The significance of the relationship between the economy and selected economic indicators of Russia

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ABSTRACT

Purpose: Russia's economy has progressively moved from a planned to a mixed, market-oriented economy. It possesses vast natural resource reserves, especially in relation to Russian oil and gas reserves, and as a result, its exports have substantial economic strength. According to the IMF, it ranked sixth in terms of purchasing power parity (PPP) in 2023, the World Bank ranked fifth, and nominal GDP ranked it as the eleventh largest economy in the world. The high fluctuations in Russia's GDP assessed in US dollars can be attributed to a fluctuating currency exchange rate. In 2012, Russia became the final large economy to join the World Trade Organization (WTO). Indeed, in some research it is been shown that there are a lot of factors that effect on the development of the Russia economy and one the most important of them is GDP (Gross Domestic Product). The major goal of this study is to identify the challenges that the Russia will encounter and how they will affect the growth of the US economy over the next five years. Secondary data from secondary sources were retrieved for the current investigation such as an independent variable and a dependent variable used in this study, the data were prepared from the Federal Reserve Economic data (FRED), from 1990 to 2022. In our research used annual time-series data and the OLS model on GDP was the dependent variable, while Consumer Price Index, Unemployment, Export to Import ratio, Producer price Index were the independent variables.

Keywords: OLS model, GDP, Unemployment, Consumer Price Index, Export to Import ratio, Producer Price Index, regression and correlation analysis.

Introduction

Russia is the home of not one, but two lost empires: the Russian Empire and the Soviet Union. Arguably, Russia's history is unique in terms of the scale and diversity of social experimentation that the two empires imposed on Russia's population. The serfdom that existed for more than two centuries and took a more severe form than anywhere else in Europe; the tsar's liberalization reforms, which came too late and did too little; the country's abrupt fall into the hands of Bolsheviks as a result of the 1917 revolution; the drastic economic and social transformation of the Communist project, with forced "Big Push" industrialization that made the Soviet Union a global superpower, but at an enormous human cost; and the eventual spectacular collapse of the Soviet empire are arguably among the largest social experiments in human history. Social sciences have a long tradition of using Russia's historical experiments to draw out lessons relevant for other countries. For instance, the comparison between Russia's development path and that of the countries in Western Europe and nations outside Europe

played an important role in the narrative of the development studies by Rostow (1960), Gerschenkron (1962), and Kuznets (1965). Their work helped shape the early progress in the field of development economics. Soviet industrialization motivated the literature on the Big Push as a strategy for developing countries (e.g., Rosenstein-Rodan, 1943; Murphy et al., 1989). Lewis (1954) used Stalin's transformation to illustrate his model of structural change in a two-sector economy. Theoretical literature used the case of the Soviet economy to motivate modeling of the incentive schemes in large hierarchies (e.g. Holmstrom, 1982; Freixas et al., 1985). Interest in the subject has only grown since these seminal studies. In this survey, we review the recent progress in research on the economic history of Russia in the 20th and 21th centuries. The present economy of Russia based on Macroeconomic Factors:

1. Natural Resources: Russia is rich in natural resources, particularly oil, natural gas, and minerals. These resources have historically played a crucial role in shaping the country's economy and influencing global markets.

2. Energy Sector: The energy sector, especially oil and gas, has been a major driver of Russia's economy. Fluctuations in global energy prices have had a significant impact on the country's economic performance.

3. Economic Reforms: Russia has undergone various economic reforms aimed at stabilizing the economy, controlling inflation, and attracting foreign investment. However, progress has been uneven, and challenges such as corruption and bureaucratic inefficiencies persist.

4. International Relations: Russia's economic policies have been influenced by its geopolitical position and international relations. Sanctions imposed by Western countries in response to actions such as the annexation of Crimea have affected the Russian economy.

Overall, Russia's economy has evolved significantly over time, shaped by historical events and global economic forces. The country continues to navigate various macroeconomic factors as it seeks to maintain stability and foster sustainable growth.

Methodology

In order to identify the relationship among GDP, Unemployment, Consumer Price Index, Export to Import ratio, Producer Price Index, we have opted for a quantitative approach using multi-factor time series model. GDP was selected as a dependent variable, because we learned how GDP will change under other independent variables. Unemployment, CPI and other variables were selected as an independent variable.

Actually, we took the available data of Russia from 1990 till 2022, in order to develop an econometric model and equations using multi-factor time series to construct econometric equations. A number of methods and techniques were used to analyze these data and obtain results from STATA. The used methods will be mentioned below:

- Dickey-Fuller test; In this test method, p-values were checked according to the criteria, and if it did not meet the specified criteria, it was passed to the second test.
- Differentiate; The values that did not pass the first test were differentiated and adjusted in the second test method.
- Logarithmic model; In this method, all dependent and independent variables were transferred to the same unit through the ln function.

  Dependent variable = 0 + 1*independent variable + (standart error)

  lnGDPpercapita = 0 + 1*lnInflation + (standart error)

  lnGDPpercapita = 0 + 1*lnUneployment + (standart error)

- OLS model; OLS (Ordinary Least Squares) is a statistical method used to estimate the relationship between a dependent variable (Y) and one or more independent variables (X). It is a linear regression technique that aims to minimize the sum of squared errors

between the observed values of Y and the predicted values of Y.

The formula for OLS model is:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k + \varepsilon$$

where:

- Y is the dependent variable
- $X_1, X_2, \ldots, X_k$ are the independent variables
- β_0 is the intercept (the value of Y when all Xs are zero)
- $\beta_1, \beta_2, \ldots, \beta_k$ are the regression coefficients (the change in Y for a unit change in X)
- ε is the error term (the difference between the observed value of Y and the predicted value of Y)

Literature review

Khanin, G., & Fomin, D. (2017). Post-Soviet Society and Russia's Macroeconomic Statistics. *Russian Politics & Law*, *55*(3), 199–222 learned that their estimates for the period of 1992–2015 differ substantially from those reported by the Russian Federal State Statistics Service (Rosstat). According to their estimates, GDP declined by 10.2 percent, which is in sharp contrast with the official estimate reporting growth of 13.4 percent. The same is found with regard to labor productivity, for which they find a decline of 30.1 percent instead of a growth of 9.2 percent. Vladimir Mau and Tatiana Drobyshevskaya - In "The Russian Economy in 2019," they highlight a negative relationship between GDP and unemployment, consistent with Okun's Law. They also discuss how external shocks, like sanctions and oil price fluctuations, impact GDP and trade balances, often leading to volatility in these relationships. Sergei Guriev and Andrei Rachinsky - Their work often points to a complex relationship between GDP and economic indicators like trade balances and unemployment. For example, in "The Role of Oligarchs in Russian Capitalism," they suggest that high levels of economic inequality can distort these relationships, sometimes weakening the expected negative correlation between GDP and unemployment. Vladimir Popov - In "Mixed Fortunes," Popov finds a positive relationship between GDP growth and export performance, noting that strong export sectors (like energy) have historically driven Russian GDP. However, he also highlights the vulnerability of this relationship to global market changes. Tatiana Mikhailova and Andrei Markevich - In "Economic Geography of Russia," they discuss regional disparities, showing that while some regions exhibit a strong negative relationship between GDP and unemployment, others do not, due to varying degrees of economic diversification and dependency on state support. Also, Aleksashenko (2016) discusses the relationship between GDP and PPI, noting that a high PPI can indicate increased costs for producers, which might negatively impact GDP. However, in cases where the increase in PPI is due to higher demand, it can be a sign of economic growth. World Bank Reports also analyze this relationship, showing that while a rising PPI can sometimes coincide with economic expansion, persistent high producer prices can lead to inflationary pressures that eventually dampen GDP growth. `in "The Economic Crisis in Russia: Current Situation and Future Scenarios," explores the negative relationship between GDP and CPI. High inflation (measured by CPI) can harm economic growth by reducing purchasing power and increasing costs for businesses.

Results and Discussion

Table 1. Economic indicators of the USA from 1980 to 2021

Years	GDP	Unemployment	Consumer Price Index	Export to Import ratio	Producer Price index
1990	517014446227,93				
1991	517962962962,96			87,5	
1992	460290556900,73			85,8	

1993	435083713850,84		874,25	125,8	
1994	395077301248,46		307,72	133,4	
1995	395537185734,85		197,41	134,2	
1996	391724890744,50		47,75	128,5	
1997	404928954191,88		14,76	120,4	
1998	270955486862,44		27,69	138,9	
1999	195907128350,93	13,04	85,75	186,5	4,56
2000	259710142196,94	10,52	20,80	237,6	2,33
2001	306602070620,50	8,98	21,48	191,6	0,67
2002	345470494417,86	7,88	15,79	174,8	1,37
2003	430347420184,89	8,23	13,66	177,1	0,99
2004	591016690732,39	7,78	10,89	189,1	2,14
2005	764015973481,11	7,17	12,69	194,9	1,06
2006	989932071352,54	7,16	9,67	186,3	0,84
2007	1299703478481,65	6,10	9,01	156,2	1,90
2008	1660848058303,11	6,32	14,11	161,8	-0,48
2009	1222645900055,70	8,46	11,65	161,4	1,11
2010	1524916715223,95	7,47	6,85	163,4	1,31
2011	2045922753398,04	6,50	8,44	162,5	0,93
2012	2208293553878,42	5,46	5,07	157,9	0,45
2013	2292470078346,22	5,48	6,75	152,9	0,29
2014	2059241589895,01	5,16	7,82	161,3	0,51
2015	1363482182197,71	5,57	15,53	177,0	0,98
2016	1276786350881,14	5,54	7,04	147,7	0,61
2017	1574199360089,00	5,21	3,68	148,5	0,69
2018	1657328773461,31	4,81	2,88	177,7	0,94
2019	1693115002708,32	4,60	4,47	165,7	-0,36
2020	1493075894362,14	5,77	3,38	138,0	0,34
2021	1836892075547,52	4,82	6,69	161,1	2,12
2022	2240422427458,58			219,9	

In the first table, information about the main economic indicators of Russia from 1990 to 2022 is given. If we pay attention, out of five important indicators GDP and Export to Import ratio have grown significantly while other variables saw a fluctuation for 30 years. In the beginning of the 1990 the GDP of Russia was around 0.52 trillion USD, and in the end of 2022 this numbers reached to 2.24 trillion of USD, whereas in terms of available information about unemployment rate, it decreased from 13.04% in 1999 to 4.82% in 2021. Consumer Price Index stood at outrageous 874.25% in 1993, however then had a decrease to 6.69% in 2021 and another index had a fluctuation ranging from 4.56 in 1999 to 2.12 in 2021. Lastly, Export-to-Import ratio accounted for 87.5% in 1991 and had an increase to 219.9 in 2022.

As earlier mentioned above, we will see how the variables listed in the first table are related to each other. As we know the main regression function, here too GDP indicators are used as dependent variable and the remaining 4 variables - Consumer Price Index, Unemployment and others - are used as independent variables.

Since our study is conducted in multi-factor time series, the first step in the criterion of multi-factor time series is to examine the variables which are non-stationary or stationary in the Dickey-Fuller test and find if

they are cointegrated or not. After that, we can select a particular appropriate model.

Firstly, we can see p-value is 0.998 and greater than 0.005, it should be less than 0.005. And also all critical values (1%, 5%, 10%) should be greater than test statistic value and it is non-stationary indicators, we should differentiate these indicators.

Table 2.GDP of Russia after differentiate

	Test statistic	1% Critical Value	5% Critical Value	10% Critical Value	p-value
Z(t)	-6.537	-3.716	-2.986	-2.624	0.000

As you can see in this table, p-value is less than 0.05 and all critical values (1%, 5%, 10%) greater than test statistic value after we differentiated the data and it changed to stationary indicators.

Table 3. Unemployment of Russia in the Dickey-Fuller test

	Test statistic	1% Critical Value	5% Critical Value	10% Critical Value	p-value
Z(t)	-5.822	-3.750	-3.000	-2.630	0.000

According the table 3, p-value is 0.000 less than 0.05 and test statistic value is -5.822, it is also less than 1%, 5% and 10% critical values. It means all data is stationary and we don`t need differentiate the data. All the information which given by Consumer Price Index is stationary. Test statistic value is -14.517 and smaller than all critical values. We should differentiate the data of unemployment rate.

Table 4. Consumer Price Index rate of USA after differentiate.

	Test statistic	1% Critical Value	5% Critical Value	10% Critical Value	p-value
Z(t)	-14.517	-3.743	-2.997	-2.629	0.000

Table 5. Export-to-Import ratio of Russia after differentiate.

	Test statistic	1% Critical Value	5% Critical Value	10% Critical Value	p-value
Z(t)	-6.033	-3.723	-2.989	-2.625	0.000

As you see, there is not stationary indicators, yet. P-value is equal to 0.000 and test statistic value is also less than critical values, we do not have to differentiate one more time.

Table 6. Producer Price Index indicators of Russia after two times differentiate.

	Test statistic	1% Critical Value	5% Critical Value	10% Critical Value	p-value
Z(t)	-8.281	-3.750	-3.000	-2.630	0.000

Now our data transferred to stationary after we differentiated two times. P-value, test statistic value and all critical values are perfectly combined. Test statistic value is less compared to critical values and p-value is equal to 0.00 which is considered to be applicable.

Now we will consider the relationship of all economic indicators with the help of the correlation function using STATA. Here, the main indicator is GDP and it is a non-independent value, and we take other indicators as independent variables. And also, we used the ln function to be in the same unit. Being in the same unit shows that the indicators are more clearly connected to each other.

Table 7. Correlation of economic indicators(ln) of Russia.

	lnGDP	lnUnemployment	lnCPI	lnExport-to-Import ratio	lnPPI

lnGDP	1.0000				
lnUnemployment	-0.8734	1.0000			
lnCPI	-0.8084	0.8479	1.0000		
lnExport-to-Import ratio	-0.7173	0.6475	0.6178	1.0000	
lnPPI	-0.5854	0.5920	0.6258	0.5566	1.0000

The correlation between these model indicators indicates that there is a long-term correlation between the model indicators. If we analyze according to the above table 7, all indicators are interrelated. And there are two kinds of relationship, which are negative and positive relationship. Positive relationship means that if one indicator increases, the value of the second indicator also increases as directly proportional, and if the first value decreases, the second one also decreases. The negative relationship is that if the amount of the first value increases, the value of the second indicator decreases depending on it as inversely proportional, and vice versa, if the first value decreases, the second value increases.

Firstly, there is negative 87.34% correlation between GDP and unemployment, it means if unemployment increases 1 unit, GDP decreases 0.87 unit. Because, GDP is a dependent variable, here. There is also negative 80.8% correlation between GDP and CPI, if CPI decreases for 1 unit, GDP per capita increases for 0.81 unit. And there are negative 71.7%, 58.5% correlation between GDP and export-to-import ratio, PPI directly. If export-to-import ratio, PPI increases 1 unit, GDP per capita will decrease for 71.7, 58.5, according to the which is independent variable in the correlation function and vice versa. These indicators consist of GDP, that's why they influence more.

Secondly, there is also connection between independent indicators. There are positive 84.8% correlation between CPI and unemployment, non-negative 59.2% correlation between PPI and unemployment, also positive 55.7% correlations between unemployment and Export-to-Import ratio

Thirdly, CPI is positively correlated with lnExport-to-Import ratio (0.6178) and PPI (0.6258).

Scheme 1. Regression scheme with the same unit(ln).

```
      Source |       SS           df       MS      Number of obs   =        21
-------------+----------------------------------   F(4, 16)        =     17.23
       Model |  9.60881837         4  2.40220459   Prob > F        =    0.0000
    Residual |  2.23024894        16  .139390559   R-squared       =    0.8116
-------------+----------------------------------   Adj R-squared   =    0.7645
       Total |  11.8390673        20  .591953366   Root MSE        =    .37335
```

lnGDP	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lnUnemployment	-1.616767	.6175308	-2.62	0.019	-2.925874	-.3076606
lnConsumerPriceIndex	-.1852203	.2212115	-0.84	0.415	-.6541677	.2837271
lnExporttoImportratio	-1.502389	.9419324	-1.60	0.130	-3.499197	.4944183
lnProducerPriceindex	-.0084253	.1656651	-0.05	0.960	-.3596197	.342769
_cons	38.83908	4.550117	8.54	0.000	29.19326	48.48489

In order to make it easier to understand, there are examples of regression functions below, with the indicators presented in the table above. As you see on Scheme 1, there are all the values of each indicator and how they related to dependent variable and also how they interrelated to independent variables. Probability amount is satisfactory, because it less than 0.05. R-squared (R^2) is a statistical measure that represents the proportion of the variance in a dependent variable that can be explained by an independent variable or variables in a regression model. It ranges from 0 to 1, with 1 indicating a perfect fit where all the variation in the dependent variable is explained by the independent variables and 0 indicating no relationship between the variables. R-squared is 0.8116, it is less and not equal to 1 and it will appropriate to the criteria.

Dependent variable = 0 + 1*independent variable + (standart error)

*lnGDP= 38.83908+(1.616767)*lnUnemployment+0 .6175308*

*lnGDP= 38.83908+(-0 .1852203)*lnCPI+0 .2212115*

We used the information from the regression table and build these equations, which is given above.

According to our analysis GDP which is a dependent variable is mostly characterized by CPI and unemployment which are independent variables which have biggest slope in our illustrated regression analysis. Slope is negative in both variables meaning there is an inverse relationship between these factors and it refers that if GDP will continue to soar it can be exceptionally affected by the decrease in these variables in the future.

Conclusion

According to the findings of our investigation, the GDP, which was used as a dependent variable, was significantly characterized over the past three decades by our dependent variables, having a negative relationship with all independent variables including Unemployment, CPI, Export to Import ratio, Producer price Index.

By the way, as we discovered in our research about the Russia by some analysis, a research by Lu and Yao (2019) revealed a positive correlation between China's GDP and economic development, while a study by Li et al. (2018) found a positive correlation between China's GDP and exports. And constrasting to our research Gurvich and Kvasha (2015) specifically analyze the relationship between GDP and the export-to-import ratio. They find a positive relationship, where a higher ratio (more exports relative to imports) is associated with higher GDP. This is because exports drive economic growth by bringing in revenue and supporting domestic industries.

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