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The Inflation and Unemployment Processes During and After the COVID-19 Pandemic



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Abstract. The article considers the features of the dynamics of the main macroeconomic indicators in related developing economies during the economic crisis and after it. Latin American countries (2020–2022) are the object of the study. The aim of the work is to empirically verify the presence and closeness of significant relationships between the processes of inflation and unemployment, including the possibility of taking into account other macroeconomic variables affecting the processes of inflation and unemployment during and after the COVID-19 pandemic. The relevance of the study is determined by the possibility of monitoring the development of the economic crisis. The analysis of linear regressions on pseudo-panel data was carried out. The general model took into account the size and features of the economy, economic policy, as well as some social effects (the dynamics of unemployment and inflation, specific mortality due to coronavirus, the size of the labor resources for the economy). The models constructed help to study the general crisis dynamics and show the rate of recovery for the trends. The novelty of the results includes an assessment of the effectiveness of management tools in the context of strong external shocks. It is empirically confirmed that there was no direct relationship between the processes of inflation and unemployment in Latin American countries during the period under consideration. A detailed analysis of the impact of macroeconomic factors and factors reflecting the behavior of state institutions may be useful for considering the risks of anti-crisis measures. Inflation is the most controllable process that can be influenced by tools. Unemployment, as a subject of regulation, is a more complex process involving various state institutions; at that, the success of decisions depends mainly on taking into account the country's export specialization, the pace and severity of anti-crisis measures.

Key words: inflation, unemployment, crisis, COVID-19, macroeconomics, behavior, finance, modeling, regulation.

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Introduction

In our opinion, the relevance of the research is conditioned by three interrelated factors, which can be designated as temporal, socio-political and scientific-theoretical. Unprecedented in its depth and catastrophic for the world economic system, the crisis associated with the consequences of the COVID-19 pandemic differs from previous ones in that it is not a purely economic crisis, but rather the result of active intervention in economic processes by state institutions (Mau, 2022). The experiences of different countries ranged from “pouring money” policies to “containing inflation and preventing unemployment” (Ohchr, Ocha, 2023). In the above context, we have articulated the need to empirically test the rationale of economic policies, typically relying on Phillips' assumption that there is a trade-off between inflation and unemployment that can be used to reduce unemployment (Phillips, 1958). The validity of policies to curb inflation is criticized in times of severe crises, the main risks of which are often cited as rising unemployment.

The World Bank in its Global Economic Report 2021 pointed out that the world economy is experiencing an exceptionally strong but highly

uneven post-crisis recovery¹. The reasoning that the economic shock caused by the spread of COVID-19 and the announced lockdowns brought many industries to a halt, disrupted supply chains, and shifted the global economy to a new employment model has been confirmed by authoritative studies both for the world as a whole and in terms of specific countries and regions (Takes, 2020). In order to maintain population and working capacity of economies, governments increased budget expenditures, removed a number of restrictions for monetary policy, which caused an increase in inflation in 2021 around the world (Bratersky, 2022).

There is an ongoing debate about how adequate the strongest restrictive and paternalistic measures have been and what their long-term effects have been. On the one hand, there is convincing evidence that coronavirus mortality rates are declining under strong restrictions, and it justifies any economic sacrifice by national governments. On the other hand, World Health Organization (WHO) reports and publications have indicated that excess mortality in developing and economically weak countries has more to do with restrictions for a variety of social, economic, and health reasons than with the coronavirus itself. Twenty countries, representing approximately half the world's population, account for more than 80% of the estimated global excess mortality in the two years after January 2021. The first 15 are Brazil, Colombia, Egypt, Germany, India, Indonesia, Iran, Italy, Mexico, Nigeria, Pakistan, Peru, the Philippines, Poland, and Russia². Moreover, the WHO referred the countries of Latin America to the most affected ones. According to E.G. Ermolieva,

mass spread of infection and high mortality rates from COVID-19 in Latin American countries were caused by slow reaction of the authorities, especially in the first epidemic wave, underestimation of the disease risk, weakness of national health systems (Ermolieva, 2021).

Research problematic

Based on the above, we formulate the aim of the research – to empirically test the presence and closeness of significant relationships between the processes of inflation and unemployment, including the possibility of accounting for other macroeconomic variables affecting the processes of inflation and unemployment, during and after the pandemic COVID-19.

In accordance with the aim, the research problems are related to:

(1) the analysis of theory and empirically testing of the possible relationships between the processes of inflation and unemployment in a real economic system, which is exposed to crises;

(2) the identification of the drivers affecting the processes of inflation and unemployment, taking into account the features of economic development and socio-economic policy of state institutions in the context of the overall crisis dynamics;

(3) the choice of the research object – twelve Latin American countries, characterized by a great variety of approaches to macroeconomic and financial policies, especially in times of crisis; the justification of possible theoretical and empirical comparisons of the identified trends with other national economic systems, such as Russia.

We consider these relationships using twelve Latin American countries as examples. Choosing the research region is conditioned by a number of general and specific factors. First, these are developing countries with a high degree of interconnectedness of their economies and a strong influence of the large economy (USA) (Tolmachev, Nikiforova, 2021). Second, Latin American countries are characterized by the social

¹ World Bank. (2021, June). Global economic prospects [World Bank Group Flagship Report]. Available at: <https://thedocs.worldbank.org/en/doc/600223300a3685fe68016a484ee867fb-0350012021/original/Global-Economic-Prospect-2021.pdf> (accessed: April 5, 2023).

² Available at: <https://www.who.int/data/stories/global-excess-deaths-associated-with-covid-19-january-2020-december-2021> (accessed: April 5, 2023).

and economic interconnectedness of national economies against the background of a great variety of approaches to macroeconomic and financial policies, especially in times of crisis. In addition, Latin American countries have specific trade specializations, which allows classifying the effects of the crisis depending on the countries' position in the global specialization of labor.

Unemployment, as one of the macroeconomic indicators, belongs to the sphere of regulation on the part of government institutions related to the Ministry of Labor, the Ministry of Finance (represented by tax authorities), and sectoral ministries. When we talk about inflation, this is a group of indicators, which belong to the sphere of regulation by the institutions of the monetary system, with the main functional role of the regulator belonging to the central bank of the country (Central Bank). From the position of tasks of state management of the national economy, the financial system institutions and the monetary system institutions are in constant conflict of interests. The practice of the world economy knows various examples of optimal accounting of these interests, for example, the practice of weekly closed-door meetings of heads of the Ministry of Finance and the Central Bank of Japan.

We chose the following Latin American countries as the object of our research: Argentina (ARG), Brazil (BRA), Guatemala (GUA), the Dominican Republic (DR), Colombia (COL), Costa Rica (CR), Mexico (MEX), Panama (PAN), Peru (PER), Uruguay (URU), Chile (CHI), and Ecuador (ECV). The symbols are applied to Figures 1–4 and later in the text. We excluded Venezuela from the sample due to strong data outliers. The island states differ significantly from continental Latin America, both in size and type of economy, so we did not consider them in the analysis.

To achieve this goal, we built models of the relationship between the behavior of basic macroeconomic indicators (inflation and unemployment),

taking into account the economy's specialization and the current conjuncture in the development of crisis processes in the world economy. The novelty of this formulation of the problem is determined, first, by taking into account export specialization, and second, by expanding the sample of related developing economies in the crisis period from 2020 to 2022. The third aspect of the novelty is determined by the attempt to bring together in a single comprehensive model the behavior of various related economies during the global crisis. The theoretical significance consists in the analysis of the theory and empirical verification of the possible existence of relationships between the processes of inflation and unemployment in the real economic system, which is exposed to crises. Practical significance includes the identification of factors influencing the processes of inflation and unemployment, taking into account the features of economic development and socio-economic policy of state institutions under conditions of general crisis dynamics.

We use quarterly data covering the period from the 1st quarter of 2021 to the 3rd quarter of 2022 to build models. This interval allows studying the patterns of post-crisis recovery of the economies of the region under consideration without the direct influence of internal factors on the crisis processes. Our analysis is based on the fact that the export specialization of the countries affects the nature of economic relations within the economy, and hence the processes of adaptation of the economy in crisis.

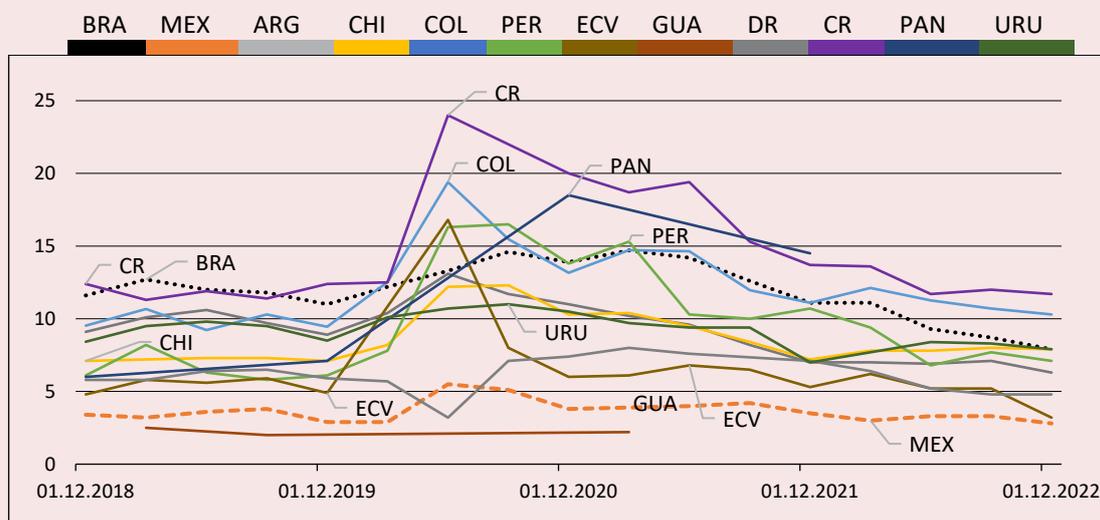
The two parameters that characterize inflation and the unemployment rate, respectively, show the extent to which monetary policy and macroeconomic policy in a country, in a group of countries, can be linked and complement each other; or government institutions, while implementing their functions and achieving their set goals, interact weakly with each other. As a result, the relevant indicators turn out to be unrelated.

We have formulated the following hypotheses: (1) there is a mutual influence of the dynamics of the unemployment rate and the consumer price index; (2) the dynamics of the unemployment rate and the consumer price index (taking into account reciprocity) can be influenced by the specialization of the country's export; (3) the dynamics of the unemployment rate and the consumer price index (taking into account reciprocity) can show the combined effect of the country's export

specialization, the severity of the COVID-19 pandemic, the characteristics of financial regulation and the functioning of the economy.

Here is a brief description of the countries, starting in 1st quarter of 2020. Brazil, Mexico, and Argentina are the largest economies in the region (see Appendix). Brazil, with (as of 2019) an annual GDP of 1873.27 billion U.S. dollars, entered the global crisis with an annual inflation rate of 3.31% and unemployment at 11% (Fig. 1, 2). Further,

Figure 1. Unemployment rates in the countries under consideration



According to (Fig. 1–4): data from official websites of central banks and stock exchanges of the countries under consideration.

Figure 2. Inflation rates in the countries under consideration (Argentina is on auxiliary scale)

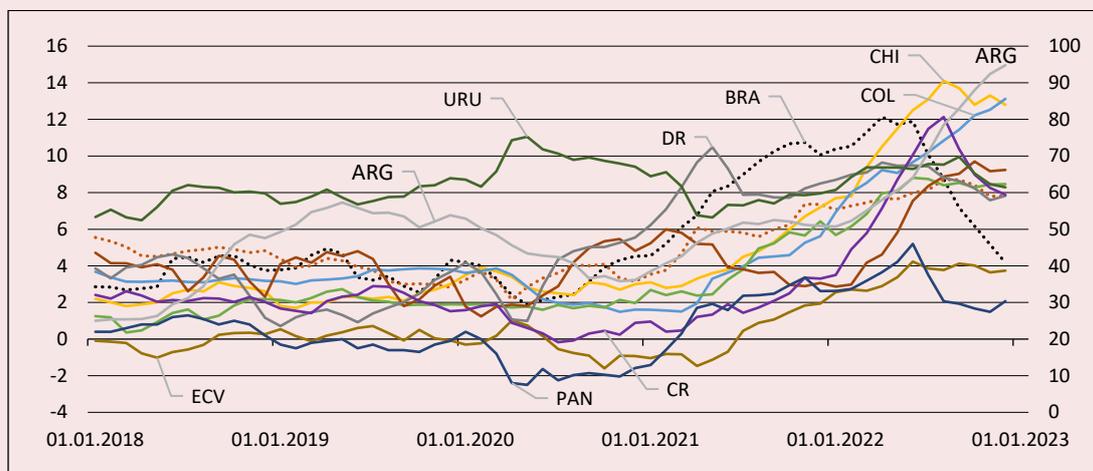


Figure 3. Index of exchange rates of the national currencies of the countries under consideration

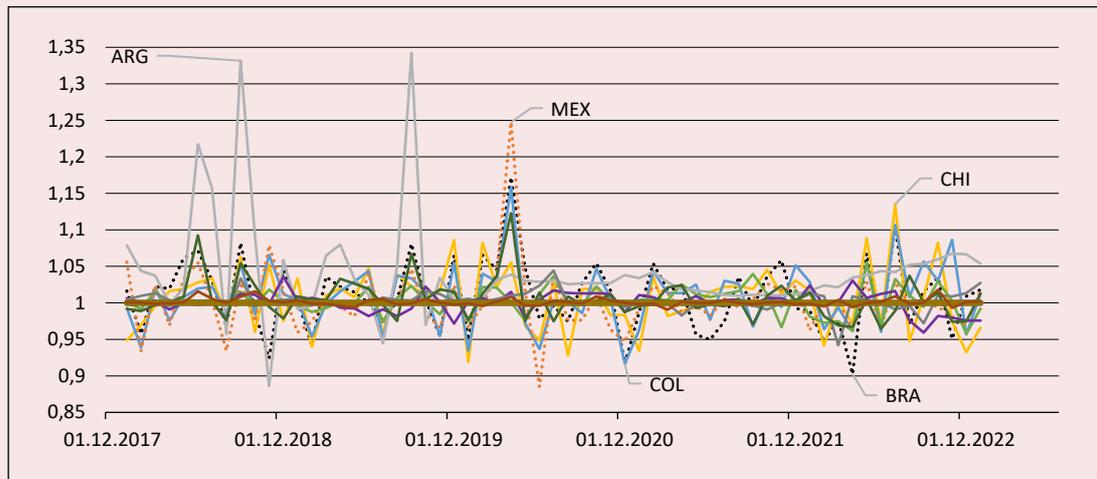
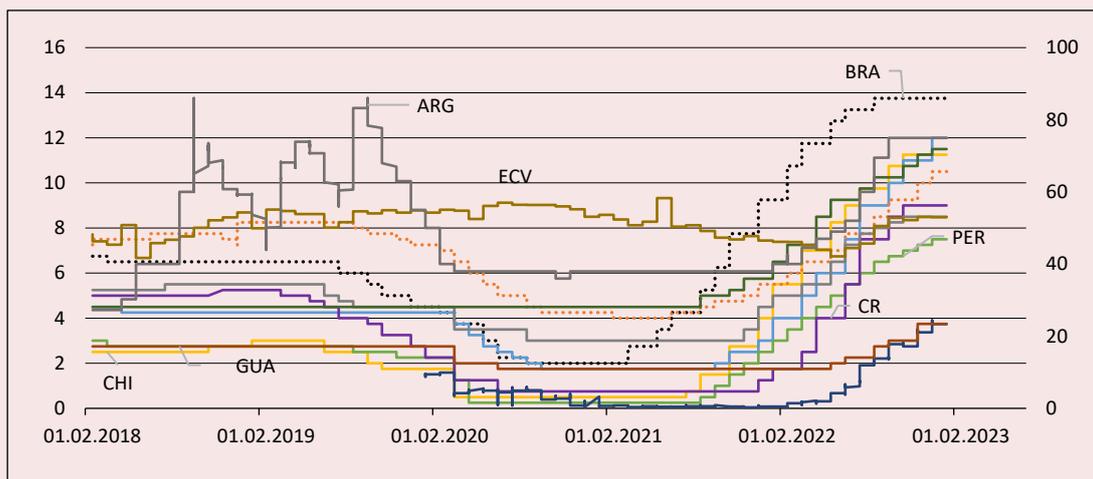


Figure 4. Dynamics of rates of central banks of the countries under consideration (Argentina is on the auxiliary scale)



Brazil failed to recover its GDP even by 2022 (see Appendix). By early 2020 its public debt was 74.44% of GDP. According to Spector’s conclusions, the Brazilian economy grew rapidly until 2020, after which it went into recession, accompanied by high inflation, which caused a decline in population’s solvency. Brazil’s economy is a good model to demonstrate the “middle-income trap”: stagflation, rising social inequality, production inefficiencies, declining production competitiveness and economic growth, and difficulties in implementing institutional reforms (Spector, 2022, p. 25). Brazil’s

economy is very similar to Russia’s in a number of macroeconomic indicators (Spector, 2022).

Figures 1–4 show the dynamics of key indicators for 2018–2022.

The size of Mexico’s economy for 2019 was estimated at 1269.01 billion U.S. dollars, annual inflation was 2.8%, and the unemployment rate by early 2020 was well below the Brazilian rate of 2.9%. The public debt level was 45.1% of GDP. During the crisis year of 2020 and the two next years, both economies were able to return unemployment to pre-crisis levels. Meanwhile, Brazil managed to

stabilize inflation at 5.79% (by the end of 2022), while inflation in Mexico remains at a much higher (relative to pre-crisis) level of 7.82%. For Argentina, the region's third-largest economy, the global crises have overlaid a dire economic situation caused by domestic causes. The country greeted 2020 with inflation at 53.8%, at the end of 2022 it was 94.8%, and at the beginning of 2023 the figure was already over 100%, with unemployment at its lowest values since 2015 by the beginning of 2023 (see Fig. 1, 2, Appendix).

The remaining nine countries can be classified as small economies, characterized by considerable variation in macroeconomic indicators (see Fig. 1–4). Chile, Colombia, Peru, and Costa Rica had the highest rates of inflation during the period under consideration. The next (in descending order of inflation rate) are Guatemala, Paraguay, Mexico, the Dominican Republic, and Ecuador.

For all of the countries under consideration except the Dominican Republic, there was a sharp jump in the unemployment rate in the 2nd quarter of 2020; Costa Rica was a kind of anti-leader with an unemployment rate of 24%. Further periods were characterized by a smooth decline in unemployment in all countries. By the end of 2022, the leaders in unemployment were Costa Rica (11.7%) and Colombia (10.3%; see Appendix). Figures 3, 4 show the indices of exchange rates and central bank rates in the countries under consideration. It is important to note how the speed of decision-making on financial regulation is significant in determining the nature of the crisis dynamics.

Thus, we form a sample of developing Latin American countries, which are in a period of high volatility in terms of unemployment and inflation, as well as other indicators of economic dynamics. At the same time, the countries differ significantly in the behavior of financial authorities and other national economic institutions, which allows empirically testing the above assumptions.

Literature review

A large number of scientific publications have been devoted to study the inflation and unemployment in their relationship and dependence on other macroeconomic factors. It is impossible to give a complete bibliography here, let us point out the general outline of the discussion about the existence of a trade-off between inflation and unemployment according to the Phillips hypothesis to justify and test the economic policies chosen by state institutions; some publications focused on the analysis of Latin American countries; important, in our opinion, methodological clarifications for further modeling and accounting for the features of the 2020–2022 crisis.

A. Phillips showed the correlation between unemployment and the growth rate of wages using the example of the United Kingdom on a long time period from 1861 to 1957. He introduced the concept of the Phillips curve into economic theory, a graphical relationship between inflation and unemployment (Phillips, 1958). Long-term evaluation finds evidence of a negative relationship between inflation and employment, leading to the conclusion that inflation hurts job creation, for example, according to U.S. data (King, Watson, 1994). The explanation of this relationship has traditionally differed between monetarists, followers of the classical school of economics, and institutionalists. The more recent academic literature more often fails to support a level of trade-off between inflation and the unemployment rate in the short run, which many economists believe reinforces the orthodox view (Gokal, 2004). At the same time, there is evidence of a positive relationship between inflation and employment growth over the long run. Inflation, according to followers of the classical school, appears if the money supply grows with full employment in production (Weitzman, 1982). For the classical economic school, overproduction and

unemployment are temporary as the market adjusts to full employment (Tobin, 1995). The monetarist school changed the view of unemployment based on Milton Friedman's hypothesis (Juhn et al., 2002). Its representatives believed that the decline in current income and employment affects only the production volume due to the expected decline in income. Each academic school offered different policy solutions (Vermeulen, 2017). According to the general consensus among central bankers and monetarist economists, a restraining monetary shock increases unemployment, at least temporarily, and leads to a delayed and gradual fall in inflation. However, standard dynamic models of price adjustment cannot explain such a pattern (Mankiw, 2021). Criticism of central banks' over-targeting of inflation, which many economists believe constrains economic growth, has been persistently replicated in developing countries (Vermeulen, 2017).

The main focus of the debate around the Phillips hypothesis has gradually shifted toward justifying or refuting various economic policies. For example, after failing to find conclusive empirical evidence for the truth of the Phillips hypothesis, Daniel et al. argue, using Nigeria as an example, that inflation and unemployment problems stemmed from inefficiencies in both monetary and fiscal policies (Daniel et al., 2021). In our research, we also include relevant characteristics in the models.

A theoretical explanation of the processes is beyond the scope of our study. We will focus on the short-run effects associated with economic shocks and identify the mutual influence of these shocks and relevant macroeconomic indicators using the example of Latin American countries as a model. Continuing the controversy with a sample of Latin American countries, E.P. Caldentey and co-authors empirically tested the relationships described by the Phillips curve for 1992–2016 in Argentina, Brazil, Chile, and Mexico using different models (Caldentey et al., 2020). The researchers concluded

that the data did not provide evidence of such a relationship for most countries. E.P. Caldentey and co-authors provided extensive tools to test the hypothesis, but the data for each country were examined independently, in isolation from other countries. In addition, constructing regressions over long periods can blur the effects of interactions at stages of sufficiently large structural transformations (both political and economic) in the countries under consideration, which can distort the patterns revealed by the construction of the end-to-end regression.

Based on short-term panel regression, one can observe the development of the economic crisis associated with the pandemic, as different regions and countries were affected by the COVID-19 threat and responded to it in different ways. In many countries, including the Latin American countries listed above, there has been an increase in excess mortality, unemployment and inflation, leading to increased social tensions. Klaas de Vries and co-authors analyzed short-term productivity trends during the COVID-19 pandemic in France, the United Kingdom, and the United States, emphasizing that such crisis trends would be offset if one considered regressions on a longer time series (de Vries et al., 2021). They used quarterly data from three countries for 2019 and 2020, aggregating the reallocation of labor in industries with varying degrees of value added and product price dynamics, were able to capture the specifics of productivity growth by applying an industry taxonomy method. Also, countries were considered separately, which did not allow the effect of the relationship between the dynamics of the measured parameters to be taken into account for the group of countries as a whole.

It is worth noting the works devoted to studying the influence of various factors on inflation and unemployment in Latin America, but without taking into account the interaction between these

factors. For example, R. Frenkel and J. Ros in a sample of large countries for 1990–2002 have showed that unemployment can be influenced by exchange rates, the number of labor force in the economy and economic growth measured as the GDP logarithm, among other factors (Frenkel, Ros, 2006). We note that the authors considered the determinants for unemployment without taking into account inflation and country specialization and only on the example of large Latin American economies.

L. Ball and co-authors considered individual episodes of sharp increases and decreases in the inflation rate (Ball, 2013). They concluded that sharp changes in unemployment can be related to economic growth cycles, government policies, and exchange rates. Export specialization is rarely found in the academic literature as a factor for economic processes, but a number of researchers confirm that it is important for economic development (Naudé et al., 2010).

All of the papers we reviewed above refer to the period through to 2020, which started a kind of chain of upheavals in the global economy. After 2020, the works focus on how the coronavirus epidemic affected individual macroeconomic indicators in different countries. K.B. Kostin and E.A. Khomchenko presented an original methodology aimed at increasing the heuristic ability to predict the crisis using the impact of the COVID-19 pandemic as an example, but all indicators were considered separately, which in our view does not allow for structural variability (Kostin, Khomchenko, 2020). A. García-Herrero analyzed why the coronacrisis in Latin America had a greater negative impact on the economy than in Asia, and showed that it was caused by the high debt burden of governments and the availability of dollar liquidity (García-Herrero, 2021).

Multivariate analysis of the dynamics of interrelated economies is used by researchers to

identify relative characteristics, which becomes relevant for short-term periods in the analysis of crisis phenomena. For example, R. Nijskens and W. Wagner showed that the main cause of the 2007–2009 crisis was the various ways in which banks transferred credit risk into the financial system (Nijskens, Wagner, 2011). A. Fontana and M. Scheicher on panel regressions of euro area countries reflected how in the global crisis financial institutions reallocated risk to weak economies (Fontana, Scheicher, 2016). An even larger study was conducted by H. Addi and A. Abubakar, showing the interaction of state institutions and economic development characteristics using examples from 27 countries over the period 2005–2018 (Addi, Abubakar, 2022).

We should note an interesting article from a methodological point of view by C. Albulescu, devoted to a detailed modeling of the positive impact on financial volatility in the U.S. and euro area countries of COVID-19 mortality information according to daily reports for the period March – May 2020 (Albulescu, 2021). The author details the analytical possibilities of stepwise regression at the global level, for a group of interconnected countries and the USA. An interesting finding is that data reported at the global level have a stronger impact than data at the national level (the example is the U.S.). The external effects were stronger than the characteristics of the economies themselves.

Based on the studied literature, we conclude that there is scientific novelty and theoretical validity of the research of interrelated economies in the crisis period. Our work is designed to continue the logic of empirical search.

The Russian Federation, being one of the largest economies in the world, is characterized by extremely diversified values of the most important indicators of socio-economic and innovation and technological development. Such diversification, both in terms of the levels of indicators and their

significance for the economy, creates significant difficulties for a balanced socio-economic policy, especially in periods of crisis. O. Dmitrieva and D. Ushakov have analyzed the Russian economy using data up to 2010 and conclude that there is no correlation between inflation and unemployment (Dmitrieva, Ushakov, 2011). The authors show that inflation in Russia is a cost inflation due to the transfer of raw material rents into final consumption prices. It seems to us that simply analyzing correlations cannot be a convincing argument, and this statement has been confirmed by many foreign researchers of similar problems. To test the validity of the arguments of monetarism in public administration, it seems important to study how decisive was the influence of macroeconomic indicators on the crisis dynamics, or to a greater extent reflected the influence of state institutions on the example of other countries. Latin American countries can act as a model precisely because of the differences in the policies of the monetary authorities, with at least one economy (Brazil) being a testing ground for comparative analysis in a number of indicators. The simulation of interrelated dynamics allows assessing the direction of the influence of relevant characteristics. It is worth noting that following V.M. Polterovich, that simple borrowing of economic support and development institutions is inefficient (Polterovich, 2022, p. 41).

Based on the above, we believe that the theoretical and empirical conclusions obtained in this research can be useful in assessing the relevant risks for the Russian economy, identifying effective management tools in the face of strong external shocks, including from the perspective of assessing the current Russian economic model.

Data and methodology

As an indicator measuring unemployment, we chose the unemployment rate at the end of the quarter (Unemp) as a share of the unemployed (in %) in the total working-age population. Inflation

was measured through the Consumer Price Index (CPI) – the ratio of the cost of the consumer basket in the current quarter to the cost of the consumer basket in the previous quarter. The data source for inflation and unemployment indicators is local statistical bodies.

We entered four dummy variables determining the export specialization of countries into the data set. To calculate the export specialization of countries, we used data on the export volume of the UN Conference on Trade and Development (UNCTAD). For each export group, we calculated the ratio to total exports in 2021. An export group was recognized as a country's specialization if its share in total exports exceeded 20%, then the corresponding dummy variable took a value of one: Food (agricultural products – Argentina, Brazil, Guatemala, Dominican Republic, Costa Rica, Peru, Uruguay); Energy (energy resources – Ecuador, Colombia); Product (industrial production – Guatemala, Dominican Republic, Costa Rica); Metals (metals and ores exports – Panama, Peru, Chile). A specialization for Mexico is the export of motor vehicles and machinery. Since such specialization is unique to Mexico, when included in the regression model, this variable could aggregate all the variation that is specific to Mexico. In order to avoid this situation, we decided not to include such a variable and to limit ourselves to the four specializations presented.

To control for pandemic severity in each country and time interval considered, we used the cumulative ratio of coronavirus deaths to 1 million people (Covid_death). We used a dataset based on data from Johns Hopkins University³.

As a characteristic of export-oriented developing economies, we considered the change in the exchange rate of the national currency, calculated as the ratio of the current exchange rate to the basis

³ Yandex Lens. Available at: <https://datalens.yandex.ru/marketplace/f2eb8io5l5q4rp84fe01> (accessed: April 5, 2023).

(the basis is the average value of the 1st quarter of 2020) (Currency). We should note that in a number of studies, it has been attributed to the factors determining inflation (for instance, Frenkel, 2006).

Since the instrument of the monetary policy of the state is the central bank rate (or its analogue measured in %), the role of not only the rate itself, but also its deviation from the comfortable value for the economy, which allows forming the basic financial policy, is important. In addition to the deviation value, we took into account the speed at which the decision to raise the rate is made. For example, the Brazilian Central Bank was one of the first to raise the SELIC rate target (Brazil's analogue of the key rate), which led to a fairly rapid decline in inflation in the country, and as of the first quarter of 2023, Brazil's inflation is one of the lowest in the region. To account for these factors, the models used two variables: the central bank rate itself at the start of each period (CB_rates) and the "central bank reaction" to the key rate (the rate at which central banks raise rates). The indicator of "CB_reaction" (CB_reaction) was calculated according to the following formula:

$$\sum_{t_0=01.02.2021}^{t_n} \frac{RG}{\ln(t_n - t_0)},$$

where RG – value of the rate increase on the date t_n , t_n – each date, t_0 – February 1, 2021.

To aggregate data on financial indicators, we used data from local central banks.

We also added a number of macroeconomic variables to the model: GDP size (GDP) in billion USD and GDP per capita (GDP_PC) in USD to control for the size of the economy and the level of economic development (intensity) at the beginning of 2020.

The ratio of government borrowing through Eurobonds to GDP (calculated as ratios) and the ratio of domestic credit to GDP (in %) to control

the degree of indebtedness of the economy (Eurobonds). Depending on the degree of indebtedness and the borrowing policy of the authorities, the macroeconomic policy and hence the degree of impact of crises on the economy may differ significantly.

For the unemployment model, the logarithm of Labor force (hereafter Labor) is included as a variable indicating the size of the labor force for the economy. According to the definition on the Worldbank website, the labor force is the sum of working-age people who are employed, engaged in self-employment, income-generating activities, or looking for work⁴.

All control variables were taken at the beginning of 2020 to exclude the influence of crisis phenomena on them, i.e. the presence of endogeneity. The data were also sourced from local statistical agencies and Worldbank data.

The feature of the model of interconnected economies is the comparative aspect, which is implemented through the evaluation of regression models not for each country separately, but for a group of countries. We were interested in the speed and drivers of the economy's return to "pre-crisis" trends, so short time periods were chosen. When each country is modeled by regression separately, comparisons are usually made by regression coefficients, which, strictly speaking, is not correct for multivariate models, since coefficients account for the relative effect on average for that particular regression. In addition, structural variables describing the size and type of economy, financial instruments, and mortality from COVID-19 were included in our models. Panel and pseudo-panel regression analyses allow dynamically accounting for the relative effect between countries, which makes the analysis of the effect of country

⁴ Available at: <https://data.worldbank.org/indicator/SL.TLF.TOTL.IN?locations=MX>

(structural) variables more reliable. The latter is particularly important because short time intervals impose additional limitations on the dimensionality of the model. Regression models on long time intervals, as the analysis of the literature has shown, level out crisis dynamics, as they highlight long-term effects, which may lose their relevance during crisis periods.

Data quality issues

The data were collected from databases provided by national statistical authorities, the UN Conference on Trade and Development (UNCTAD), and the World Bank databases⁵. Due to the fragmentation of sources, a certain challenge was the aggregation of all necessary parameters in a single database for the subsequent use of models. In particular, the absence of some parameters led to the need to replace some of the data with their estimates for inclusion in the model of the third economy of the country – Argentina.

Due to the fact that the World Bank database does not provide data on the variable “domestic credit to GDP ratio” for Argentina after 2017, instead we used estimates obtained by linear approximation from the indicator “household debt as a % of GDP”. The theoretical rationale for the obtained estimates is that domestic credit is a debt in the form of credit mass of commercial enterprises and households to the banking system, with household debt for any economy constituting a significant part of the value of domestic credit. Empirically, the correlation coefficient between the two indicators was 0.52, with significance at the 5% level. For 2020, the estimate obtained and used in the models was 15.28%.

Models and their calculation methodology

We used six sequentially computed linear multivariate regression models to find relationships. *Table 1* presents the variables of the models and their descriptive statistics.

Table 1. Descriptive data statistics for relevant countries in the region

Variable	N	Average	Min	Max	Meaning
Unemp	71	9.079	2.200	19.400	Unemployment rate for the period, reporting at the end of the quarter, %
CPI	84	1.028	0.974	1.220	Consumer price index for the quarter
Food	84	0.75	0	1	Specialization in the export of agricultural products
Energy	84	0.167	0	1	Specialization in energy exports
Product	84	0.25	0	1	Specialization in the export of industrial products
Metals	84	0.25	0	1	Specialization in metal and ore exports
Covid_death	84	2270.78	284.214	6952.282	Number of coronavirus deaths cumulative total since the beginning of 2020 by the end of the quarter, persons per 1 million population
Currency	84	1.061	0.905	1.918	Change in the exchange rate, calculated to the basis (the basis – the average value of the 1st quarter of 2020)
CB_rates	84	7.338	0.04	52	Value of the central bank rate at the beginning of the quarter, %
CB_reaction	84	0.457	-0.291	5.949	Скорость подъема ставок центральными банками
GDP	84	407.241	61.23	1873.27	GDP 2020, billion USD without PPP
GDP_PC	84	10029.24	4263.08	16192.16	GDP 2020, USD excluding PPP, per capita
Eurobonds	84	0.164	0.02	0.381	Ratio of total volume of government Eurobonds to GDP (2020, USD)
Loan	84	55.457	15.283	124.6	Ratio of domestic credit to GDP, %
Labor	84	2.314	0.532	4.6	Logarithm of the labor force at the end of the quarter

Source: own compilation.

⁵ World Bank Group (vsemirnyjbank.org) (accessed: April 6, 2023).

We conducted the research by the least squares method (LSM) on pseudo-panel data in three steps. *Table 2* presents the simulation results. In the first step, we checked the level of correlation and built simple regression models by pairwise LSM, assigning inflation and unemployment as the target variables, respectively, to check the presence of these patterns described by the Phillips curve.

The correlation coefficient between the unemployment rate in the period and inflation in the corresponding period is 0.12, the significance level is higher than 0.05, we should accept the hypothesis H0. Next, we constructed models of the form (1) and (2) in this step.

$$CPI = b_1 * Unemp + Const \quad (1)$$

$$Unemp = b_1 * CPI + Const \quad (2)$$

In the second step, we added the control variables of country specializations for each of the equations of the previous step. The general form of equations of the second step (3) and (4) is shown below.

$$Unemp = b_1 * CPI + b_2 * Food + b_3 * Energy + b_4 * Product + b_5 * Metals + Const \quad (3)$$

$$CPI = b_1 * Unemp + b_2 * Food + b_3 * Energy + b_4 * Product + b_5 * Metals + Const \quad (4)$$

In the third step, we added all other listed variables to the models. Due to the differences in the fundamental assumptions for the analysis of inflation and unemployment the equations used a slightly different set of variables for their analysis.

For example, following the results of R. Frenkel

Table 2. Results of model building by the linear LSM

Variables	Models					
	(1)	(2)	(3)	(4)	(5)	(6)
Unemp	-0.0013		-0.0005		-0.0007	
CPI		-11.3876 **		-4.4710		13.4879
Food			0.0212 **	0.8011	0.0014	4.0946 **
Energy			-0.0283 **	1.7706	0.0437	50.5079 ***
Product			-0.0373 ***	1.8615	0.0201	26.8144 ***
Metals			-0.0334 ***	1.3481	0.0705 **	53.5203 ***
Covid_death					-0.0008 ***	-0.1661 ***
Currency					0.1415 ***	11.8764 **
CB_rates					0.0014 ***	0.1795
CB_reaction					0.0025	-1.4586 ***
GDP					0.0026 **	3.6463 ***
GDP_PC					0.0036 *	2.4509 ***
Eurobonds					-0.0604**	-50.3291***
Loan					-0.0007 **	-0.4586 ***
Labor						-8.0409 ***
Const	1.044 ***	20.818 ***	1.038 ***	12.054*	0.861 ***	-33.628*
R^2	0.0016	0.0016	0.1356	0.0009	0.9049	0.6546
N	71	71	71	71	71	71

(1) – pairwise regression with the dependent variable CPI; (2) – pairwise regression with the dependent variable unemployment; (3) – multiple regression with specializations, dependent variable CPI; (4) – multiple regression with specializations, dependent variable unemployment; (5) – full model, dependent variable CPI; (6) – full model, dependent variable unemployment.

* – significant value of the parameter (p < 0.05); ** – high value of the parameter (p < 0.01); *** –maximum meaningful value of the parameter (p < 0.001).

Source: own compilation.

and J. Ros, the labor force logarithm variable was added for unemployment models, which showed significance (Frenkel, Ros, 2006). We did not use this variable for the model with CPI as a dependent variable, due to the fact that the relationship between inflation and unemployment is not recognized as a prerequisite for job purposes, but rather is tested.

This is a type of model in which the target variable is inflation:

$$\text{CPI} = b_1 * \text{Unemp} + b_2 * \text{Food} + b_3 * \text{Energy} + b_4 * \text{Product} + b_5 * \text{Metals} + b_6 * \text{Covid_deth} + b_7 * \text{Currency} + b_8 * \text{CB_rates} + b_9 * \text{CB_reaction} + b_{10} * \text{GDP} + b_{11} * \text{GDP_PC} + b_{12} * \text{Eurobonds} + b_{13} * \text{Loan} + \text{Const} \quad (5)$$

This is a type of model in which the target variable is unemployment:

$$\text{Unemp} = b_1 * \text{CPI} + b_2 * \text{Food} + b_3 * \text{Energy} + b_4 * \text{Product} + b_5 * \text{Metals} + b_6 * \text{Covid_deth} + b_7 * \text{Currency} + b_8 * \text{CB_rates} + b_9 * \text{CB_reaction} + b_{10} * \text{GDP} + b_{11} * \text{GDP_PC} + b_{12} * \text{Eurobonds} + b_{13} * \text{Loan} + b_{14} * \text{Labor} + \text{Const} \quad (6)$$

Discussion of the results

Table 2 presents the results of the simulation. Models (1), (2) and the model with the dependent variable unemployment (4) have a significance level below the critical one and explain too small a share of the variance. We should note another general consideration: the direct relationship between the volatility of unemployment and inflation is leveled by taking into account the socio-economic parameters we selected earlier.

The main conclusion from the data of models (1) and (2) is that the assumptions of the Phillips curve are not empirically confirmed.

Model (3) has a higher level of significance at $R^2 = 0.1356$ than models (1) and (2). Based on model (3), we can assume that the inflation is higher

in countries with specialization in the export of agricultural products during the period under consideration. In countries with specialization in the export of energy resources, industrial products and metals inflation was lower on average. Hence, we can conclude that to a greater extent the economic crisis caused by international restrictions in connection with the COVID-19 pandemic affected the growth of consumer prices in countries focused on the export of agricultural products. However, the development of our models gives no grounds to confirm this assumption.

Model (4) demonstrates that the variation of the unemployment rate in the given period for the countries under consideration cannot be explained by the complex of influencing variables characterizing the inflation level and export specialization of the countries.

Model (5), in which the target variable is the quarterly consumer price index (CPI) and all external variables are included, has the highest explanatory power (except for the labor force logarithm) $R^2 = 0.9049$. This model has several important features. First, the variation in consumer prices in the countries under consideration is not explained by variation in the unemployment rate (which once again confirms the absence of relationships described by the Phillips curve), and the influence of agrarian, energy and industrial export specialization was leveled by other indicators. Second, consumer inflation rises significantly only in countries specializing in the export of metals and ores, while for the rest of the countries the variation is largely explained by other economic indicators. First of all, it is the change in the exchange rate, the value of the Central Bank rate, the static indicators of the size of the economies – GDP and GDP per capita – are also significant. A paradoxical conclusion can be called the revealed negative correlation between the level of indebtedness, with

which economies entered the crisis, and the growth of inflation. Thus, according to the data obtained, the economies with a higher ratio of domestic credit to GDP and a higher ratio of Eurobonds to GDP showed a smaller increase in inflation. In general, this can be explained by the fact that borrowed funds were effectively used to support economies, which allowed countries to feel the effects of the crisis to a lesser extent. We can conclude that the indicator of the indebtedness of the economy, along with other indicators of the financial depth of the economy (the level of monetization and capitalization of the economy - according to the methodology of the World Bank) can act as indicators-predictors of the possibility of the economy to overcome the crisis period if the above-mentioned conditions are met.

Model (6), in which the dependent variable is the unemployment rate at the end of the quarter and all variables are included, is significantly worse in explanatory power than model (5), which is understandable, since unemployment in general is quite a difficult process to regulate. The consumer price index for the quarter and the central bank rate at the beginning of the quarter are insignificant, while the other variables are significant. The country's specialization in the export of metals and ores, energy resources, and industrial exports significantly increased the dynamics of the unemployment rate. The negative effect of the labor force logarithm fully confirms the theoretical assumptions and indirectly testifies in favor of the consistency of the model. An important result is the negative coefficient of the logarithm of labor at positive coefficients of the "macroeconomic size" of economies, GDP. Econometric calculations show that the amount of labor force at the same level of GDP has a downward effect on unemployment. Conversely, when the labor force is stationary, the size of GDP has an upward effect on unemployment. An economy is considered to be more productive if

GDP increases at stationary values of labor force and industry specialization. Thus, economies with low productivity (in World Bank terms) have been less affected by rising unemployment.

Among the dynamic variables, the weakening of the national currency had a greater impact on unemployment. Faster and tighter central bank rate hikes on average were associated with lower inflation.

Contradictory is the behavior of the variable showing COVID mortality, with countries with higher mortality showing a smaller increase in the unemployment rate. This fact may show the nature of the inverse relationship, explained by the fact that the countries that did not impose lockdowns (and thus had higher morbidity and mortality rates) had a smaller increase in unemployment caused by these lockdowns. Moreover, combined with the smaller drop in unemployment in countries with higher labor force participation rates, this fact may indicate the implementation of a mercantilist economic model in which workers are forced to work extra hours at lower wage rates.

Conclusions

In this paper, we have confirmed the effectiveness of inflation management through the instrument of central bank rate regulation. In addition, we have shown that the construction of institutions of unemployment management should take into account industry specifics in the economy.

Most data for Latin America during the period under consideration show no evidence of a direct relationship between inflation and unemployment. However, both inflation and unemployment are influenced by macroeconomic and financial indicators.

In terms of looking at the indicators individually, the most regulated process is the inflation rate. In general, instrumental methods of regulating inflation rate belong to the main objectives of

central banks' activity, but local shocks and other indicators of the state of economy (for example, specialization of economies) can have quite a strong influence on the processes of regulation.

Unemployment as a subject of regulation is a more complex process. In this respect, the factors that have been empirically tested in the course of this work are of scientific novelty. One of the main conclusions concerning unemployment is that the decisions made to influence this indicator should take into account the export specialization of countries as well as the factor of labor intensification, which in the conditions of crisis processes can become a precursor of unemployment growth in the most science-intensive sectors of the economy.

The paper confirms the inverse relationship between the COVID-19 mortality rate and the unemployment rate. The same conclusion is true for the inflation rate. Thus, we show the social negative result of the choice of the governing state authorities of the analyzed countries to abandon the active "antipandemic" policy in favor of supporting the economy.

Based on the analysis, we can assume that the mercantilist model of the economy in modern conditions is more implemented in developing economies of the commodity type.

Inflation was influenced to a greater extent by the central bank rate, while the volatility of the unemployment rate was influenced by the exchange rate, which can only have limited influence by national regulators and which itself is dependent on a variety of factors outside the scope of our study.

Opportunities for research development

Inflation management is successfully implemented through an instrument of interest rate regulation. This will allow policymakers to formulate policies affecting inflation and unemployment by controlling other variables that may directly or indirectly affect inflation and unemployment.

Considering the economic situation in the Russian Federation, when developing models of the economy's reaction to the crisis, it is necessary to take into account corrections to the raw material component. Additional research in this aspect requires the relationship of export specializations with underemployment, which is a specific feature of the Russian economy's reaction to crises. In matters of employment maintenance, it is also worth paying attention to the highly skilled categories of workers, as our analysis shows that this category is more exposed to the risk of unemployment in crisis periods.

We see the development of research in order to take into account these effects in the analysis of possible risks of economic policy in times of crisis. We should note that Russia has historically had an extremely low level of financial depth of the economy. On the one hand, we can say that this fact shows a low level of borrowing of the economy, but, on the other hand, the current trend characterizes the low level of monetization of the Russian economy and, therefore, the inability to quickly redistribute the available money supply to the neediest sectors in crisis periods. The latter creates difficulties for effective overcoming of crises with the least economic losses.

The need for active use of monetary and fiscal stimulus, which the Russian government faced in this period, is characterized by low efficiency, which is confirmed by the analysis of the Central Bank. In countries with a more "favorable situation" among those considered in the model, shocks mitigation was achieved, among other things, by monetary instruments, such as debt instruments. The Eurobonds variable had a strong downward effect on inflation, which can also serve as an instrument of anti-crisis policy. The Russian monetary authorities understand such a need, so a serious work on the replacement of the relevant instruments was carried out in late 2022 – early 2023.

The conclusions about the risks of implementing the mercantilist model of economy are interesting for understanding the specifics of the development of the Russian economic model. The Russian Federation historically implements the mercantilist model of economic development both theoretically and practically. During the 2020–2022 crisis, the Central Bank of the Russian Federation held rates rather tightly, targeting inflation, which, according to the experience of other countries, proved to be an effective measure. However, in the crisis period we are considering, the countries with the highest return on labor (in terms of the World Bank) were subjected to the greatest risks. Consequently, to mitigate the effects of the crisis it was necessary to support more decisively the high-performing sectors

of the economy. Measures related to job support without taking into account industry specifics proved to be ineffective.

Arguments that hard lockdowns and over-reaction to a pandemic would collapse economies and disperse unemployment have proved untenable. Drawing on the experience of Latin America, we note that in countries whose governments chose soft and incomplete lockdowns, the interlocking factors triggered a dramatic increase in COVID mortality. The latter led to strong social tensions and rapid inflation associated with panic. In countries that imposed fast and hard restrictive measures, the shocks were strong but short-lived, and the economy was already back on its pre-crisis trajectory by 2022.

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Appendix. Main economic indicators of the countries under consideration, 2021

	Share of unemployed in working-age population, %	Consumer price index, %	Ratio of the national currency exchange rate to the basis	CB rate, %	GDP excluding PPP, billion USD	GDP excluding PPP per capita, USD
BRA	7.9	5.79	1.018	13.75	1608.98	8537.94
CHI	7.9	12.8	0.966	11.25	317.06	14115.96
COL	10.3	13.12	1.013	12	314.46	6418.1
MEX	2.8	7.82	1.017	10.5	1272.84	9525.41
PER	7.1	8.46	0.992	7.5	223.25	6437.1
ARG	6.3	94.8	1.054	75	487.23	12402.49
CR	11.7	7.88	0.976	9	64.28	12894.3
DR	4.8	7.83	1.027	8.5	94.24	8410.61
URU	7.9	8.29	1.013	11.5	59.32	15874.74
PAN	14.5*	2.08	1	3.74	63.61	13921.26
ECV	3.2	3.74	1	8.48	106.17	5492.49
GUA	2.2**	9.24	1.002	3.75	85.99	4388.44
RF	3.5–4	10–11 ⁶	0.78–1.8	7.5–8.5	1775.8	10216.3

Notes:
All indicators except GDP are as of December 31, 2022, GDP data are as of December 31, 2021; unemployment data are as of December 21, 2021; * as of March 03, 2021; ** as of September 30, 2021.
Data for the Russian Federation are given as a spread for 2022, compiled according to official statistical reports⁷, data on nominal GDP as of December 31, 2021 (according to the IMF).

⁶ Available at: https://buh.ru/news/uchet_nalogi/161618/#:~:text=%D0%A2%D0%B0%D0%BA%D0%B8%D0%BC%20%D0%BE%D0%B1%D1%80%D0%B0%D0%B7%D0%BE%D0%BC%2C%20%D0%BF%D0%BE%20%D0%B4%D0%B0%D0%BD%D0%BD%D1%8B%D0%BC%20%D0%A0%D0%BE%D1%81%D1%81%D1%82%D0%B0%D1%82%D0%B0,%D0%B3%D0%BE%D0%B4%20%D1%81%D0%BE%D1%81%D1%82%D0%B0%D0%B2%D0%B8%D0%BB%2011%2C94%25 (accessed: April 5, 2023)

⁷ Available at: http://www.cbr.ru/hd_base/inf/_/ (accessed: April 5, 2023).

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