

# NBU University Challenge

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Team № 3





# Goals of the NBU



Promotion of economic recovery and development



Digital finance as a driver for digitalization of the economy

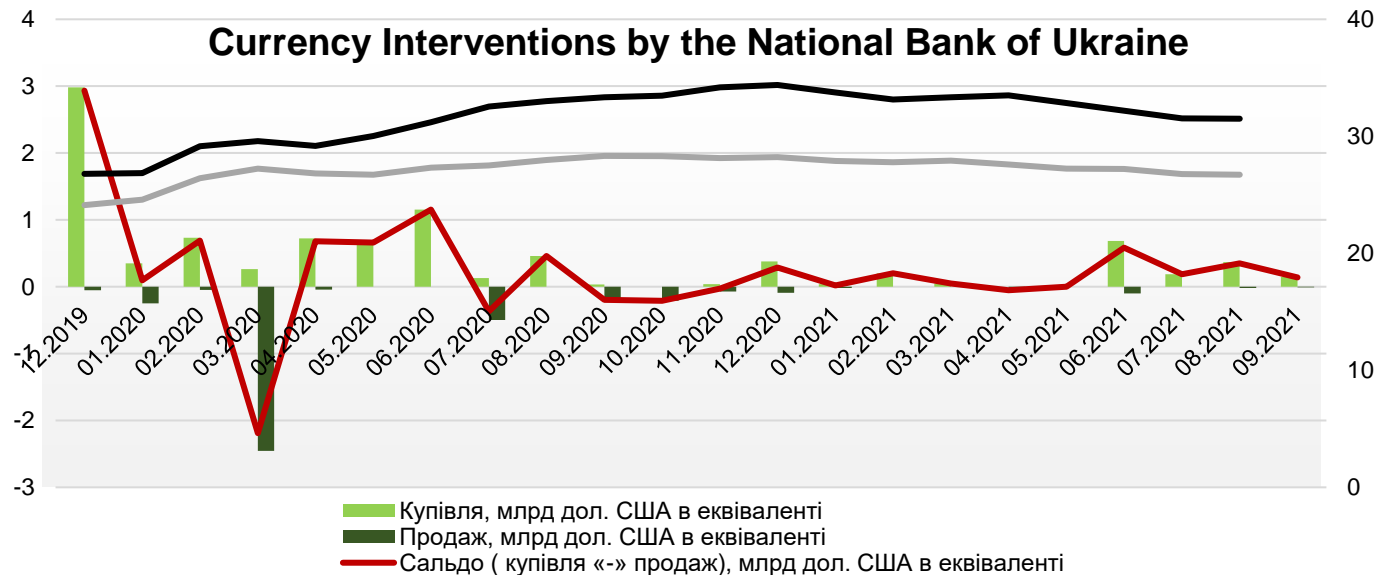


Institutional development and operational excellence of the National Bank

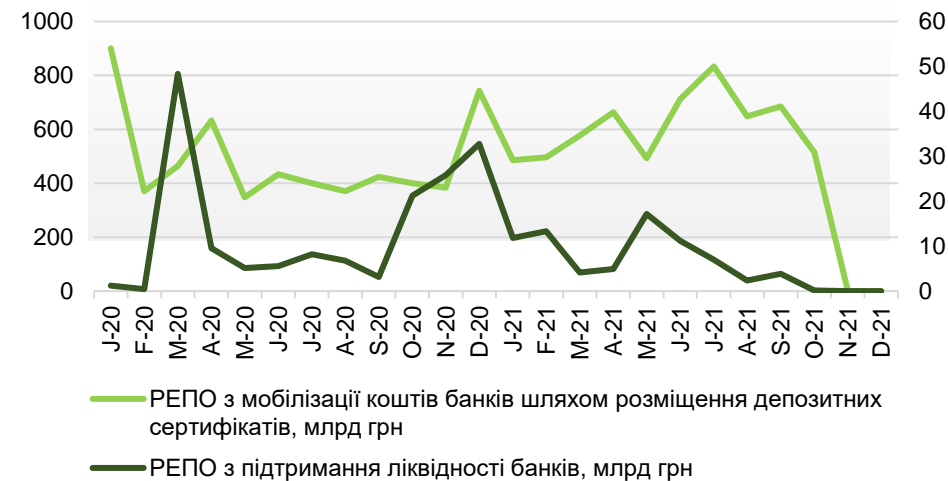


**NBU** is a modern, innovative, open and independent central bank that is a leader in the development of the financial ecosystem, cares about users of financial services, integrated into the European community of central banks, and has the trust of society and international partners.

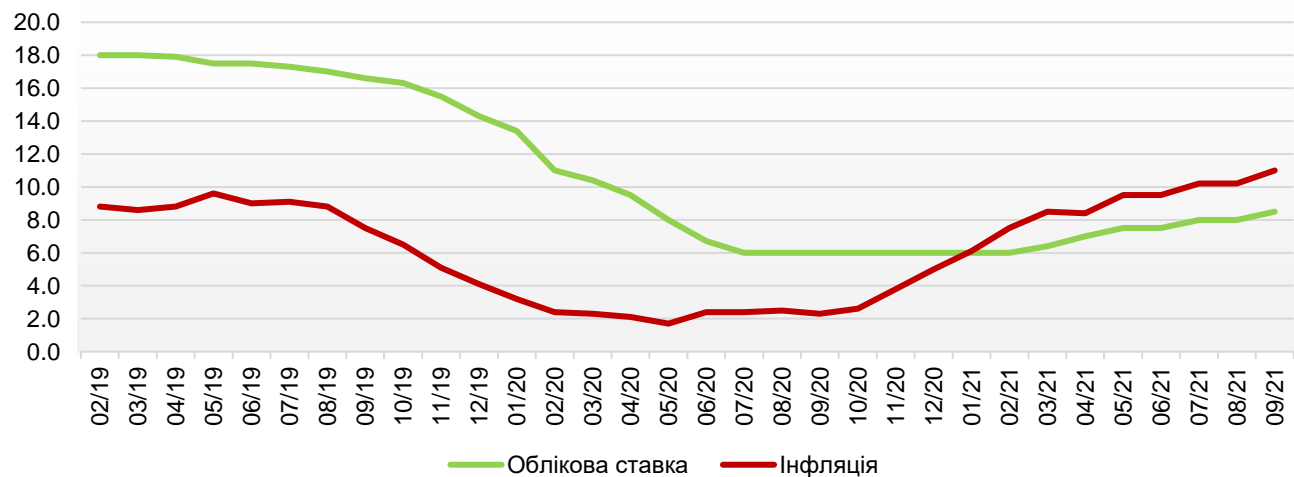
### Currency Interventions by the National Bank of Ukraine



### REPO Operations



### Discount Rate (Annual) and Inflation in Ukraine



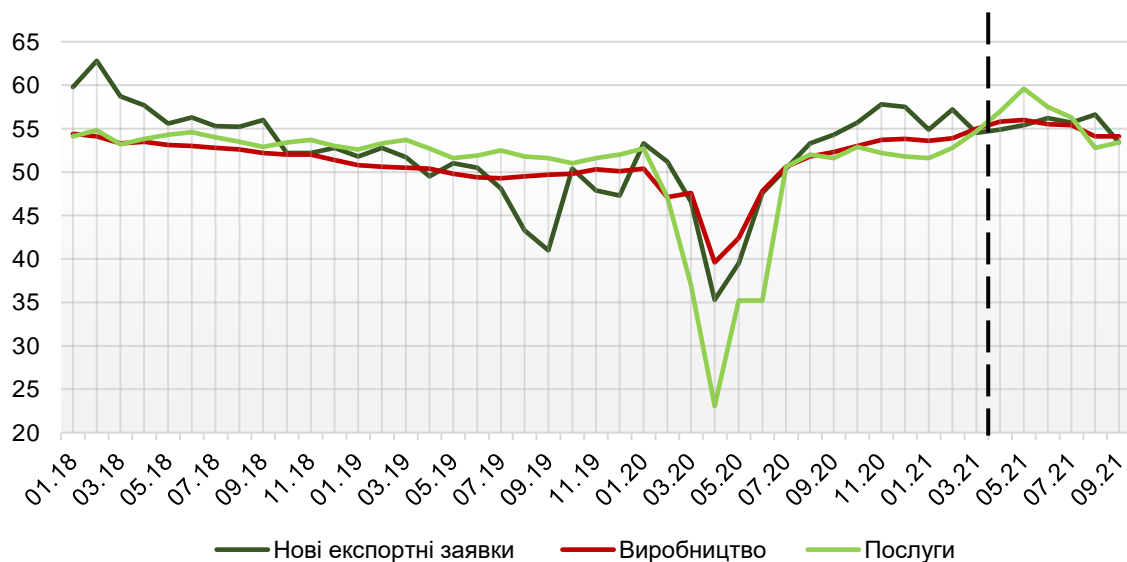
[Source: <https://tradingeconomics.com/ukraine/inflation-cpi>]

### RESERVE REQUIREMENT

Term Deposit  
3%

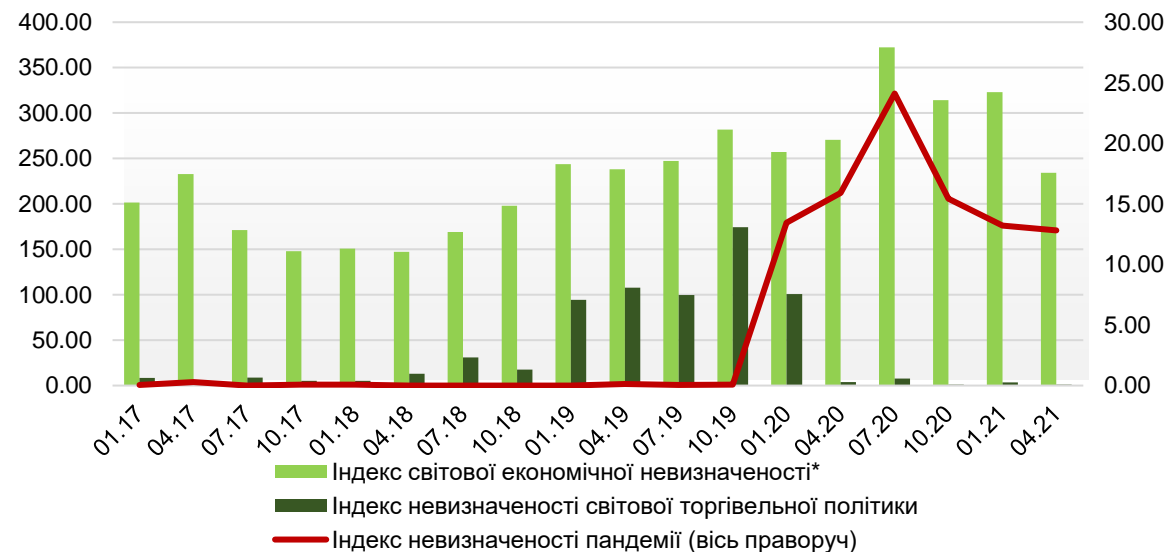
Current Accounts  
6.5%

# Dynamic changes in the global economy



Currently, the global Purchasing Managers' Index (PMI) is at a 6-month low, and the growth rate of its components is low, as there is limited supply, which could lead to higher inflation.

Please note that the pace of export expansion is low due to problems with the restoration of supply chains.

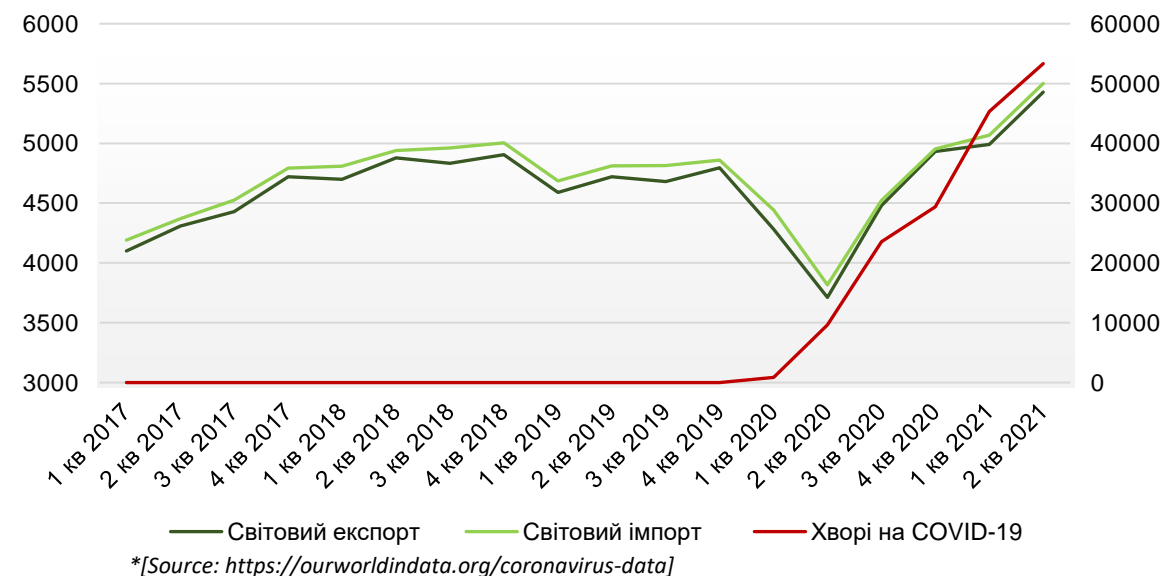
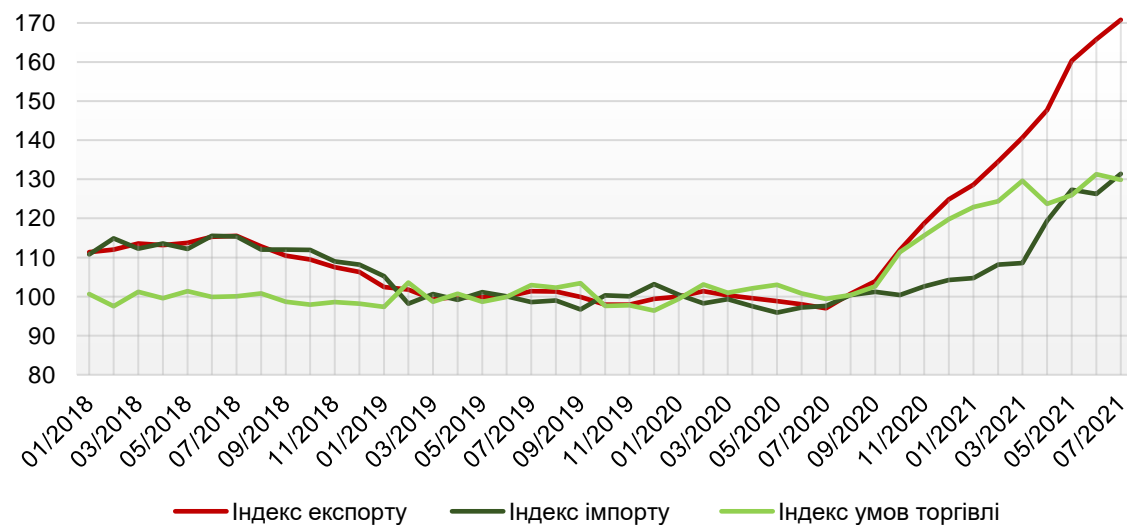


\*[Source: Economic Policy Uncertainty]



The uncertainty of economic and trade policies of countries had a significant impact on the level of trade and business development. The greatest tension is observed in periods of exacerbation of the epidemiological situation and increase in the uncertainty index of the pandemic during 3rd quarter of 2019 - 3rd quarter of 2020, but in 2021 the situation is improving, as the states have implemented an effective system of measures to support the economy.

# Indicators of world trade and Ukraine

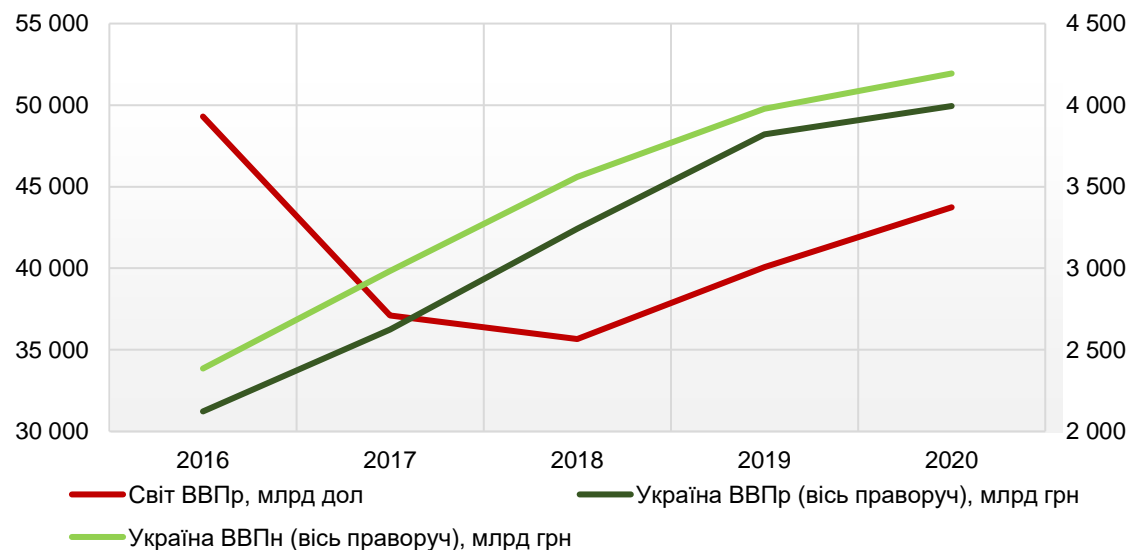


During the first 2 quarters In 2021, the prices of Ukraine's export goods increased significantly, which is due to limited supply and growing demand in the world. Import prices had less growth, as it was possible to limit the shortage of goods and balance demand in Ukraine.

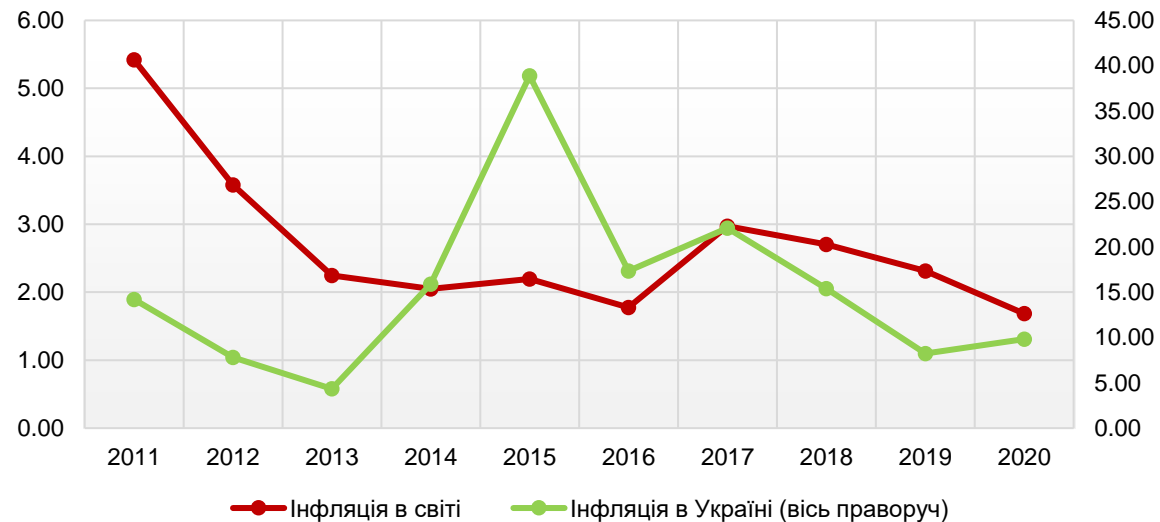
High export prices improved the terms of trade index and ensured a current account surplus and strengthened the national currency.

Since the beginning of the pandemic, global exports and imports have changed significantly, but gradually during 2020. countries and businesses adapted to the conditions of the pandemic, the process of restoring supply chains and active mass vaccination began, which led to further rapid growth of exports and imports and recovery of the economy (Q2 2020).

# Dynamics of GDP, inflation in the world and in Ukraine



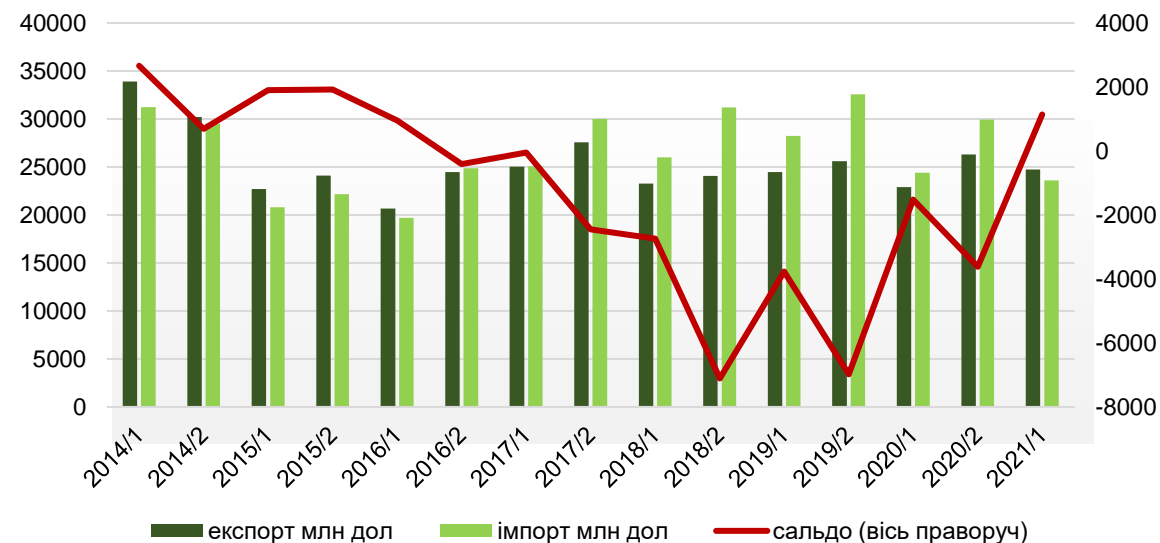
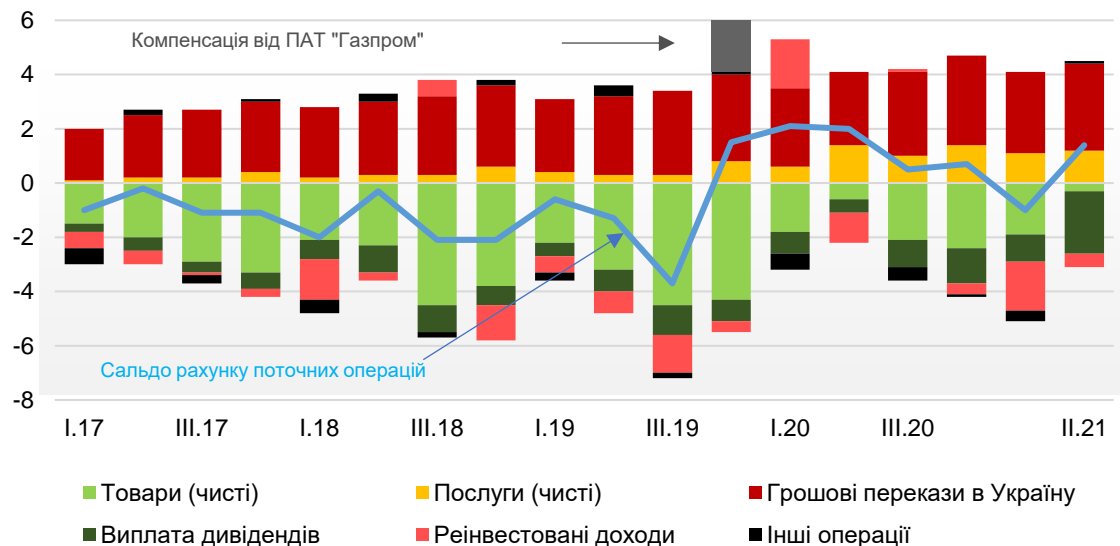
Growth rates of global and Ukrainian GDP, both real and nominal, decreased due to the pandemic. In Ukraine, there is a drop of 1 sq. In 2021, real GDP (-2% y/y), which is due to the growth of inflation, problems in the real sector of the Ukrainian economy (resumption of business activity provoked an increase in demand for imported goods; new outbreaks of disease).



As a result of the COVID-19 pandemic, the central banks of the countries began to reduce the discount rates and actively influence the money supply in the economy. In addition, limited supply and unsatisfied demand increased product prices, which caused inflation to rise in the Eurozone, the United States, and Ukraine.



# Dynamics of the balance of current operations, changes in exports and imports

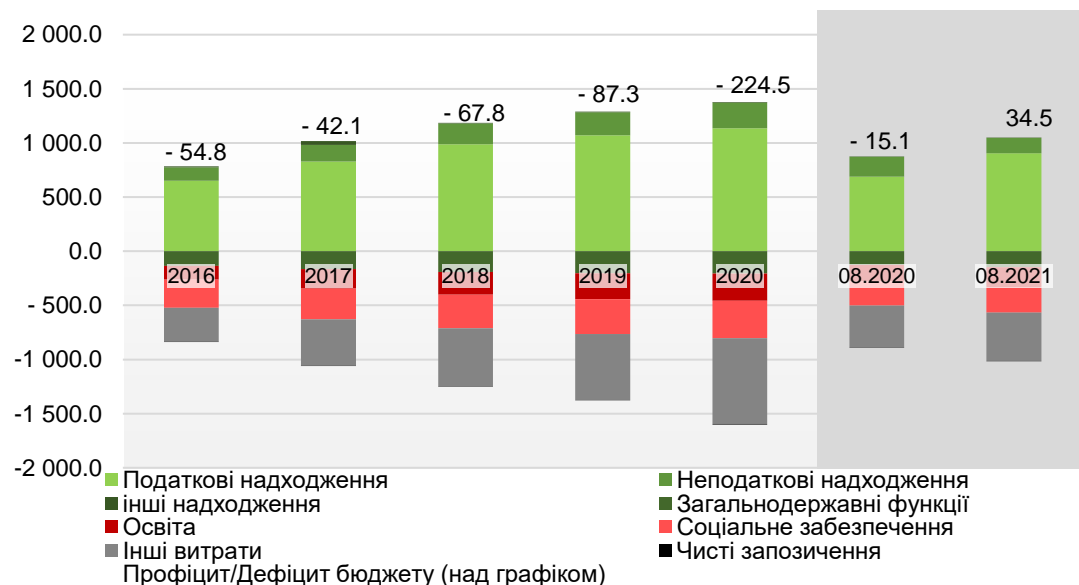


The current account balance was positive in 2021 thanks to the infusion of funds from wage earners, high export prices, and the expansion of the trade surplus in services. It is worth paying attention to the increase in the amount of dividends paid and the increase in the prices of imported goods, namely chemical, energy and food products.



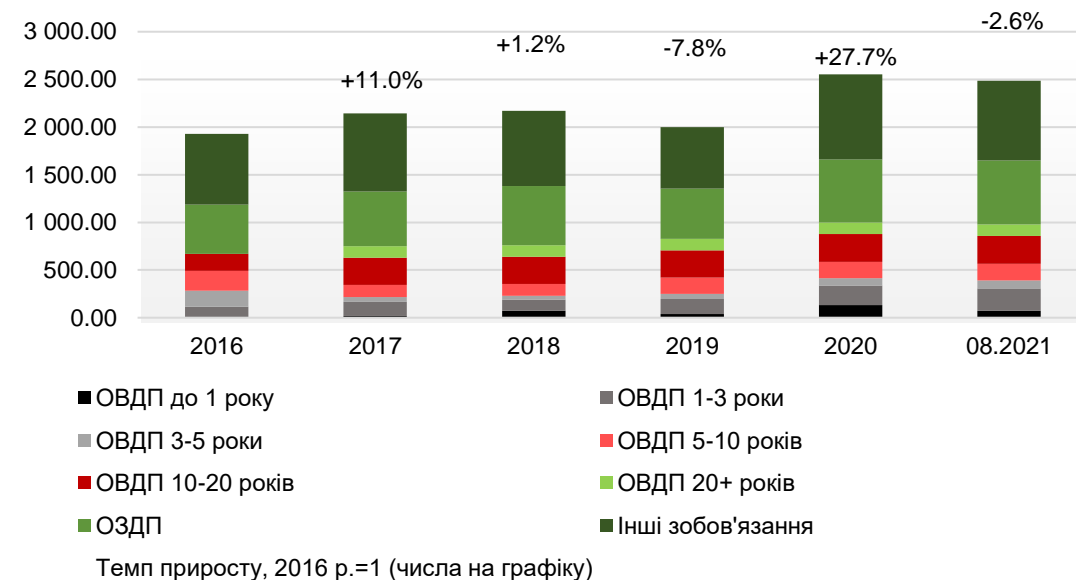
Net exports in Ukraine until 2021 were negative, and in 2021 they became positive, as the prices of Ukraine's export goods increased significantly. Economic activity did not recover, which limited the demand for imported goods. In the future, we will observe an increase in imports and the normalization of prices in the world, so a negative foreign trade balance is expected.

# The structure of the budget of Ukraine and the dynamics of the state debt



During the last 5 years, there has been a state budget deficit in Ukraine. In particular, there is a significant exaggeration of expenses over income in 2020.

80% of revenues are taxes (as of 08.2021 VAT -31%, personal income tax -21%, PPP -11%). More than 20% of all expenses are social benefits, 14% - state functions, 19% - education. In 2021, a budget surplus is observed.



The public debt of Ukraine as a whole has a growing tendency. The pandemic of coronavirus infection contributed to the increase of the indicator by 27.7%.

More than 60% of the state debt is state bonds (as of August 2021, the share of OVDP is 39.4%; OZDP is 27%). In particular, these are long-term OVDPs with a term of more than 10 years.

59% of the state debt is external borrowing.

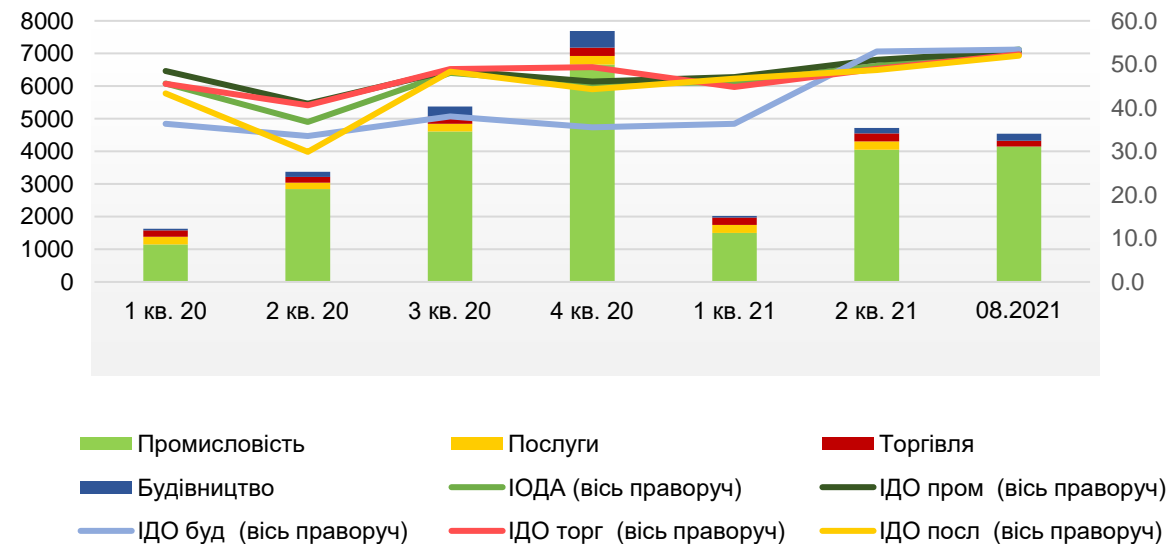


# The state of sentiment and business expectations of households and enterprises



A sharp decrease in household consumption in Q2. 2020 is primarily due to a decrease in income (purchase of goods and services decreased by 7% compared to the 2nd quarter of 2019). The first half of 2021 is characterized by the revival of the activity of individuals.

There is also a slight improvement in the index of consumer sentiment and the index of feasibility of large purchases, and therefore, the country's economy is gradually recovering from the consequences of the pandemic.



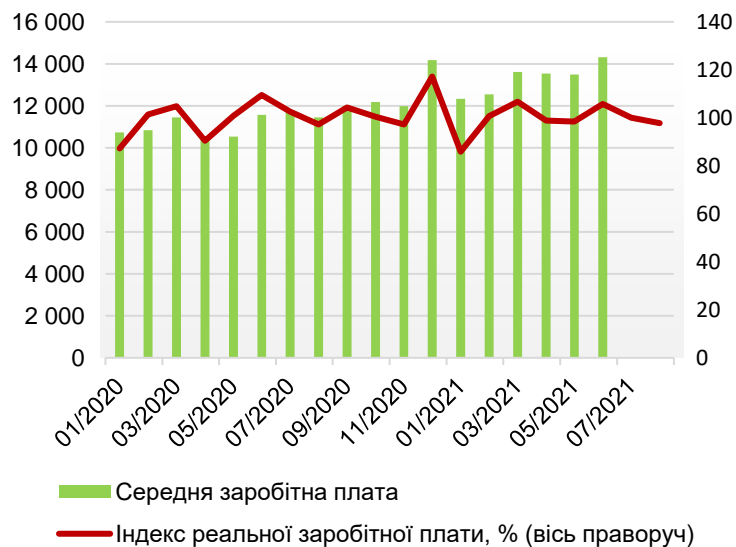
\*Індекс ділових очікувань (ІДО)



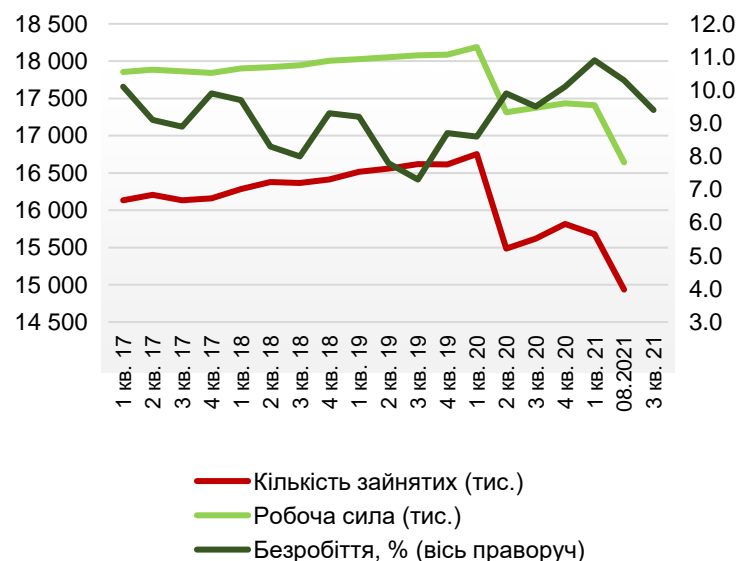
As a result of the increase in the price of raw materials and energy resources, the introduction of quarantine regulations during the first 2 quarters of 2020. and powerful outbreaks of the coronavirus at the beginning of 2021, production volumes in the country decreased significantly, but gradually enterprises adapted to the conditions of the pandemic, which led to an increase in the indicators of production and sales of products.

Currently, the sales of products in the industrial sector, construction and the service sector are expanding the most.

## Overview of the economic situation

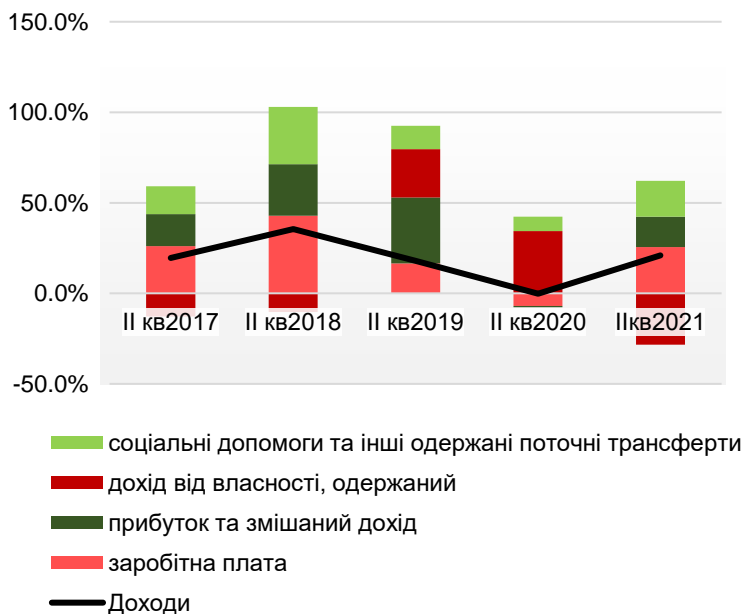
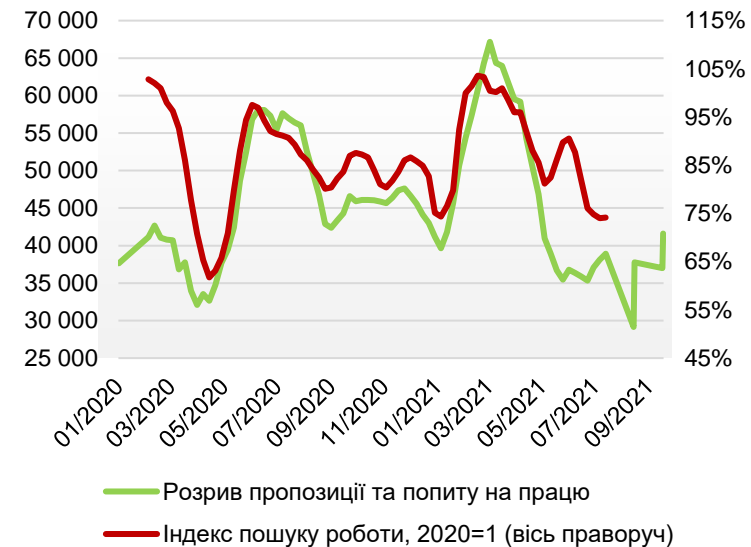


## Macroeconomic forecasting



## Forecast risks

## Macroeconomic policy



For the period from the 3rd quarter 2019 to the 1st quarter In 2021, the unemployment rate steadily increased in connection with the corona crisis (the decrease in economic activity and the financial security of enterprises led to a decrease in the demand for labor and a decrease in the level of the economically active population). In 2021 the situation is improving (decrease in the unemployment rate by 1 percentage point, increase in vacancies, increase in the population's activity in looking for work).

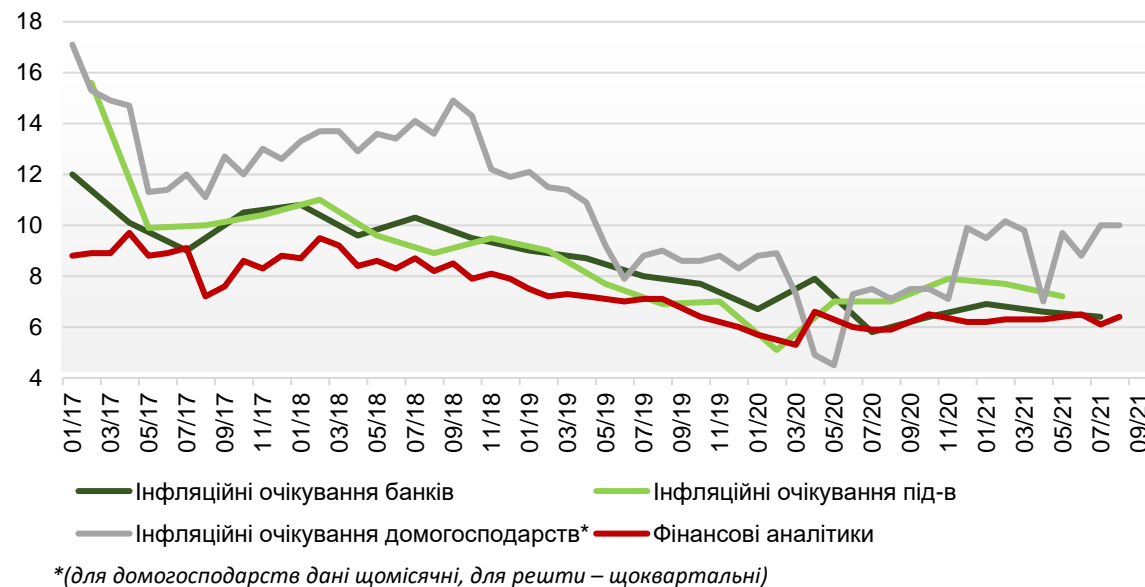
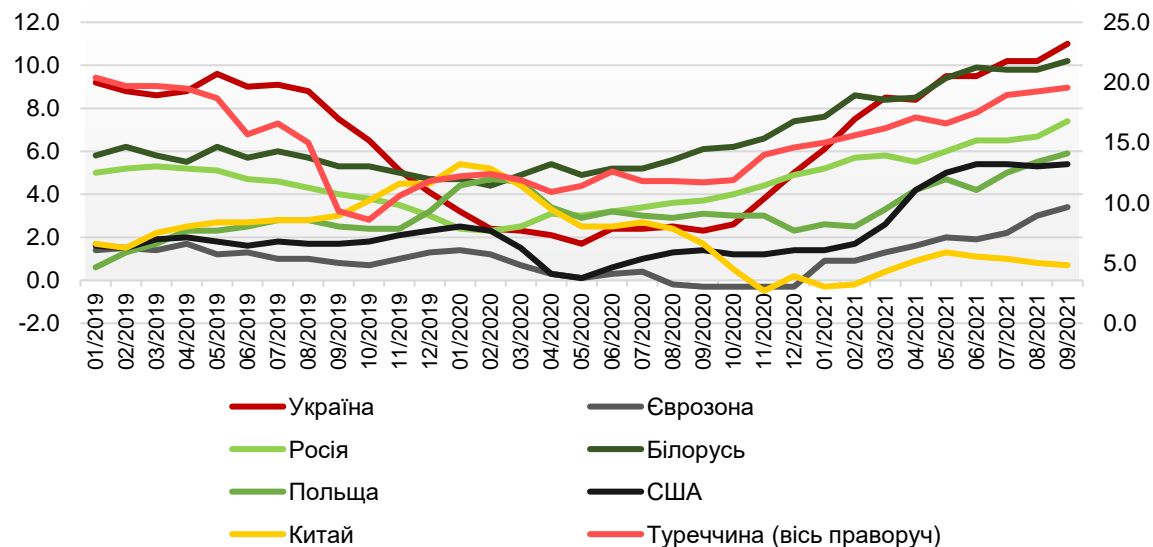


Incomes of the population for the period of 2020. - 2021 increased significantly (+24%), but real wages have worse indicators due to high inflation rates. It is worth noting that during the pandemic, the state's social payments became additional income. The growth of the nominal salary is caused by the growth of the minimum wage, the planned increase of wages in certain sectors of the economy in budget institutions, as well as the growth of payments to medical workers.



The majority of the population's income is made up of wages and social assistance.

# Inflation and inflation expectations



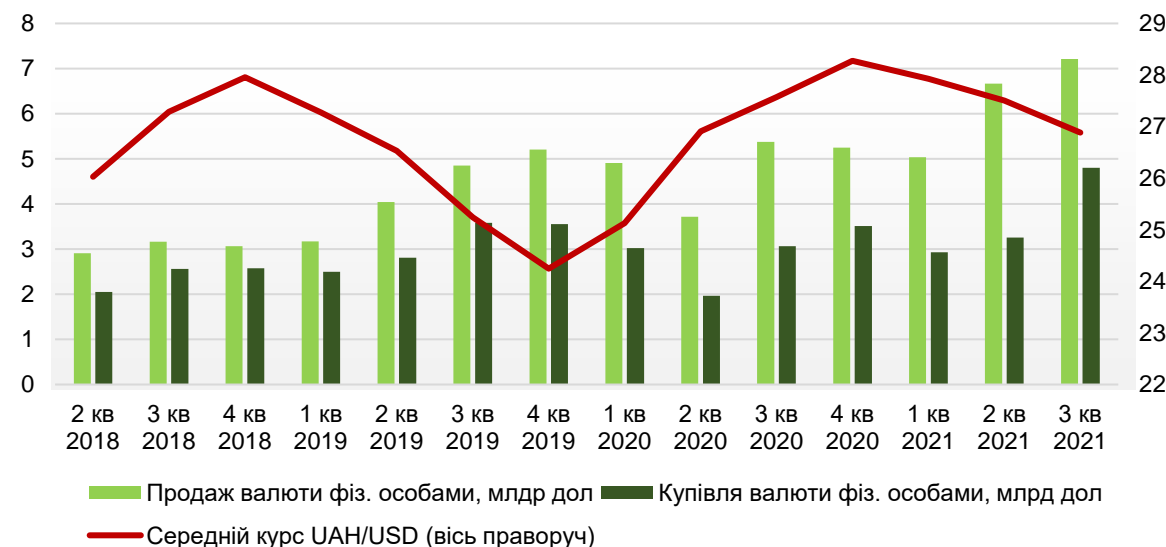
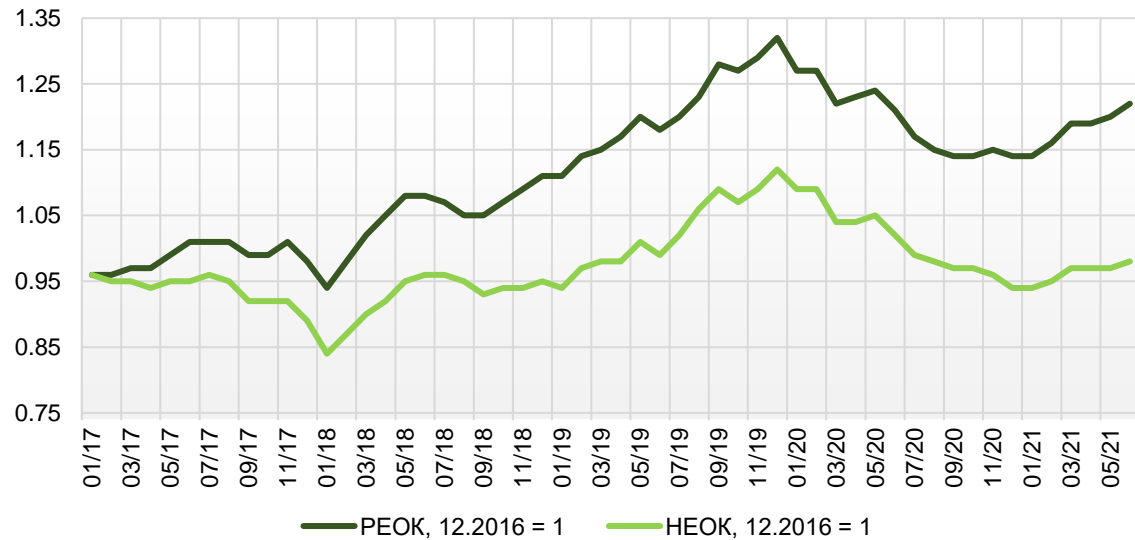
In Ukraine and its main counterparties, inflation steadily increased from 2020 to 2021. This is due to rising energy and food prices, damaged supply chains, limited supply and growing demand.



Currently in Ukraine, inflation expectations among economic entities are different (based on the analysis of data for 2020-2021, the trend of inflation expectations of banks is positive, while that of households, enterprises and financial analysts is negative).



# Exchange rate and foreign exchange market

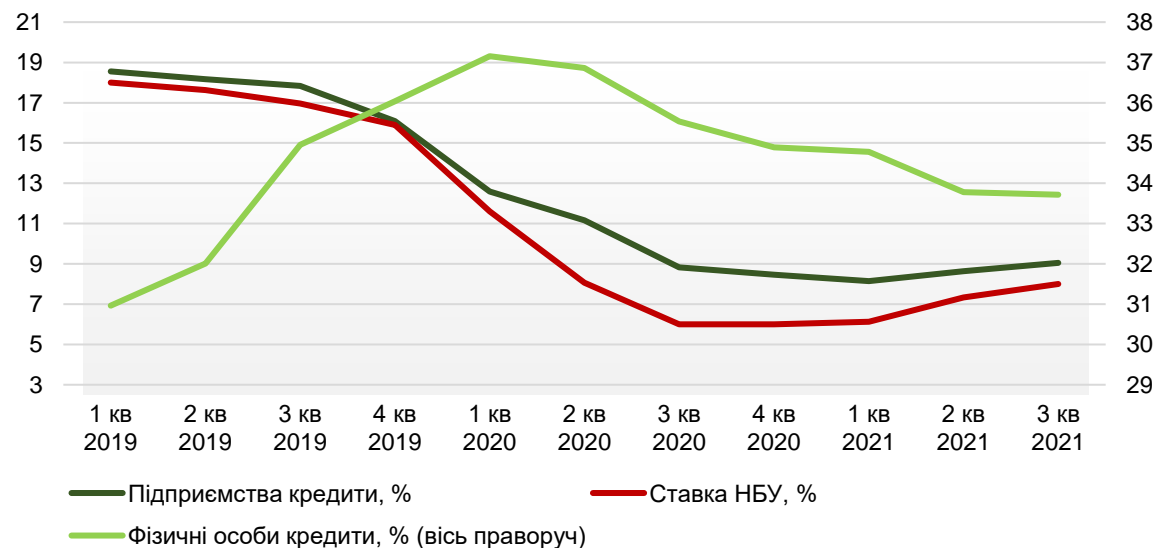


Since the beginning of 2021, there has been an increase in the real and nominal effective exchange rates (REOK and NEOC, respectively), from which it can be argued that the hryvnia is revaluation, and Ukrainian goods are becoming less competitive on the international market. In addition, there is a revival of transactions on the foreign exchange market from the 2nd quarter of 2021 - this applies to both the sale (+32%) and the purchase (+34%) of the currency.

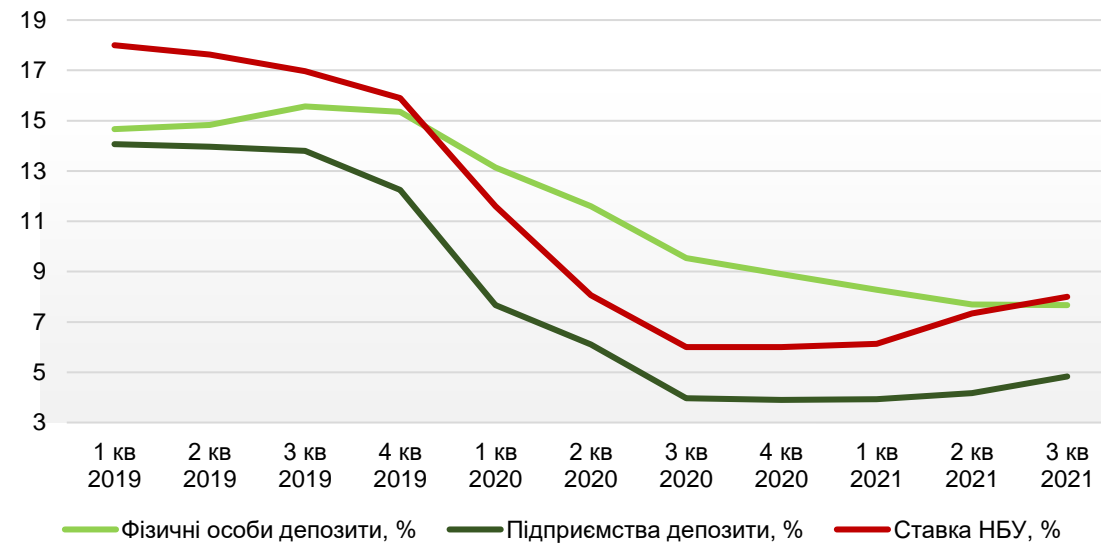


An increase in the sale of foreign currency is typical for the second half of the year (exporting companies exchange foreign currency earnings to pay taxes, which leads to a revaluation of the hryvnia). And the increase in purchase volumes is connected with the expectation of devaluation of the hryvnia in the future in order to obtain speculative profit.

# Dynamics of rates for loans and deposits



The lending rate depends on the size of the discount rate, so when the NBU applies a low discount rate in order to stimulate economic development, banks can also reduce the cost of loans. This leads to an increase in the volume of demand for loans, which serve as an additional source of financing for households and enterprises.



Deposit rates decreased due to a decrease in the discount rate in 2019-2020, and in 2021 the trend has changed. We also note that the inflow of household deposits has increased, which is due to the desire to receive additional income for the placement of temporarily free funds.

# Index of the economic situation based on the growth rate of indicators\* (base year - previous year)

Increases in indicators relative to the previous year are calculated, so the value of the index in the current year shows how much the situation has changed only relative to the previous year.

Table of percentage growth rates of indicators for calculating the economic situation index\*\*

Year	GDP	Unemployment	Inflation	Exchange Rate	Reserves	External Debt	Doing Business Rating (Position)	Corruption Index (Position)	Global Competitiveness Index (Position)
2010	16,14%	-8,37%	-5,62%	3,70%	30,45%	13,49%	-2,07%	9,09%	13,89%
2011	19,96%	-3,07%	-1,30%	-0,33%	-8,04%	7,58%	2,11%	-4,17%	8,54%
2012	7,74%	-4,11%	-6,84%	0,39%	-22,80%	6,99%	4,83%	13,04%	-7,87%
2013	4,28%	-4,77%	-0,80%	0,04%	-16,83%	5,19%	-9,87%	-3,85%	-10,98%
2014	-27,17%	29,29%	12,34%	0,00%	-63,10%	-11,10%	-18,25%	4,00%	15,07%
2015	-31,81%	-1,40%	32,68%	97,29%	76,55%	-6,00%	-14,29%	3,85%	-9,52%
2016	2,55%	2,30%	-23,39%	51,89%	16,84%	-4,39%	-13,54%	7,41%	3,95%
2017	20,17%	1,60%	0,46%	9,75%	21,04%	2,70%	-3,61%	3,45%	12,66%
2018	16,68%	-7,37%	-3,05%	6,10%	10,70%	-1,60%	-5,00%	6,67%	-6,74%
2019	17,59%	-6,88%	-2,76%	1,36%	21,53%	6,13%	-6,58%	-6,25%	2,41%
2020	1,07%	15,69%	-6,20%	0,34%	15,14%	3,25%	-9,86%	5,56%	0,78%
2021	5,79%	-1,90%	-10,24%	-7,13%	-1,47%	-0,33%	0,00%	-4,04%	-1,30%

The value of the economic situation index in 2010-2020.

Part of the index calculation code

Pik	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
IEC	3	3	3	4	3	5	2	3	3	6	2	2

```
SCORE=IF(GDP>12%;1)+IF(UNEMPL.<5%;1)+
+IF((INF^<-1%)*AND(INF<103);1;0)+IF(COURSE<3%;1)+
+IF(RESERVE>20%;1)+IF(EXT.DEBT<-5%;1)+
+IF(I.D.B.<-5%;1;0)+IF(I.COR<-5%;1)+IF(I.COM<-5%;1;0) 14
```

\* Розроблено авторами

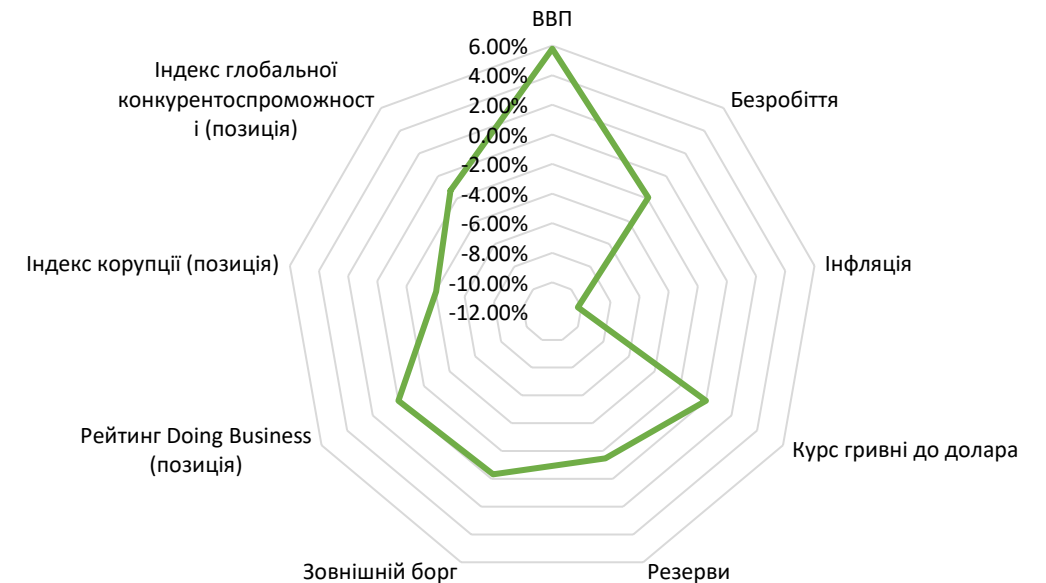
\*\*Через відсутність частини опублікованих даних позиція України за індексами (7-9) розраховувалася на основі середнього плинного за три роки; значення макроекономічних показників як середньозважені (припускається, що тенденції не зміняться)



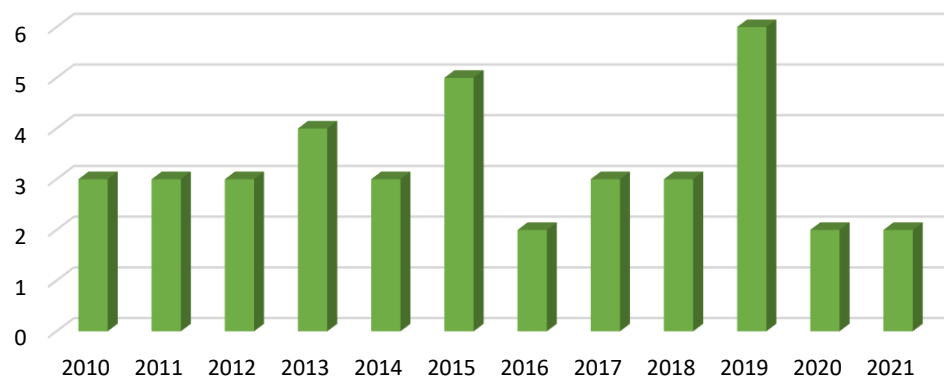
# Index of the economic situation based on growth rates of indicators (base year - previous year)

The value of the economic situation index for each indicator in 2021

Indicators	Value in 2021	Benchmark
GDP	5,79%	>12%
Unemployment	-1,90%	<5%
Inflation	-10,24%	<-1%
Exchange Rate (Hryvnia to Dollar)	0,00%	<3%
Reserves	-1,47%	>20%
External Debt	-0,33%	<-5%
Doing Business Rating (Position)	0,00%	<-5%
Corruption Index (Position)	-4,04%	<-5%
Global Competitiveness Index (Position)	-1,30%	<-5%



Dynamics of the economic situation index in 2010-2021.



According to the economic situation index, Ukraine's score in 2021 is 2 (maximum 9).

# Index of the economic situation based on growth rates of indicators (base year – 2010)

Table of percentage growth rates of indicators for calculating the index of the economic situation

Year	GDP	Unemployment	Inflation	Exchange Rate	Reserves	External Debt	Doing Business Rating (Position)	Corruption Index (Position)	Global Competitiveness Index (Position)
2010	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
2011	19,96%	-3,07%	-1,30%	-0,33%	-8,04%	7,58%	2,11%	-4,17%	8,54%
2012	29,24%	-7,05%	-8,05%	0,06%	-29,01%	15,10%	7,04%	8,33%	0,00%
2013	34,77%	-11,48%	-8,79%	0,10%	-40,95%	21,08%	-3,52%	4,17%	-10,98%
2014	-1,85%	14,44%	2,47%	0,10%	-78,21%	7,64%	-21,13%	8,33%	2,44%
2015	-33,07%	12,84%	35,96%	97,48%	-61,53%	1,18%	-32,39%	12,50%	-7,32%
2016	-31,36%	15,43%	4,15%	199,95%	-55,06%	-3,26%	-41,55%	20,83%	-3,66%
2017	-17,52%	17,28%	4,63%	229,20%	-45,60%	-0,65%	-43,66%	25,00%	8,54%
2018	-3,76%	8,63%	1,44%	249,29%	-39,78%	-2,24%	-46,48%	33,33%	1,22%
2019	13,17%	1,17%	-1,36%	254,04%	-26,82%	3,75%	-50,00%	25,00%	3,66%
2020	14,39%	17,04%	3,08%	255,23%	-15,74%	7,11%	-54,93%	37,50%	4,47%
2021	21,01%	14,81%	-7,47%	229,89%	-16,98%	6,76%	-54,93%	31,94%	3,12%

The value of the economic situation index in 2010-2021.

PiK	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
IEC	2	3	3	5	2	2	1	1	1	3	2	2

Part of the index calculation code

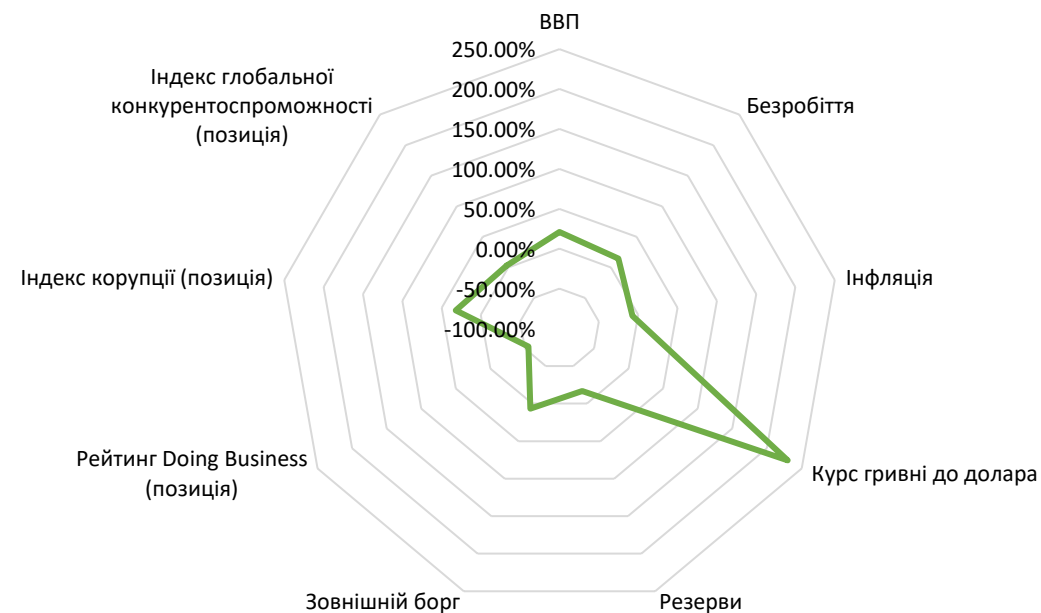
```
SCORE=IF(GDP>12%;1)+IF(UNEMPL<0%;1)+
+IF((INF^<1%)*AND(INF<103);1;0)+IF(COURSE<3%;1)+
+IF(RESERVE>5%;1)+IF(EXT.DEBT<0%;1)+
+IF(I.D.B<-1%;1;0)+IF(I.COR<-1%;1)+IF(I.COM<-1%;1;0)
```

\* Due to the lack of part of the published data, the position of Ukraine according to indices (7-9) was calculated on the basis of the rolling average for three years; values of macroeconomic indicators as weighted averages (it is assumed that the trends will not change)

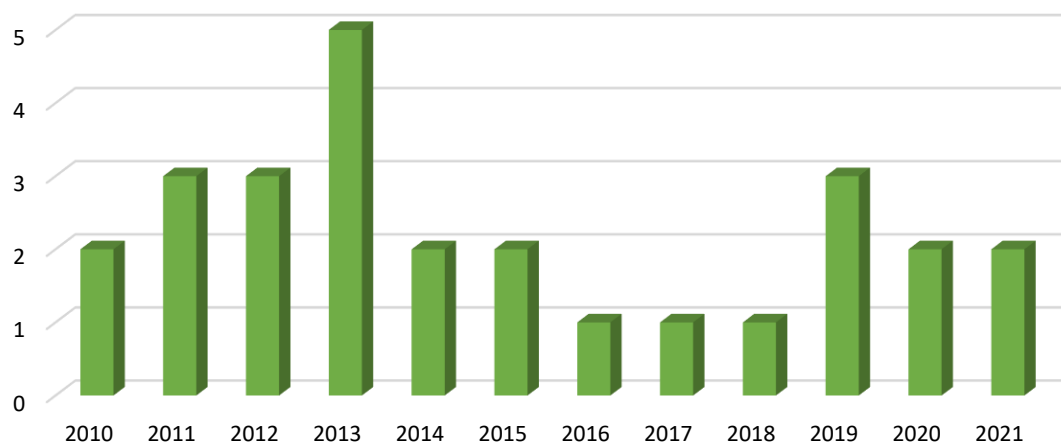
# Index of the economic situation based on growth rates of indicators (base year – 2010)

The value of the economic situation index for each indicator in 2021

Indicators	Value in 2021	Benchmark
GDP	21.01%	>12%
Unemployment	14.81%	<5%
Inflation	-7.47%	<-1%
Exchange Rate (Hryvnia to Dollar)	229.89%	<3%
Reserves	-16.98%	>20%
External Debt	6.76%	<-5%
Doing Business Rating (Position)	-54.93%	<-5%
Corruption Index (Position)	31.94%	<-5%
Global Competitiveness Index (Position)	3.12%	<-5%



Dynamics of the economic situation index in 2010-2021.



According to this index of the economic situation, Ukraine's score in 2021 is 2 (maximum 9). The best economic situation in 2013 (5 points)



# Stages of building macroeconomic models

- 1 • Selection of the form of equations
- 2 • Formation of statistical data
- 3 • Checking data for trends, seasonality, residuals (STL method)
- 4 • Formation of forecast of auxiliary parameters
- 5 • Derivation of models and forecasting
- 6 • Interpretation of results

*The R environment was used to implement the models*



# General view of the modified Phillips equation\*

$$\pi_t = \alpha_1 \pi_{t-1} + \alpha_2 \pi_t^{tr} + \alpha_3 peer_t + \alpha_4 \pi_t^{exp.bank} + \alpha_5 \pi_t^{exp.bus} + \alpha_6 \pi_t^{exp.hous} + \alpha_7 \pi_t^{exp.fin} + \alpha_8 Y_t^{gap} + \varepsilon_t^\pi$$

$\pi_t$  – the current inflation rate

$\pi_{t-1}$  – inflation of the previous quarter

$\pi_t^{tr}$  - inflation of major trading partner countries

$peer_t$  - the real effective exchange rate

$\pi_t^{exp.fin}$  - inflation expectations of financial experts

$\pi_t^{exp.bank}$  - NBU inflation expectations

$\pi_t^{exp.bus}$  - expectation of business inflation

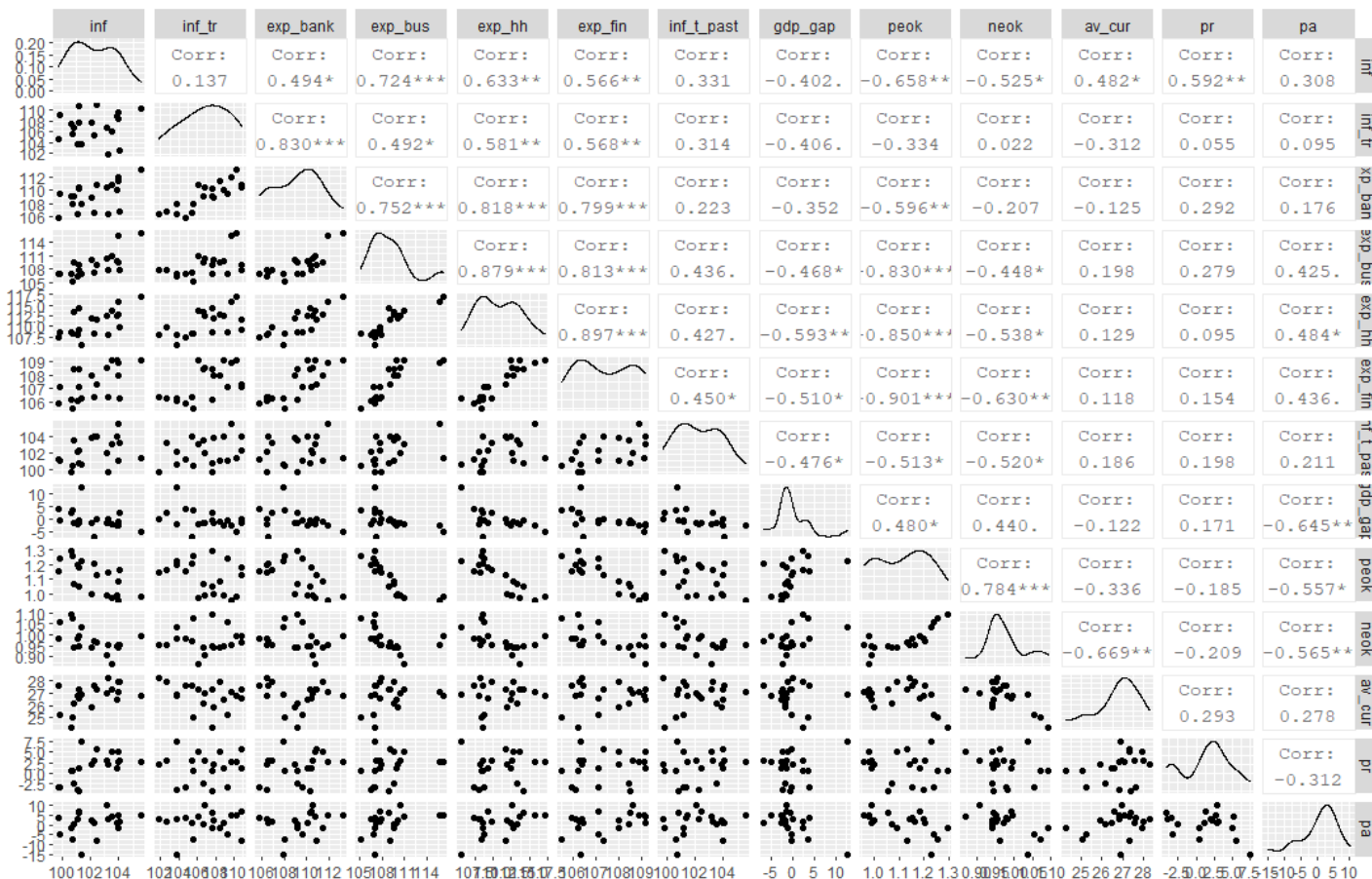
$\pi_t^{exp.hous}$  - household inflation expectations

$Y_t^{gap}$  - GDP gap

$\varepsilon_t^\pi$  - random disturbance

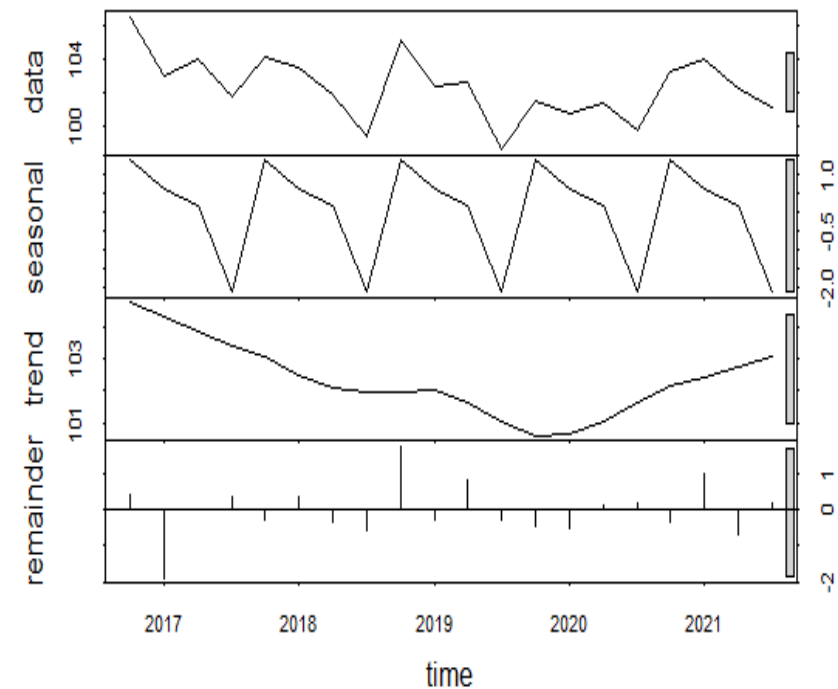
\* modified by the team based on information from scientific sources and econometric analysis

# Dependence of variables Phillips rule



The degree of linear dependence of individual indicators was determined and the inclusion of variables in the model was modified based on the result of the form of dependence.

# STL method



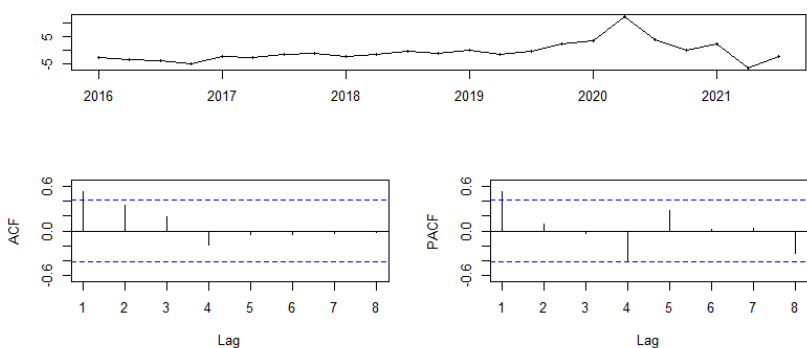
The quarterly inflation rate is characterized by seasonality and the presence of a changing trend.



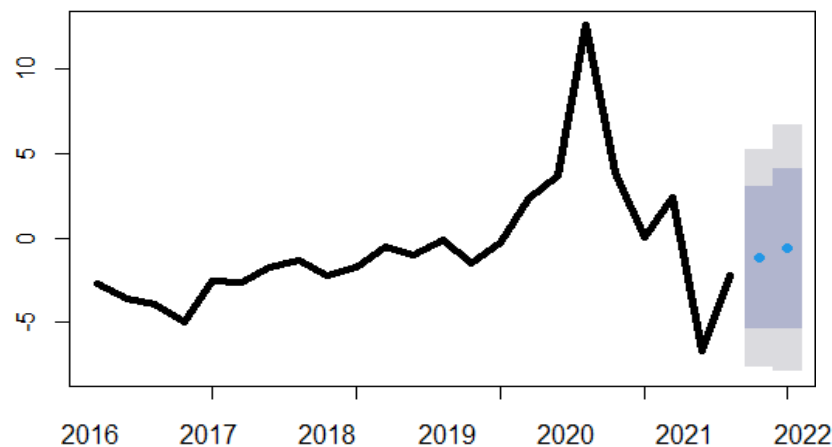
# Forecast of individual indicators for the Phillips rule by ARIMA

## *GDP gap*

gdp\_gap.ts

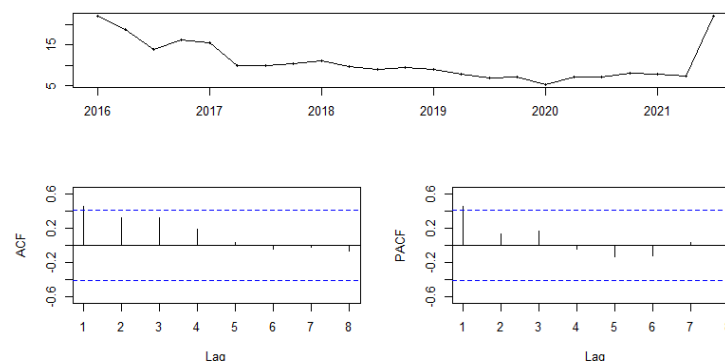


Forecasts from ARIMA(1,0,0) with zero mean

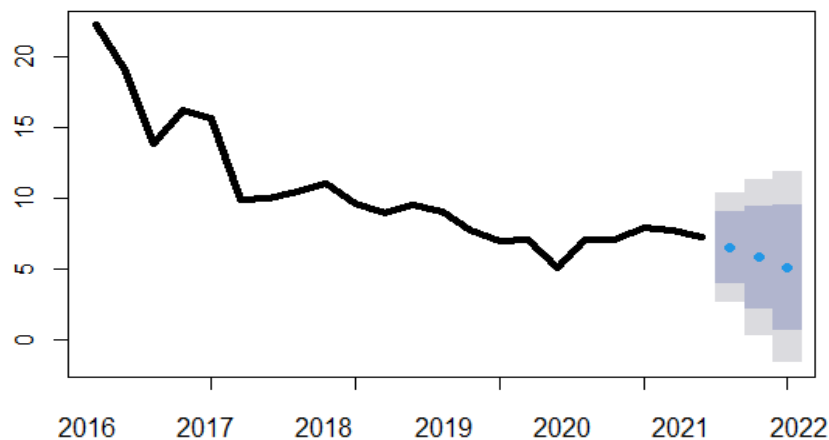


## *Business expectation*

exp\_bus.ts

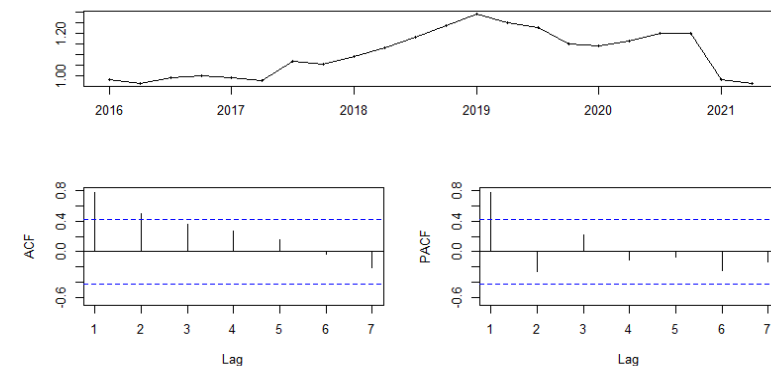


Forecasts from ARIMA(0,1,0) with drift

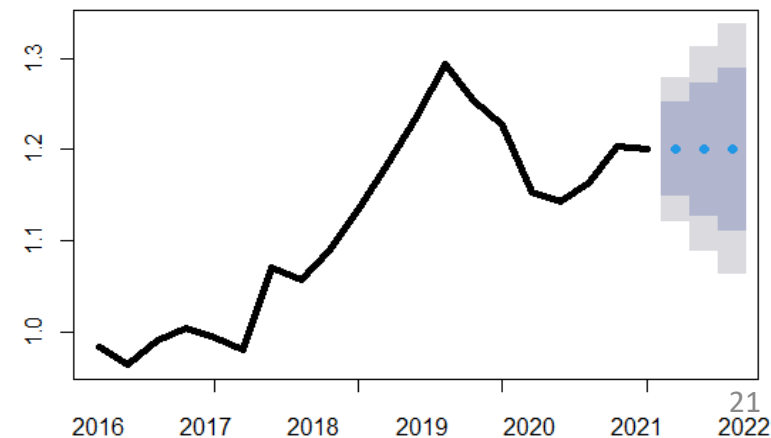


## *PEOK*

peok.ts



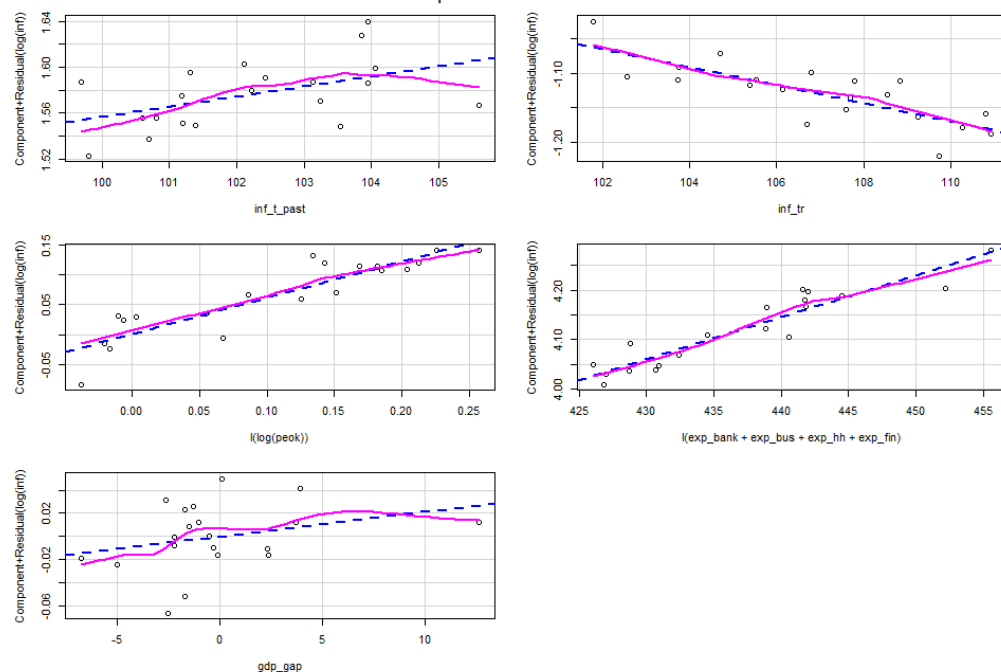
Forecasts from ARIMA(0,1,0)



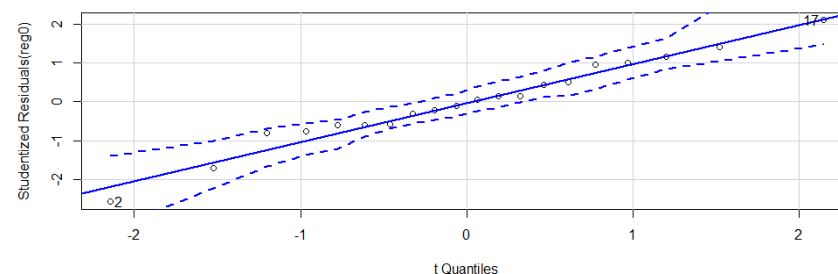
# Phillips model

$$\ln(\pi_t) = 0.0154\pi_{t-1} - 0.0106\pi_t^{tr} + 0.6092\ln(peer_t) + \\ + 0.0094 \left( \pi_t^{exp.bank} + \pi_t^{exp.bus} + \pi_t^{exp.hous} + \pi_t^{exp.fin} \right) + 0.0021Y_t^{gap}$$

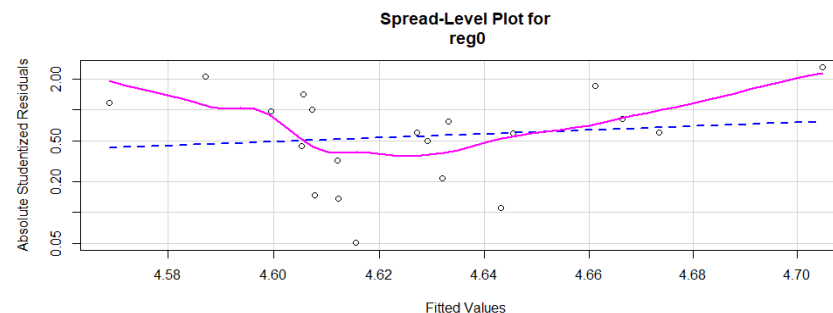
Component + Residual Plots



*There are linear and non-linear relationships of variables*



*There are no abnormal values*



*The remains have a parallelogram shape*

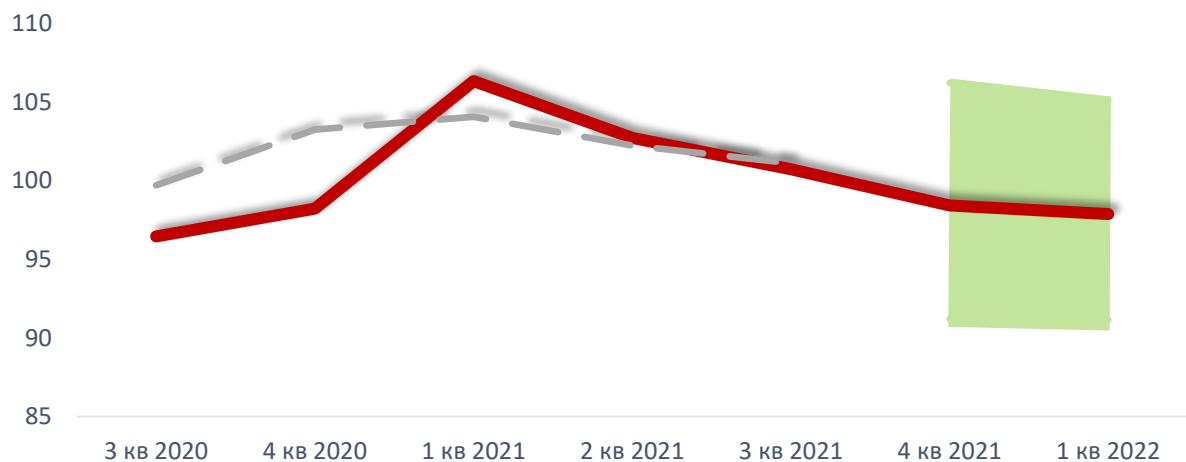
RESET test

data: reg0  
RESET = 44.565, df1 = 2, df2 = 13, p-value = 1.518e-06

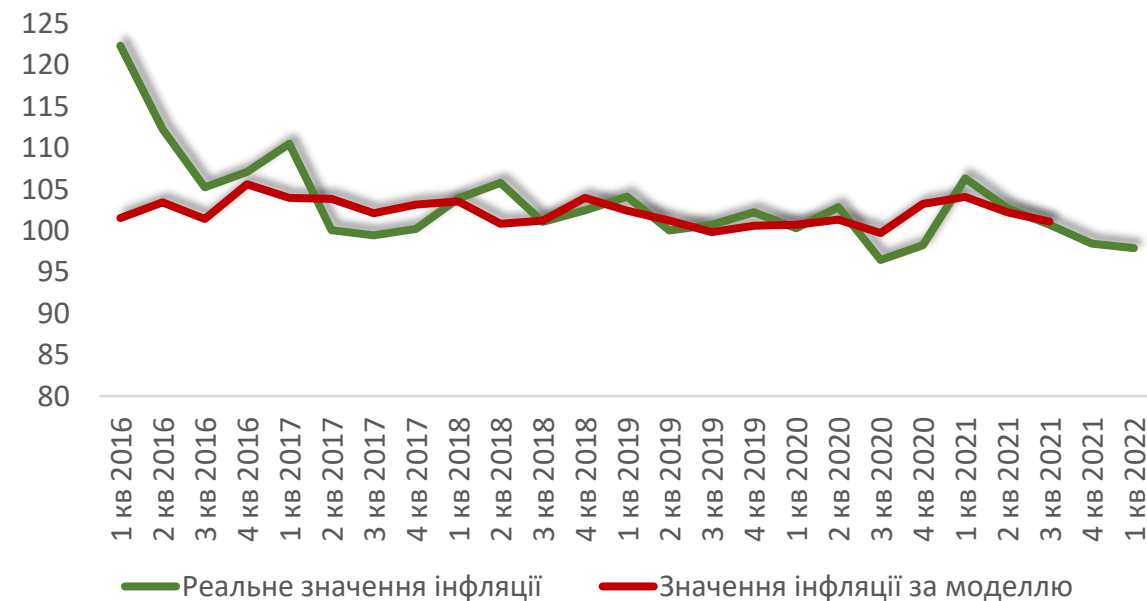
*According to the Ramsey test, there are no missing variables in the model with a significance level of more than*

# Forecast of the value of inflation

Period	Point value of inflation	The lower limit of inflation	The upper limit of inflation
Q4 2021	98.4259	91.2227	106.1978
Q1 2022	97.8768	91.1482	105.1021



Прогнозні межі інфляції за моделлю    Інфляція за моделлю    Реальне значення інфляції



*The percentage growth of inflation depends on the nominal values of inflation of the previous quarter, the inflation of trading partners, the percentage growth of the real effective exchange rate, the sum of inflation expectations of the subjects and the GDP gap.*

# General view of the modified Taylor rule\*

$$i_t = \beta_1 i_{t-1} + \beta_2 r_t + \beta_3 (\pi_{t+1} + \pi_{t+1}^{targ}) + \beta_4 Y_t^{gap} + \varepsilon_t^i$$

$i_{t-1}$  - the retrospective interest rate

$r_t$  - the real discount rate

$\pi_{t+1}$  - inflation forecast for the next quarter

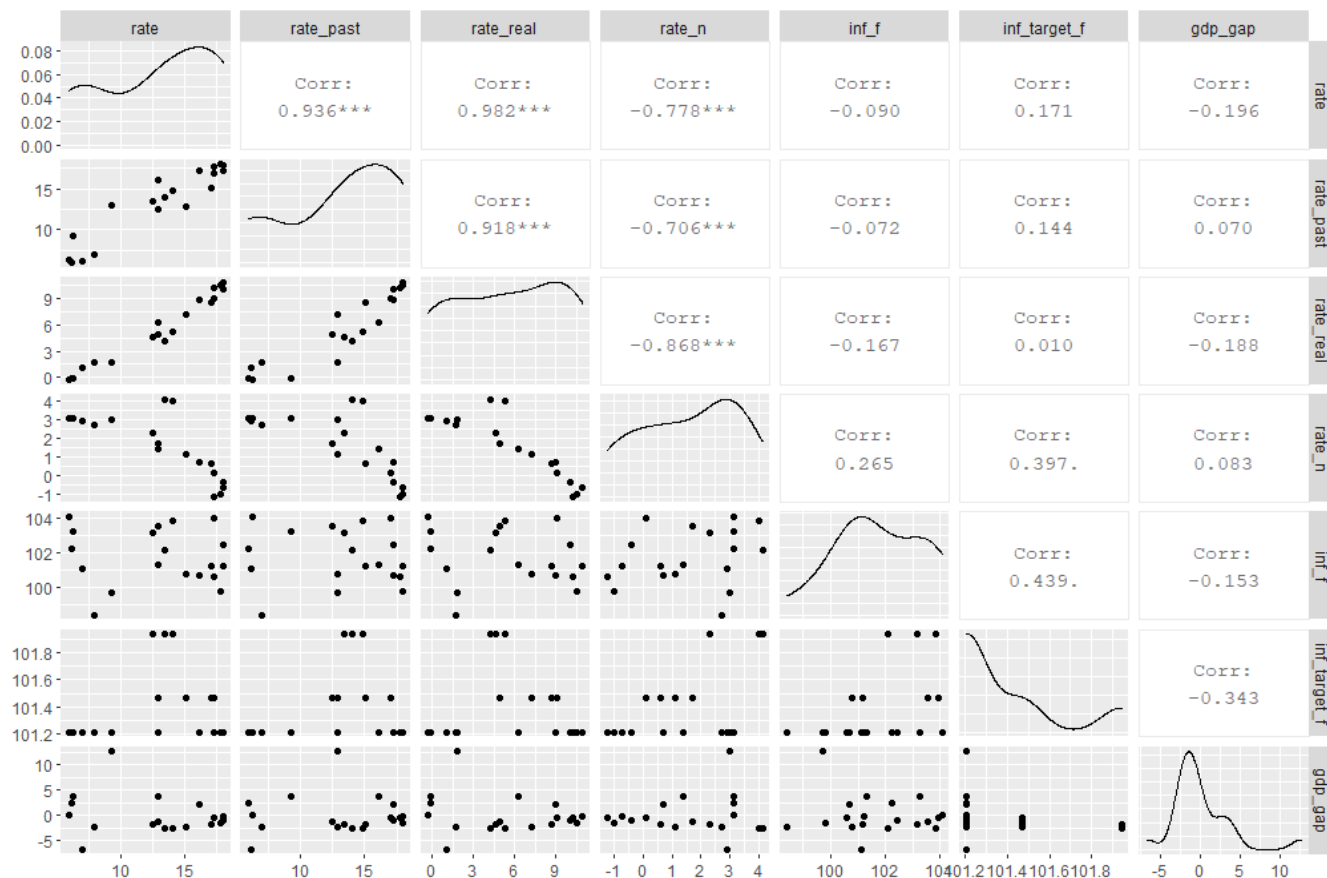
$\pi_{t+1}^{targ}$  - inflation target for the next quarter

$Y_t^{gap}$  - GDP gap

$\varepsilon_t^i$  - a random disturbance

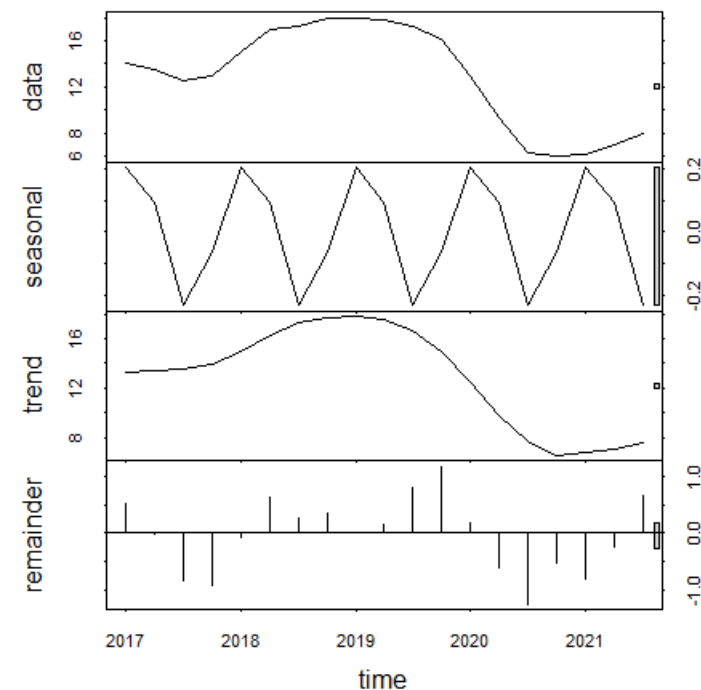
\* modified by the team based on information from scientific sources and econometric analysis

# Dependence of Taylor rule variables



The degree of linear dependence of individual indicators was determined and the inclusion of variables in the model was modified based on the result of the form of dependence.

# STL method

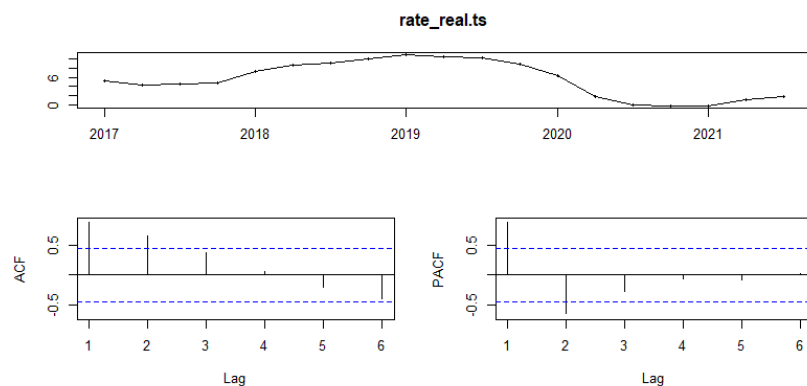


Seasonality and the presence of a trend are characteristic of the indicator of the accounting rate for the quarter.

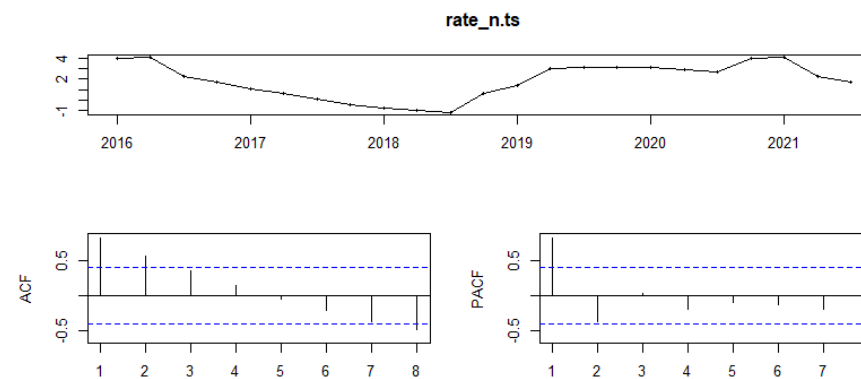


# Forecast of individual indicators for the Taylor rule by ARIMA

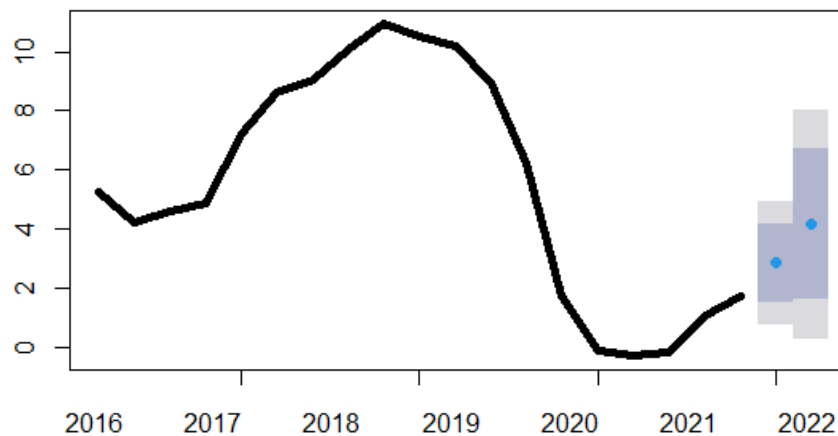
## *Real discount rate*



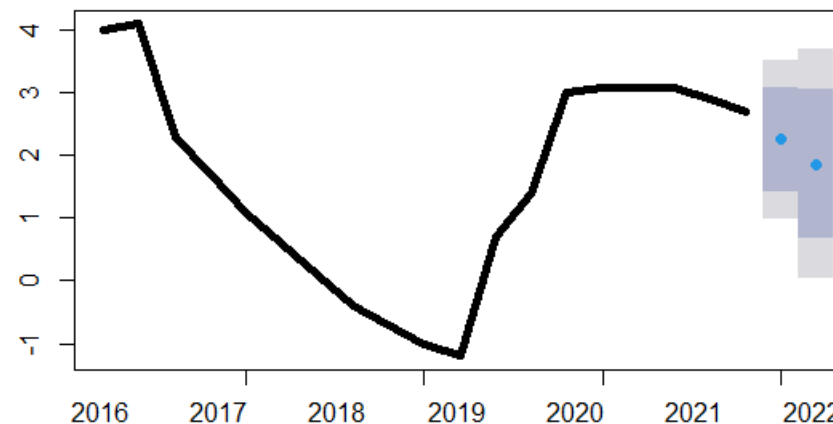
## *Neutral discount rate*



Forecasts from ARIMA(2,0,0) with non-zero mean



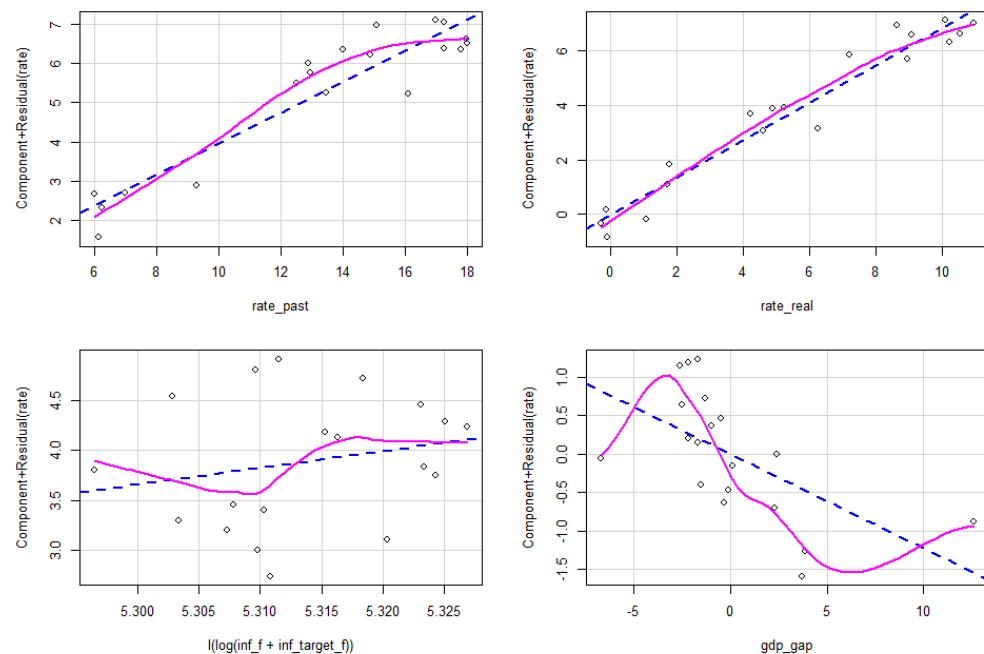
Forecasts from ARIMA(3,0,0) with non-zero mean



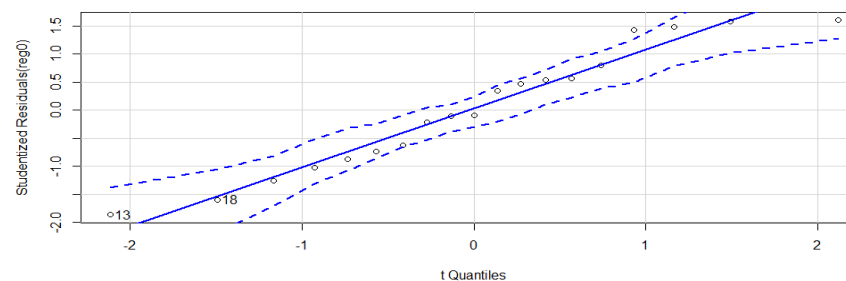
# Taylor's model

$$i_t = 0.3952_1 i_{t-1} + 0.6847 r_t + 0.7313 \ln(\pi_{t+1} + \pi_{t+1}^{targ}) - 0.1222 Y_t^{gap}$$

Component + Residual Plots

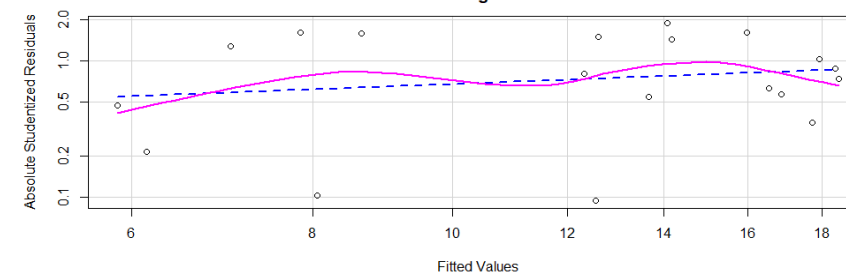


There are linear and non-linear relationships of variables



There are no abnormal values

Spread-Level Plot for reg0



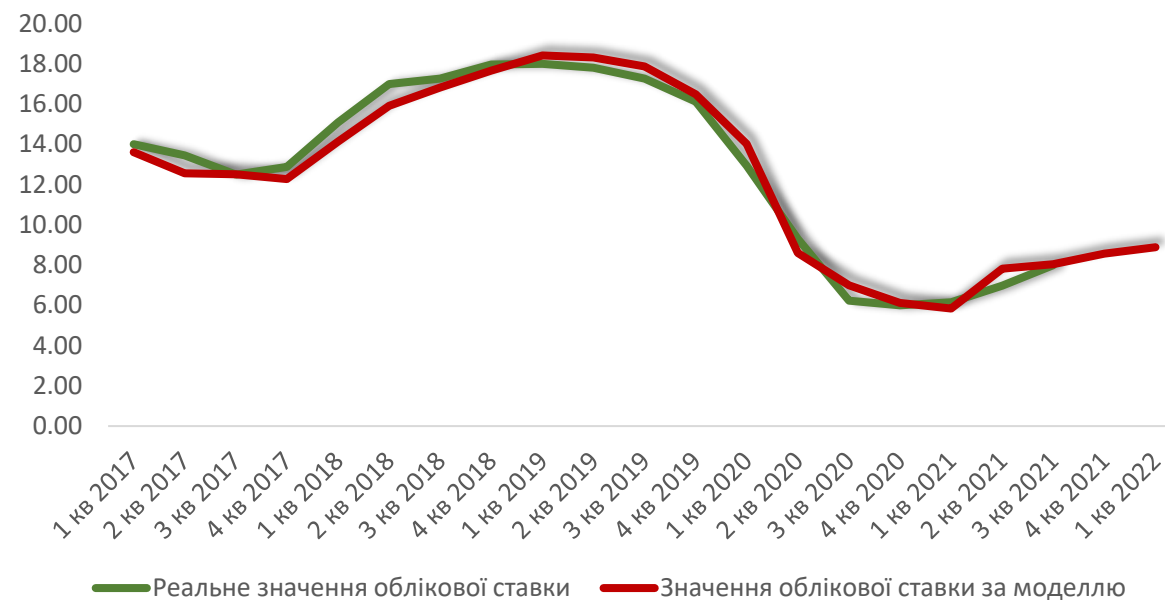
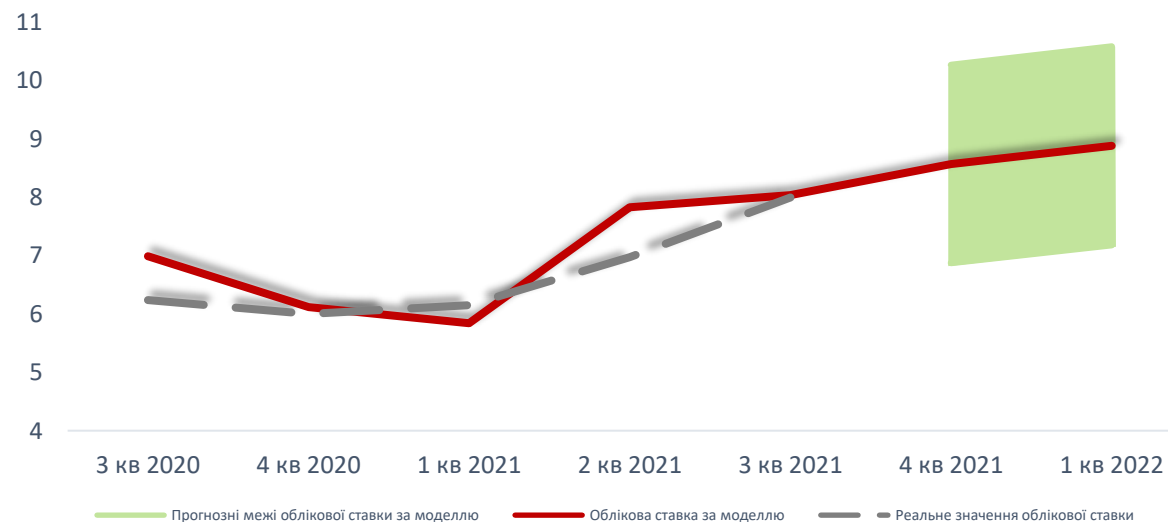
The residuals have a non-linear form

```
data: reg1
RESET = 2.4118, df1 = 2, df2 = 13, p-value = 0.1286
```

According to the Ramsey test, there are no missing variables in the model with a significance level of more than 87%

# Forecast of the value of the discount rate

Period	Point value of discount rate	The lower limit of discount rate	The upper limit of discount rate
Q4 2021	8.5687	6.8740	10.2634
Q1 2022	8.8798	7.1798	10.5798



The value of the discount rate depends on the value of the discount rate of the previous quarter, the real discount rate, the percentage change in the projected inflation and the inflation target, the GDP gap.



# MOTIVES AND PREREQUISITES FOR THE IMPLEMENTATION OF EACH ACTION OPTION



## Do not change the discount rate

- **Containment of negative effects due to the increase in the discount rate in the past quarters**
- Slowing down of high inflation in trading partner countries
- Investors are interested because they will see the effectiveness of the causes and results of the NBU's actions (the NBU remains a pillar of stability, in particular due to the consistent implementation of its policies)
- Avoiding conflicting effects on the economy in the medium term



## Increase in the discount rate

- Inflation is increasing and deviating from the target
- Maintaining a high level of prices on world commodity markets
- An increase in the production costs of enterprises for raw materials and the wage fund
- To avoid the negative effects of a decrease in real wages



## Reduction of the discount rate

- Banks, whose lending offer will increase, and households, whose demand will increase, are interested



# MONETARY POLICY DECISION PROPOSAL

The model calculates the average value of the discount rate for the quarter. Since the average value of the discount rate for the 3rd quarter of 2021 is 7.9% (weighted by days), the recommendation of the model is to *increase the average value in In the 4th quarter of 2021, the discount rate will be up to 8.5%.*



On September 10, 2021, the discount rate was increased to 8.5%. **Accordingly, the proposal is to maintain the discount rate at the level of 8.5% throughout the Q4 2021.** However, at the end of the 1st quarter of 2022 the recommendation is to maintain the policy of "expensive money": increase the discount rate to 9% to ensure an average value for the quarter at the approximate level of 8.88%.



Thus, in the 4th quarter of 2021, the money supply will decrease and the economy will be restrained due to the actions of the previous quarters, as a result of which inflation will approach and be restrained within the target.

# ALTERNATIVE TOOLS OF MONETARY POLICY IN UKRAINE



## *Helicopter money*

- Purchase of corporate domestic bonds

*Only for "cheap money" policies*



## *Mechanisms with credit institutions*

- Provision of regular refinancing
- Mechanisms that allow credit institutions to deal with end-of-day balances to mitigate temporary fluctuations in liquidity
- Transfer of banks' overtime reserves to NBU correspondent accounts for deposits (will allow maintaining high liquidity of the banking system)





Thank you for the attention!

