.712	86.688	117.461
April	1,268.709	83.500	83.451	108.441
May	1,159.617	83.618	86.434	118.783
June	1,360.535	85.784	107.366	115.336
July	1,848.685	133.560	90.262	139.412
August	1,890.575	160.414	90.661	175.638
September	2,155.381	184.594	92.716	203.451
October	2,155.964	199.604	95.762	247.482
November	1,761.700	154.578	102.342	226.808
December	1,953.583	138.342	131.163	203.498
Average	1,651.819	129.792	94.526	166.520
Month	Revenues to local budgets of the Volyn region			
	KBCI 11010100	KBCI 18050400	KBCI 18010500	KBCI 18010600
January	283.495	69.976	15.261	16.476
February	346.532	77.374	20.543	17.946
March	326.110	33.265	19.857	19.029
April	313.934	56.759	16.938	18.571
May	325.157	62.900	19.770	19.553
June	403.898	38.719	18.763	18.928
July	339.557	61.381	21.218	19.582
August	341.057	68.996	19.293	20.764
September	348.787	39.288	18.855	19.548
October	360.247	77.784	20.483	19.918
November	385.001	83.083	18.466	21.186
December	493.421	45.993	18.207	22.866
Average	355.599	59.626	18.971	19.530

Source: calculated on the basis of Table 1 and Table 2

Seasonality indices of the largest budget-forming taxes for 2022–2023, %

Month	Revenues to the state budget in the Volyn region			
	KBCI 14070100	KBCI 15010100	KBCI 11010100	KBCI 14030800
January	78	80	80	95
February	99	100	97	110
March	81	77	92	71
April	77	64	88	65
May	70	64	91	71
June	82	66	114	69
July	112	103	95	84
August	114	124	96	105
September	130	142	98	122
October	131	154	101	149
November	107	119	108	136
December	118	107	139	122
Month	Revenues to local budgets of the Volyn region			
	KBCI 11010100	KBCI 18050400	KBCI 18010500	KBCI 18010600
January	80	117	80	84
1	2	3	4	5
February	97	130	108	92
March	92	56	105	97
April	88	95	89	95
May	91	105	104	100
June	114	65	99	97
July	95	103	112	100
August	96	116	102	106
September	98	66	99	100
October	101	130	108	102
November	108	139	97	108
December	139	77	96	117

Source: calculated on the basis of Table 3

The analysis of Table 4 shows that the most active revenues to the state budget from the Volyn region were observed in the following periods: VAT on goods imported into the customs territory of Ukraine – in July-December; customs duties on goods imported by business entities – in February and July-December; PIT – in June (the beginning of the holiday season) and October-December; excise tax on imported vehicles – in February and August-December. October-December were the most favourable months for the state budget revenues (seasonality indices were above 100 for all types of taxes analysed). Local budget revenues in the Volyn region were sporadic, with the highest revenues in the following months: PIT – in June and October-December (similar to the revenues from PIT to the state budget); single tax on individuals – in January-February, May, July-August, October-November; land tax on legal entities – in February-March, May, July-August, October; and rent from legal entities – in May, July-December. October proved to be the most favourable month for local budget revenues (seasonality indices were above 100 for all types of taxes analysed).

If we assume that the trends in budget revenues will continue in 2024, then using annual data for 2022–2023, we can build linear trend models and obtain forecast annual data for 2024 based on them:

VAT: $y_1 = 10,059 * x + 4,733.3 = 34,910.300$ million UAH;

customs duty: $y_2 = 830.85 * x + 311.23 = 2,803.780$ million UAH;

PIT to the state budget: $y_3 = 161.86 * x + 891.53 = 1,377.110$ million UAH;

excise tax: $y_4 = 1,650.4 * x - 477.33 = 4,473.870$ million UAH;

PIT to local budgets: $y_5 = 608.89 * x + 3,353.9 = 5,180.570$ million UAH;

single tax: $y_6 = 140.32 * x + 505.04 = 926.000$ million UAH;

land tax: $y_7 = -61.265 * x + 319.55 = 135.755$ million UAH;

rent: $y_8 = 44.64 * x + 167.4 = 301.320$ million UAH.

On their basis, it is possible to obtain forecast seasonal indicators of budget revenues calculated by the formula:

$$p_i = \frac{p^* i_s}{n} / 100, \quad (2)$$

where p_i – is the forecast value of the budget revenues indicator for the i -th month;

p – annual forecast value of the budget revenues indicator;

i_s – seasonality index for the respective month;

n – number of months ($n = 12$).

The results are presented in Table 5.

Table 5

Forecasted revenues of the largest budget-forming taxes for 2024, UAH million

Month	Revenues to the state budget in the Volyn region			
	KBCI 14070100	KBCI 15010100	KBCI 11010100	KBCI 14030800
January	2,272.692	187.379	91.490	355.299
February	2,877.783	233.507	111.833	410.263
March	2,364.724	179.499	105.242	262.983
April	2,234.456	150.314	101.313	242.788
1	2	3	4	5
May	2,042.324	150.527	104.935	265.942
June	2,396.181	154.426	130.346	258.226
July	3,255.913	240.431	109.582	312.129
August	3,329.691	288.772	110.066	393.235
September	3,796.068	332.301	112.561	455.507
October	3,797.094	359.320	116.259	554.088
November	3,102.715	278.267	124.248	507.800
December	3,440.660	249.039	159.237	455.611
Month	Revenues to local budgets of the Volyn region			
	KBCI 11010100	KBCI 18050400	KBCI 18010500	KBCI 18010600
January	344.176	90.560	9.101	21.183
February	420.706	100.135	12.250	23.072
March	395.913	43.050	11.841	24.465
April	381.130	73.455	10.101	23.876
May	394.755	81.403	11.789	25.139
June	490.350	50.109	11.189	24.336
July	412.238	79.437	12.653	25.177
August	414.058	89.293	11.505	26.696
September	423.444	50.845	11.244	25.132
October	437.356	100.666	12.215	25.608
November	467.409	107.524	11.012	27.239
December	599.035	59.523	10.857	29.398

Source: calculated on the basis of annual projections and Table 4

Thus, the forecast annual data is divided between months in accordance with the seasonality indices in previous years.

Conclusions. Analysing and forecasting seasonal fluctuations in budget revenues is an important tool for the government and local governments at all levels. Monitoring these fluctuations can help to avoid budget deficits, optimise resource allocation, and make more informed fiscal policy decisions.

In Ukraine, as in other countries, the analysis and forecasting of seasonal fluctuations in budget revenues is of great importance. This is due to a number of factors, such as:

- economic transformation: Ukraine is going through a significant economic transformation due to the war and post-war recovery. This can lead to significant changes in seasonal fluctuations in state budget revenues;
- decentralisation: the country is undergoing a process of decentralisation, which leads to an increased role of local budgets. Analysing and forecasting seasonal fluctuations in budget revenues at the local level can help local authorities plan their expenditures more effectively;
- European integration: Ukraine is seeking integration with the European Union. This may lead to changes in the structure of budgets and seasonal fluctuations in their revenues.

In 2022–2023, under martial law, the largest amounts of state budget revenues in the Volyn region were received from VAT on goods imported into the customs territory of Ukraine; customs duties on goods imported by business entities; personal income tax paid by tax agents on taxpayer income in the form of wages; military personal income tax; and excise tax on vehicles imported into the customs territory. In turn, the largest budget-forming taxes of the local budgets of Volyn region over the same period were: personal income tax paid by tax agents on the taxpayer's income in the form of wages; military personal income tax; single tax on individuals; land tax on legal entities; and rent on legal entities.

The most active revenues to the state budget from the Volyn region were observed in the following periods: VAT on goods imported into the customs territory of Ukraine – in July-December; customs duties on goods imported by business entities – in February and July-December; personal income tax – in June (the beginning of the holiday season) and October-December; excise tax on imported vehicles – in February and August-December. Local budget revenues in the Volyn region were sporadic, with the highest revenues in the following months: from personal income tax – in June and October-December; single tax on individuals – in January-February, May, July-August, October-November; land tax on legal entities – in February-March, May, July-August, October; rent from legal entities – in May, July-December. The month of October was the most favourable for filling the budgets of both levels in the Volyn region.

The built linear trend models for tax revenues in the Volyn region allowed us to obtain forecast annual data for 2024, which, in turn, served as the basis for calculating the relevant seasonal indicators.

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Olesia Totska, Doctor of Economic Sciences, Professor at the Department of Management, Lesya Ukrainka Volyn National University. **Vitalii Onysiuk**, Main Specialist of the Department of Operations with Financial Resources of the Office of Budget Revenues and Operations with Financial Resources, Main Department of the State Treasury Service of Ukraine in the Volyn Region. **Analysis and forecasting of seasonal fluctuations in budget revenues of different levels under martial law as a component of effective public finance management in Ukraine.**

The purpose of the article is to analyse and forecast seasonal fluctuations in tax revenues to the State Budget of Ukraine from Volyn region, as well as to local budgets of Volyn region. In 2022–2023, the State Budget of Ukraine received the largest amount of funds from VAT on goods imported into the customs territory of Ukraine; customs duties on goods imported by business entities; excise tax on vehicles imported into the customs territory, as well as PIT paid by tax agents on taxpayer's income in the form of wages; and military PIT. The local budgets of Volyn region received the largest share of these payments: PIT; military PIT; single tax on individuals; land tax on legal entities; rent on legal entities. For eight tax revenue indicators (except for military PIT), linear trend models were built, forecast annual data for 2024 were obtained, which, in turn, served as the basis for calculating the corresponding seasonal indicators.

Key words: State Budget of Ukraine, local budgets, Volyn region, tax payments, analysis, seasonality indices, trend models, forecasting.

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Тоцька Олеся Леонтіївна, доктор економічних наук, професор кафедри менеджменту, Волинський національний університет імені Лесі Українки. **Онисиук Віталій Олександрович**, головний спеціаліст відділу операцій з фінансовим ресурсом управління бюджетних надходжень та операцій з фінансовим ресурсом, Головне управління Державної казначейської служби України у Волинській області. **Аналіз і прогнозування сезонних коливань у надходженнях бюджетів різних рівнів в умовах воєнного стану як складова ефективного управління державними фінансами в Україні.**

Податкові надходження до державного та місцевих бюджетів України відбуваються нерівномірно. На них впливають різноманітні фактори, у тому числі військові дії на території країни. Метою статті є аналіз і прогнозування сезонних коливань у податкових надходженнях до Державного бюджету України з Волинської області, а також до місцевих бюджетів Волинської області в умовах воєнного стану. Волинська область є однією з прикордонних областей України. Тому з Волинської області до Державного бюджету України в 2022–2023 рр. надійшло найбільше коштів від ПДВ із ввезених на митну територію України товарів; мита на товари, що ввозяться суб'єктами підприємницької діяльності; акцизного податку з ввезених на митну територію транспортних засобів, а також ПДФО, що сплачується податковими агентами із доходів платника податку у вигляді заробітної плати; військового ПДФО. Місцеві бюджети Волинської області найбільше наповнили такі платежі: ПДФО, що сплачується податковими агентами із доходів платника податку у вигляді заробітної плати; військового ПДФО; єдиний податок з фізичних осіб; земельний податок з юридичних осіб; орендна плата з юридичних осіб. Обчислені індекси сезонності вказують на такі періоди активного наповнення Державного бюджету по Волинській області: ПДВ з ввезених на митну територію України товарів – у липні-грудні; мита на товари, що ввозяться суб'єктами підприємницької діяльності, – лютому та липні-грудні; ПДФО – червні та жовтні-грудні; акцизного податку з ввезених транспортних засобів – лютому та серпні-грудні. Наповнення місцевих бюджетів Волинської області найактивніше відбувалося в такі місяці: ПДФО – в червні та жовтні-грудні; єдиний податок з фізичних осіб – січні-лютому, травні, липні-серпні, жовтні-листопад; земельний податок з юридичних осіб – лютому-березні, травні, липні-серпні, жовтні; орендна плата з юридичних осіб – травні, липні-грудні. Для восьми показників податкових надходжень (за винятком військового ПДФО) побудовано лінійні трендові моделі, використовуючи річні дані за 2022–2023 рр., та на їх основі отримано прогнозні річні дані на 2024 р., які, своєю чергою, послугували базою для обчислення відповідних сезонних показників.

Ключові слова: Державний бюджет України, місцеві бюджети, Волинська область, податкові платежі, аналіз, індекси сезонності, трендові моделі, прогнозування.