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Detecting irregularities in Russian
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Heli Simola

Detecting irregularities in Russian economic statistics

Abstract

In addition to increased uncertainty related to Russian statistics since the invasion of Ukraine, some observers have raised doubts about the quality of Russian statistics. Applying simple analytical tools to detecting irregularities in Russian economic data that could implicate data manipulation, our analysis reveals irregularities and confirms the increased uncertainty related to Russia's post-invasion statistical data. We find, however, no compelling evidence of extensive systematic data manipulation. Therefore, it would be risky to assume that the Russian statistics deliberately paint an overly rosy picture of economic conditions.

Keywords: Russia, economy, statistics

1. Introduction

Uncertainty related to Russian statistics has increased since Russia's invasion of Ukraine. Russia has shifted to publishing less granular figures on foreign trade, balance of payments and budget spending, as well as ceased entirely the release of economically strategic data such as oil production. Most of Russia's key macroeconomic data series are, however, still publicly available. There have also been suspicions about the quality of Russian statistics, with some observers going so far as to suggest that Russian statistical data have been manipulated to mask economic troubles arising from the war and sanctions. These concerns are by no means limited to economic data, as discussed in CEDAR (2024) and Mashukov et al. (2024), but we focus on the macroeconomic perspective.

Applying simple analytical tools to detect possible irregularities in Russian economic data that might suggest data manipulation, our analysis indicates sharp increases in volatility of certain series and certain irregularities. However, it produces no compelling evidence of systematic, large-scale manipulation of statistics since the invasion of Ukraine.

This brief is organized in the following way. Section 2 provides a short discussion of how Benford's first-digit law may be applied here. Section 3 examines the evolution of correlations between economic series. In section 4, we shift to econometric analyses to test for structural breaks. Section 5 offers estimates of simple binary regressions to see if the war has significantly affected the relationship and explanatory power of certain economic variables. Section 6 presents binary VAR-models to examine potential changes in their ability to forecast developments of selected economic variables. Section 7 provides comparisons of Russian data with data from external providers. Section 8 concludes with a summary of the findings.

2. Benford's law

Benford's first-digit law (Benford, 1938) has been used widely to track manipulation of economic statistics and identify data fraud, including the case of Russia (Davydov & Swidler, 2016; Kauko, 2019). Numerous studies establish that many economic data series follow Benford's law, whereby the distribution of first significant digits in data observations follows a predictable pattern. The presence of data violating the predicted distribution may indicate data manipulation. Of course, Benford's law is a simple test that any serious data manipulator would be expected to anticipate. The challenge for a deceptive statistician, therefore, is coherent manipulation of large datasets that evade Benford's law analysis.

Starting at the aggregate level, we apply Benford's law to suitable Russian data series depicting country-level trends. We check if the series follow Benford's law in the time period preceding Russia's invasion of Ukraine and whether the post-invasion situation has changed. To maximize the number of post-invasion observations, we only use monthly data series.

Our analysis suggests that vast majority of Russian data series did not follow Benford's law even before the invasion. Samples of the examined aggregate-level series are presented in Table 1 and regional-level series in Table 2. While our analysis covered many additional variables with similar results, it is difficult to make a general conclusion as to the potential effect of the invasion on these data.

A few important exceptions stand out. Most series depicting tax revenue collected at both the federal level and the consolidated level followed Benford's law in the pre-invasion period. This ceases to be the case after the invasion of Ukraine. As no major changes in the tax code occurred around the

time of the invasion,¹ these findings point to potential problems with the budget revenue data. (It should be noted that the number of observations in the post-invasion period is still quite small from a statistical viewpoint.)

Table 1. Test results for Benford's law for variables at the aggregate level of the Russian economy.

Variable	Pre-invasion	Post-invasion
Average monthly wage	61.00***	107.61***
Retail trade	76.03***	105.97***
Wholesale trade	36.30***	63.52***
Market services	82.49***	69.66***
Consolidated budget income tax	38.21***	37.06***
Corporate profit	11.91	29.51***
Consolidated budget profit tax	6.76	21.73**
Consolidated budget VAT	12.19	21.20**
Federal budget VAT	9.56	31.89***
Federal budget profit tax	13.88*	20.58**
Construction value	43.56***	24.81***
Housing construction (m ² of floorspace)	84.48***	87.26***
Freight volume	932.37***	144.95***

Note: Chi-square test statistics for Benford's law in the pre-invasion period (up to 2022) and post-invasion period (2022 onwards) with the null hypothesis that the data series follow Benford's law. *** denotes statistical significance at the 1 % confidence level, ** at the 5 % confidence level and * at the 10 % confidence level. Shaded cells refer to series that switch from following Benford's law in the pre-invasion period to not following it in the post-invasion period at the confidence level of 1 % (rose) and 5 % (violet).

Table 2. Test results for Benford's law for variables at the regional level of the Russian economy.

Variable	Pre-invasion	Post-invasion
Investment	10.40	8.16
Buildings completed	7.57	8.16
Corporate profit	111.55***	68.99***
Retail trade	336.29***	248.76***
Construction value	32.27***	24.92***
Consolidated budget revenue	28.96***	13.98*

Note: Chi-square test statistics for Benford's law in the pre-invasion period (up to 2022) and post-invasion period (2022 onwards) with the null hypothesis that the data series follow Benford's law. *** denotes statistical significance at the 1 % confidence level (rose?), ** at 5 % confidence level (violet?) and * at 10 % confidence level (sand?). Shaded cells refer to series that follow Benford's law both in the pre- and post-invasion periods.

¹ Russia raised the standard VAT rate from 18 % to 20 % at the beginning of 2019, while the flat income tax rate of 13 %, remained in place for almost all Russian taxpayers. An income tax rate of 15 % was introduced at the beginning of 2021 for annual incomes in excess of 5 million rubles, an amount that applied only to a tiny share of taxpayers. The standard profit tax, which has stood at 20 % for over a decade, is set to increase to 25 % at the beginning of 2025. A one-off excess profit tax (10 % of the part of the average profit in 2022–2023 in excess of the average profit in 2018–2019) was imposed in August 2023 with a payment due by the end of January 2024. These payments have apparently been considered in the Russian budget framework as “other” one-off revenue events. The emphasis of oil taxation has shifted in recent years from exports to crude oil production but is still based on the oil price of Russian oil in the international markets and the ruble-dollar exchange rate.

We also apply the Benford's law at the regional level, analyzing a panel data sample for several variables. Here, data on fixed investment and the floorspace area of buildings completed (reported quarterly) follow Benford's law both in the pre- and post-invasion periods. None of the other data series available at the regional level and reported on a monthly basis follow Benford's law before or after the invasion, making it difficult to draw any conclusions from analysis of these data.

3. Correlations

To examine the evolution of contemporary correlations between economic variables, we consider nominal and real variables with seasonally adjusted data. For most variables, the correlation coefficients remain quite similar and equally high in both periods (Table 3). This also applies to GDP components, with the correlation of real investment and gross fixed capital formation (GFCF) actually increasing in the post-invasion period. For government consumption, the correlation with consolidated budget expenditure remains largely unchanged. The correlation with federal budget expenditure, however, declines substantially, suggesting that federal budget expenditure is currently geared more towards investment than earlier.

There are a number of series with substantial correlation declines between the pre- and post-invasion periods. These are mainly related to tax revenue and corporate profits, pointing to increased uncertainty related to data on these variables. Correlations have also declined between some data series related to construction. In particular, we see declines in the correlation between construction output and buildings completed, as well as between construction output and output of non-metallic minerals (including construction materials). This might reflect the reorientation of construction to infrastructure projects (see Simola, 2024).

Table 3. Contemporary correlations between select economic variables in the pre-invasion period (up to 2M2022 or 1Q2022) and post-invasion period (3M2022 or 2Q2022 onwards).

Variables	Pre-invasion	Post-invasion	Time period
<i>Consumption-related (nominal)</i>			
Consumer services & average wage	0.99	0.98	1M2002–5M2024
Consumer services & total wage	0.98	0.98	1M2002–5M2024
Consumer services & total wage + non-housing household credit	0.98	0.98	1M2002–5M2024
Consumer services & money income	1.00	0.98	1Q2002–2Q2024
Household consumption (GDP) & money income	0.98	0.97	1Q2011–1Q2024
Household consumption (GDP) & consumption services	1.00	0.99	1Q2011–1Q2024
Income tax & average wage	0.99	0.50	1M2002–5M2024
Income tax & total wage	0.99	0.51	1M2002–5M2024
VAT & retail trade	0.90	0.22	1M2005–6M2024
Household credit (excl. housing) & auto sales	-0.30	0.78	1M2010–6M2024
<i>Consumption-related (real)</i>			
Consumer services & average wage	0.94	0.95	1M2002–5M2024
Consumer services & real disposable income	0.98	0.94	1Q2002–2Q2024

Household consumption (GDP) & real disposable income	0.56	0.60	1Q2011–1Q2024
Household consumption (GDP) & consumption services	0.89	0.84	1Q2011–1Q2024
<i>Investment-related (nominal)</i>			
Profit & profit tax	0.75	0.14	1M2002–5M2024
Profit & investment	0.85	0.30	1Q2002–1Q2024
Profit & GFCF	0.83	0.26	1Q2011–1Q2024
Investment & GFCF	0.98	1.00	1Q2011–1Q2024
Investment & corporate loan stock	0.99	0.99	1Q2010–1Q2024
GFCF & corporate loan stock	0.99	0.99	1Q2011–1Q2024
Investment & construction	1.00	0.99	1Q2002–1Q2024
Housing construction & housing loan stock	0.69	0.16	1Q2010–1Q2024
<i>Investment-related (real)</i>			
Construction & non-metallic minerals manufacturing	0.76	0.64	1M2015–6M2024
Construction & investment	0.91	0.94	1Q2004–1Q2024
Construction & buildings completed	0.74	0.17	1Q2002–2Q2024
Investment & GFCF	0.47	0.99	1Q2011–1Q2024
Passenger car sales & production	0.73	0.75	1M2008–6M2024
<i>Other (nominal)</i>			
Exports BoP (RUB) & Exports GDP	1.00	0.99	1Q2011–1Q2024
Imports BoP (RUB) & Imports GDP	1.00	1.00	1Q2011–1Q2024
Imports BoP (RUB) & consolidated budget VAT from imported items	0.99	0.97	1M2005–6M2024
Consolidated budget expenditure & government consumption (GDP)	0.99	0.93	1Q2011–1Q2024
Federal budget expenditure & government consumption (GDP)	0.95	0.44	1Q2011–1Q2024

Note. All data seasonally adjusted. Shaded cells refer to series with a substantial change in the correlation coefficient between the pre- and post-invasion periods: a decline of over 0.5 (rose), a decline of over 0.1 (violet) and an increase of over 0.5 (sand).

4. Structural breaks

We next estimate simple binary regressions for the variables under examination to test for structural breaks in their co-movement in the pre- and post-invasion periods. We regress the dependent variable on one independent variable at a time and perform a Wald test to see if the coefficients vary over the periods. For the lion's share of variables, the results suggest a structural break in spring 2022 (Table 4). In other words, the war apparently shifted relationships between key economic variables. This

finding in itself does not indicate whether the changes represent structural shifts in the Russian economy or statistical manipulation.

Table 4. Test statistics for a structural break in 3M2022.

Estimated regression: $\ln(Y_t) = \ln(X_t)$		
Dependent var (Y_t)	Independent var (X_t)	Structural break at 3M2022
<i>Monthly series</i>		
Consumer services	Average wage	54.04***
Consumer services (real)	Average wage (real)	30.05***
Govt. income tax revenue	Average wage	6.8**
Govt. VAT revenue	Retail trade sales	24.62***
Govt. profit tax revenue	Profit	21.25***
Govt. VAT revenue from imports	Imports BoP	1.5
Car sales (number)	Household loan stock (ex. housing loans)	225.07***
Car production (number)	Car sales (number)	23.16***
Housing construction (m ² of floorspace)	Housing loan stock	27.00***
Output volume of non-metallic minerals	Construction	15.81***
Value of goods exports	Urals price (USD)	50.16***
Govt. oil & gas revenue	Urals price (RUB)	25.75***
<i>Quarterly series</i>		
Consumer services	Money income	1.83
GDP household consumption	Money income	1.44
GDP household consumption	Consumer services	15.17***
Consumer services (real)	Disposable income (real)	9.24***
GDP household consumption (real)	Disposable income (real)	0.09
GDP household consumption (real)	Consumer services (real)	37.62***
GFCF	Investment	0.93
GFCF (real)	Investment (real)	8.32**
Investment	Profit	33.59***
Investment	Corporate loan stock	20.38***
Construction value	Investment	18.23***
Construction volume	Investment (real)	1.78
Construction volume	Buildings completed (m2)	10.18***
Housing construction value	Housing loan stock	9.69***
Exports GDP	Exports BoP	14.43***
Imports GDP	Imports BoP	1.96
Government consumption	Consolidated budget expenditure	0.40
Government consumption	Federal budget expenditure	2.58

Note: All data seasonally adjusted. Nominal value unless otherwise stated.

5. War dummy and explanatory power

We now perform additional simple regressions to shed light on changes in the relationship between variables after the invasion. We regress (logarithm of) the dependent variable on (logarithm of) the independent variable and its interaction with a dummy variable depicting the post-invasion time period. If the dummy variable is statistically significant, there has been a change in the effect of the independent variable on the dependent variable after the invasion. In addition, we compare the R^2 of the simple models in the pre- and post-invasion periods to detect potential changes in the explanatory power of the regressors.

The brevity of the post-invasion period obviously increases uncertainty related to the estimates, especially with respect to quarterly data. In Table 5, we present the results obtained with monthly data (which we consider more reliable). The post-war interaction coefficient is highly statistically significant in nearly all specifications, suggesting that relationships between variables have changed in most cases. In quantitative terms, the effects are generally quite small. For quarterly data, we statistically significant effects from the post-invasion period are rarer.

The effect of the invasion in the explanatory power of the variables varies substantially across variables. For most consumption-related variables, R^2 is very high in both the pre- and post-invasion periods (and even increases substantially for a few variables). Export and import series reported in the national accounts and balance of payments are practically identical both before and after the invasion. The most dramatic changes related to the explanatory power are related to government revenue and spending, corporate profits and construction indicators. For most of these variables, R^2 in the post-invasion period plummets to a few percent, even when it exceeded 90 % in the pre-invasion period.

Table 5. Estimation results for binary regressions on select economic variables.

Estimated regression: $\text{Ln}(Y_t) = \text{Ln}(X_t) + \text{WartimeDummy} * \text{Ln}(X_t)$				
Dependent var (Y_t)	Independent var (X_t)	Wartime interaction coefficient	Pre-invasion R^2	Post-invasion R^2
<i>Monthly series</i>				
Consumer services	Average wage	-0.007***	0.99	0.96
Consumer services (real)	Average wage (real)	-0.007***	0.94	0.90
Govt. income tax revenue	Average wage	-0.012**	0.99	0.04
Govt. VAT revenue	Retail trade sales	0.046***	0.67	0.06
Govt. profit tax revenue	Profit	0.028**	0.72	0.06
Govt. VAT revenue from imports	Imports BoP	0.000	0.99	0.94
Car sales (number)	Household loan stock (ex. housing loans)	-0.063***	0.04	0.69
Car production (number)	Car sales (number)	-0.034***	0.45	0.55
Housing construction (m ² of floorspace)	Housing loan stock	0.026***	0.43	0.04
Output volume of non-metallic minerals	Construction (real)	0.007*	0.56	0.38

<i>Quarterly series</i>				
Consumer services	Money income	-0.002	0.99	0.96
GDP household consumption	Money income	-0.000	0.96	0.92
GDP household consumption	Consumer services	0.003***	0.99	0.98
Consumer services (real)	Disposable income (real)	-0.008***	0.97	0.86
GDP household consumption (real)	Disposable income (real)	0.001	0.31	0.68
GDP household consumption (real)	Consumer services (real)	0.008***	0.80	0.95
GFCF	Investment	-0.002	0.97	0.99
GFCF (real)	Investment (real)	0.045***	0.16	0.97
Investment	Profit	0.001	0.88	0.13
Investment	Corporate loan stock	0.010***	0.96	0.99
Construction	Investment	-0.007***	0.99	0.98
Construction (real)	Investment (real)	-0.003	0.88	0.88
Construction (real)	Buildings completed (m2)	0.003	0.71	0.03
Housing construction	Housing loan stock	0.010**	0.54	0.01
Exports GDP	Exports BoP	0.000	1	1
Imports GDP	Imports BoP	-0.000	1	1
Government consumption	Consolidated budget expenditure	0.001	0.97	0.84
Government consumption	Federal budget expenditure	-0.003	0.91	0.18

Note. All data seasonally adjusted. Nominal value unless otherwise stated. Shaded cells refer to series with a substantial change in the explanatory power between the pre- and post-invasion periods: a decline of over 0.5 (rose), a decline of over 0.1 (violet) and an increase of over 0.1 (sand).

6. VAR analysis

To capture more subtle temporal effects, we construct simple binary VAR models for several key variables and check to see if the model fit has changed in the post-invasion period. We regress the dependent variable on the independent variable and two lags of both variables² from the beginning of 2002 (when available) up to end-2021. We then compare the value predicted by the model with the realized outcome. We also examine the evolution of standard errors of the predictions.

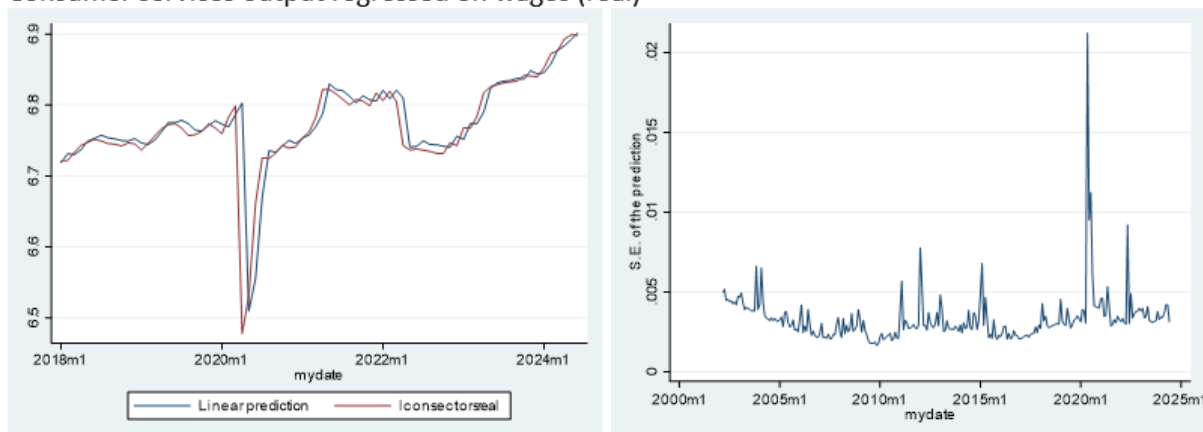
For most series, the standard error of the prediction has substantially increased in the post-invasion period (presented in the first rows of Figures 1 and 2, and in Appendix 2). For many of the series, the increase in the standard error of the prediction is similar to the period when the Covid-19 pandemic was at its height. The main exception is the lack of increase in consumption-related series, particularly when compared to the Covid-19 episode. The standard error only climbs to similar levels to those recorded in 2020 for the real household consumption – real disposable income model (Figure 2, first row).

² The data is seasonally adjusted and expressed in most cases in logs. For a few series we use instead series without taking the logarithms, because they have some negative values, and we want to include also these values.

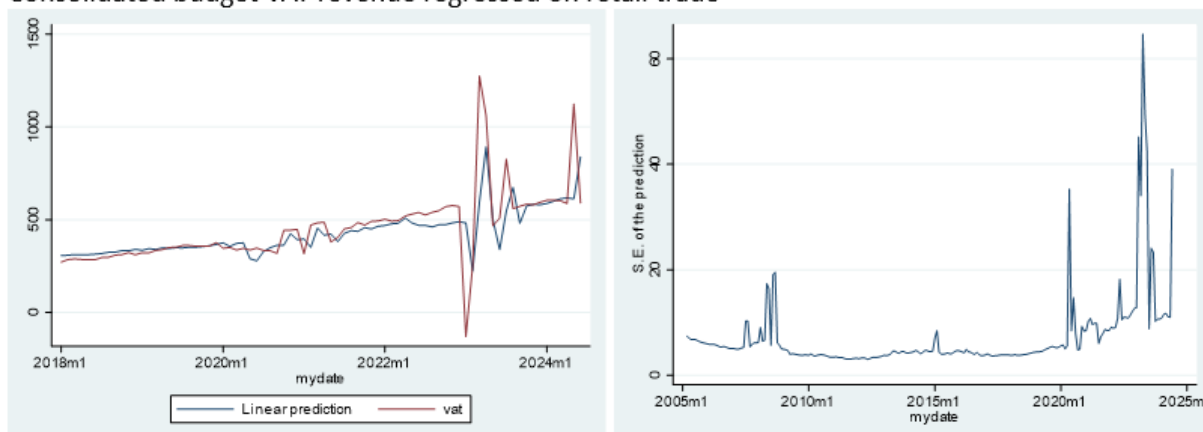
The most striking jump in the standard error is seen for tax-related variables. The standard errors of predictions for VAT and profit tax sharply increase in the latest time-period and rise much more than during the covid-19 period (Figure 1, second and third rows). Similar developments are to some extent recorded also for predictions from investment-profit and government consumption-consolidated budget revenue models (Figure 2, beginning of third and fourth rows).

Figure 1. VAR-model predictions and prediction standard errors for selected monthly variables.

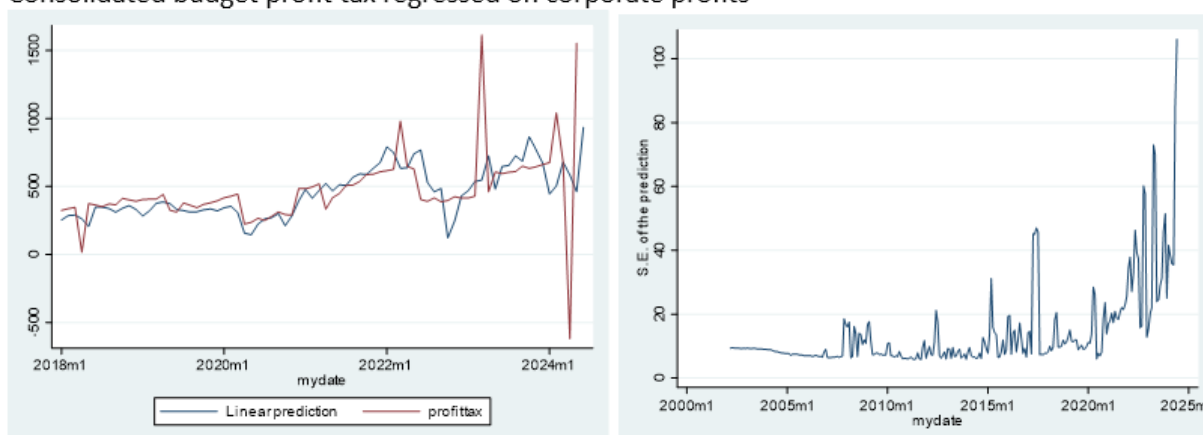
Consumer services output regressed on wages (real)



Consolidated budget VAT revenue regressed on retail trade



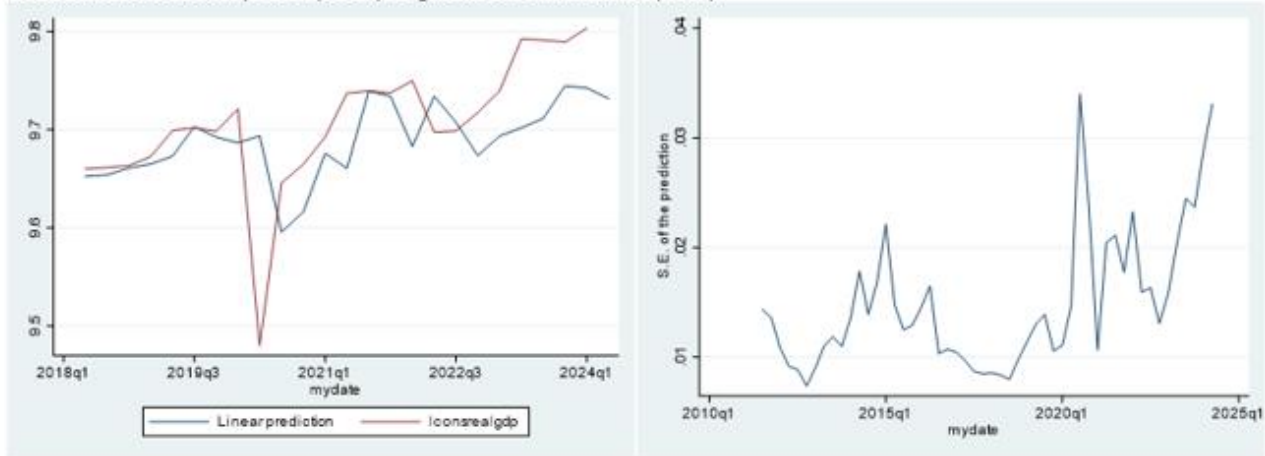
Consolidated budget profit tax regressed on corporate profits



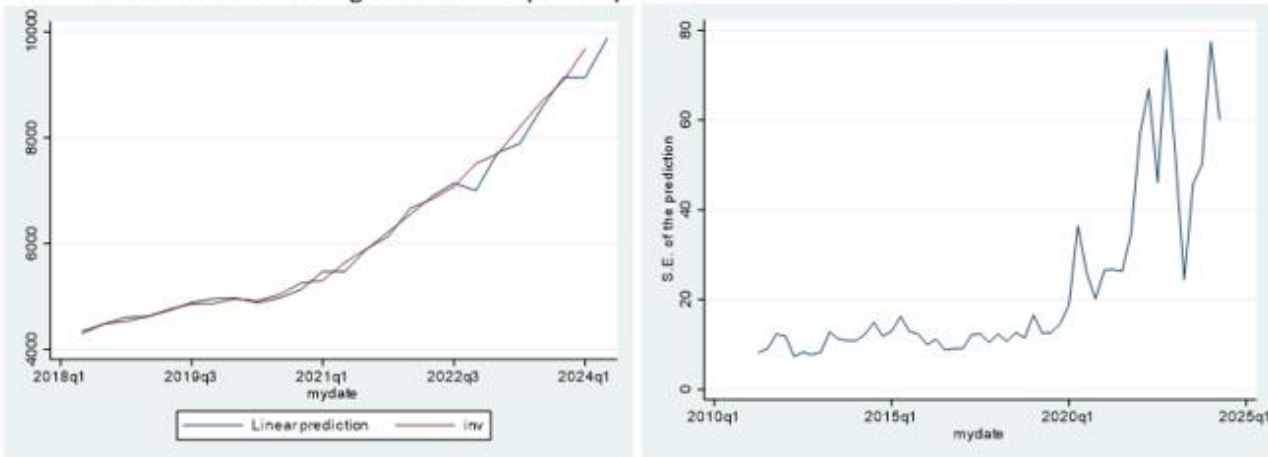
Source: Author's calculations.

Figure 2. VAR-model predictions and prediction standard errors for selected quarterly variables.

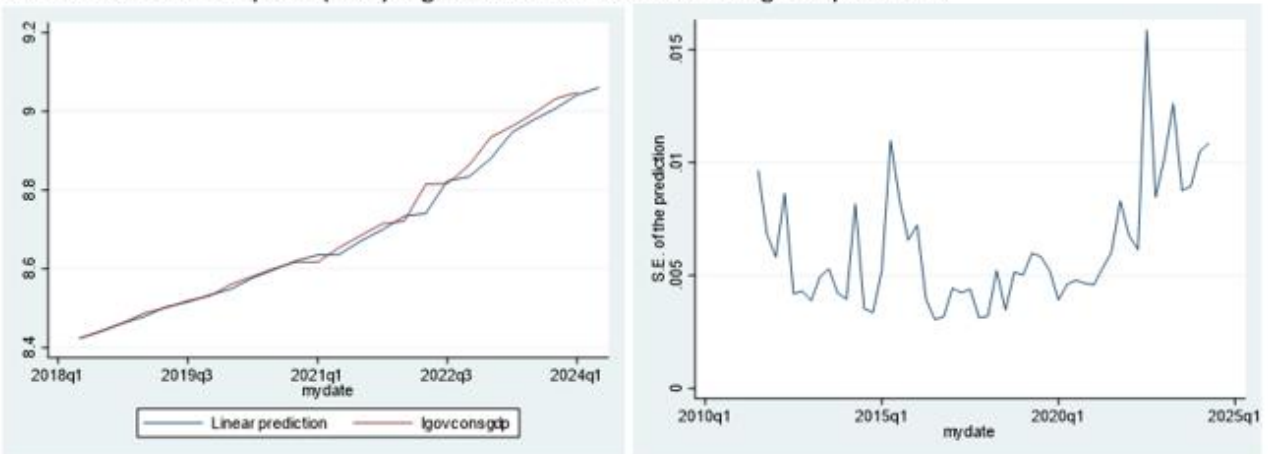
Household consumption (GDP) regressed on income (real)



Investment in fixed assets regressed on corporate profits



Government consumption (GDP) regressed on consolidated budget expenditure



Source: Author's calculations.

7. Comparison with external statistics

Finally, we compare Russian statistics with statistical information provided by foreign institutions. We limit our analysis to few data series due to the lack of suitable foreign data. In addition to comparing the foreign trade statistics reported by the Central Bank of Russia (CBR) against mirror data (foreign trade statistics from trade partners as reported by IMF DOTS), we also compare some series against trends in the Urals oil price. The uncertainty of Urals oil price estimates also increased after Western countries imposed sanctions on Russian oil exports.

As depicted in Table 6, the correlation between trade statistics reported by the CBR and Russia's trading partners was very high in the pre-invasion period and dipped only slightly after the invasion (see also Simola, 2023). The correlations between exports and government oil & gas revenue with Urals oil price has, however, declined notably in the post-invasion period. This finding is in line with the war-dummy regression results suggesting that the explanatory power of Urals oil price has substantially diminished in recent years (Table 7).

Table 6. Contemporary correlations between selected Russian economic variables and data provided by external sources in the pre-invasion period (up to 2M2022) and post-invasion period (from 3M2022)

Variables	Pre-invasion	Post-invasion	Time period
Russian goods exports & sum of partner country imports from Russia	0.99	0.95	1M2002–4M2024
Russian goods imports & sum of partner country exports to Russia	0.99	0.96	1M2002–4M2024
Russian goods exports & Urals oil price	0.89	0.61	1M2002–5M2024
Federal budget oil & gas revenue & Urals oil price	0.96	0.65	1M2013–5M2024

Note. Shaded cells refer to series with a substantial change in the correlation coefficient between the pre- and post-invasion periods: a decline of over 0.5 (rose), a decline of over 0.1 (violet) and an increase of over 0.5 (sand).

Table 7. Estimation results for binary regressions on Urals oil price

Estimated regression: $\text{Ln}(Y_t) = \text{Ln}(X_t) + \text{WartimeDummy} * \text{Ln}(X_t)$				
Dependent var (Y_t)	Independent var (X_t)	Wartime interaction coefficient	Pre-invasion R^2	Post-invasion R^2
Value of goods exports	Urals price (USD)	0.065***	0.80	0.28
Government oil & gas revenue	Urals price (RUB)	-0.002	0.44	0.01

Note. Shaded cells refer to series with a substantial change in the explanatory power between the pre- and post-invasion periods: a decline of over 0.5 (rose), a decline of over 0.1 (violet) and an increase of over 0.5 (sand).

8. Conclusion

Our analysis suggests that the relationship and explanatory power has remained high for various statistical series related to consumption and provided by Rosstat. This may indicate that these data have been and remain quite accurate. On the other hand, since all these series are provided by the same organization, it is less complicated to manipulate them to be internally coherent. This applies

also to series of GDP by use. Interestingly, the coherence between investment and GFCF statistics even seems to have improved in the post-invasion period.

The data suggest that increased uncertainty is associated particularly with certain budget data. All our measures indicate a notable effect of the invasion on these data series both at monthly and quarterly frequency. They cease to follow Benford's law and their previous high correlations with other related economic data have vanished. Moreover, the explanatory and predictive power associated with budget data has declined. The budget data are provided by institutions that do not generate economic statistics (Ministry of Finance and Roskazna), so it might be more difficult to coordinate or cross-check the statistics than within a single data provider.

While these findings raise suspicions related to the quality of the data, we should be cautious about drawing conclusions. We still have only a short period (from a statistical viewpoint) since the invasion and the war could cause other discrepancies in statistics unrelated to manipulation (see e.g. Solanko, 2024). For example, the notably weaker association between federal budget spending and government consumption could be related to the changes in the structure of federal budget spending – particularly the substantially larger share devoted to military expenditure.

Other statistical series that stand out from the analysis are corporate profits and variables related to construction output. While earlier there was already some uncertainty related to the corporate profits, our analysis suggests that there has been a notable increase in this uncertainty since the invasion – by all the measures we applied and at both monthly and quarterly levels. This also applies to series such as investment provided by Rosstat, and contrasts with the fact that the associations between investment and other relevant variables have actually changed very little. We find some suspicious trends with construction variables, too, but these might be explained by changes in the structure of construction output. For example, an increase emphasis on infrastructure and fortification construction could weaken the relationship with buildings completed and output of construction materials.

It appears that the changes in the relationships between some economic variables is associated with a sharp increase in the volatility of certain series (e.g. tax revenues) after Russia's invasion of Ukraine. This is not observed for other series. Whether this is related to data manipulation or other changes caused by Russia's war is difficult to determine categorically.

Thus, while we find irregularities and increased uncertainty related to Russian statistical data, there is no compelling evidence of systematic, large-scale manipulation of statistics since Russia's invasion of Ukraine. Lacking sufficient evidence of intentional fudging of figures, it would be risky to assume that official statistics paint an unrealistically rosy picture of the state of the Russian economy.

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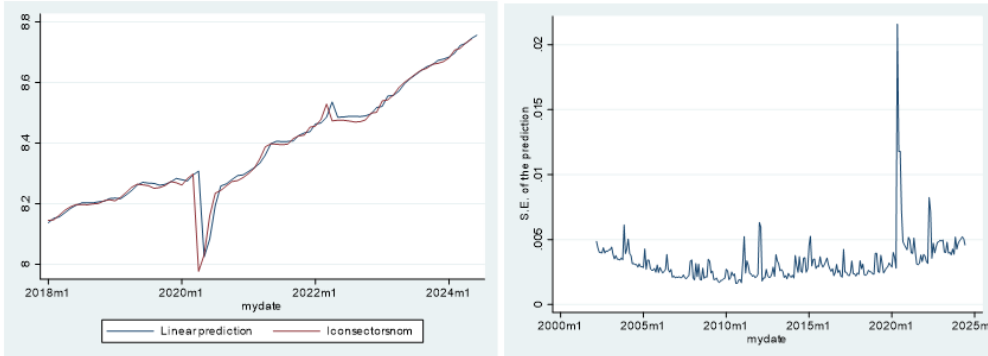
Appendix 1. Description of variables employed in the analyses

Variable	Unit	Source	Time period
Consumer services ¹	nominal & real RUB	Rosstat	1M2002–6M2024
Retail trade	nominal & real RUB	Rosstat	1M2002–6M2024
Average wage	RUB	Rosstat	1M2002–5M2024
Total wage ²	RUB	Rosstat	1M2002–5M2024
Money income	RUB	Rosstat	1Q2002–2Q2024
Real disposable income	real RUB	Rosstat	1Q2002–2Q2024
Household consumption (GDP)	nominal & real RUB	Rosstat	1Q2011–1Q2024
Household credit (ex. housing)	RUB	CBR	1M2010–6M2024
Housing loans stock	RUB	CBR	1M2010–6M2024
Car sales	number	AEB	1M2008–6M2024
Investment	nominal & real RUB	Rosstat	1Q2002–1Q2024
Gross fixed capital formation (GDP)	nominal & real RUB	Rosstat	1Q2011–1Q2024
Corporate profit	RUB	Rosstat	1M2002–5M2024
Corporate loan stock	RUB	CBR	1M2010–6M2024
Construction output	nominal & real RUB	Rosstat	1Q2011–1Q2024
Housing construction	RUB	Rosstat	1M2002–6M2024
Housing surface completed	m2	Rosstat	1M2002–6M2024
Buildings completed	m2	Rosstat	1Q2002–1Q2024
Output volume of non-metallic minerals manufacturing	real RUB	Rosstat	1M2015–6M2024
Output of passenger cars	number	Rosstat	1M2002–6M2024
Government consumption (GDP)	RUB	Rosstat	1Q2011–1Q2024
Consolidated budget expenditure	RUB	Roskazna	1M2002–5M2024
Federal budget expenditure	RUB	MoF	1M2002–5M2024
Government income tax revenue	RUB	Roskazna	1M2002–5M2024
Government VAT revenue	RUB	Roskazna	1M2002–5M2024
Government VAT revenue from imports	RUB	Roskazna	1M2005–6M2024
Exports of goods & services (BoP)	USD	CBR	1M2002–6M2024
Imports of goods & services (BoP)	USD	CBR	1M2002–6M2024
Exports of goods & services (GDP)	RUB	Rosstat	1Q2011–1Q2024
Imports of goods & services (GDP)	RUB	Rosstat	1Q2011–1Q2024
Urals oil price	USD	OPEC	1M2002–5M2024

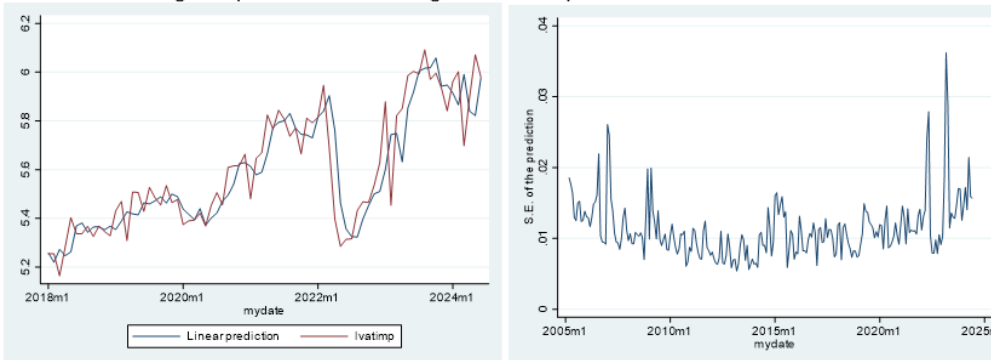
Note. ¹ Consumer services = sum of retail trade, catering services and services for households, ² Total wage = number of employed x average monthly wage

Appendix 2. Additional results of VAR models (monthly and quarterly variables)

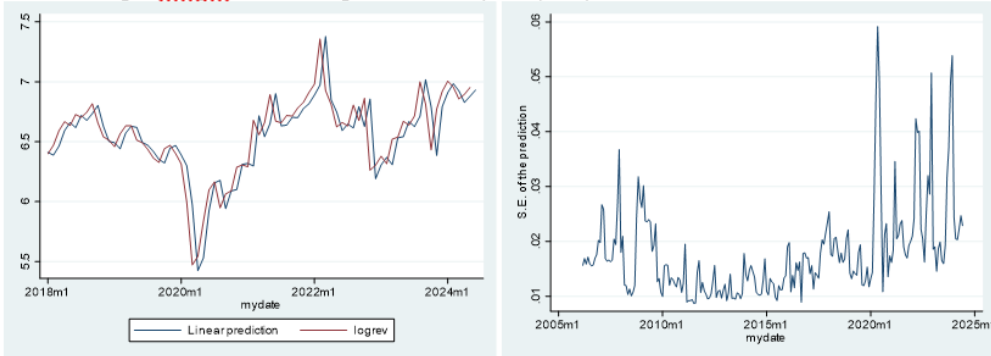
Consumer services output regressed on wages



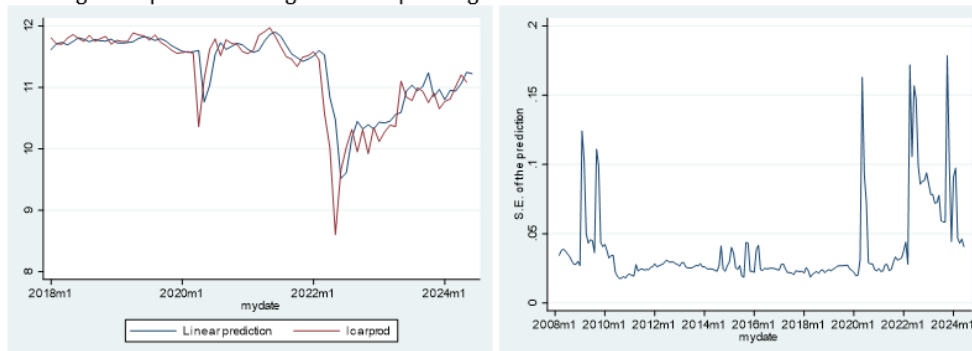
Consolidated budget import VAT revenue regressed on imports



Federal budget oil&gas revenue regressed on oil price (RUB)



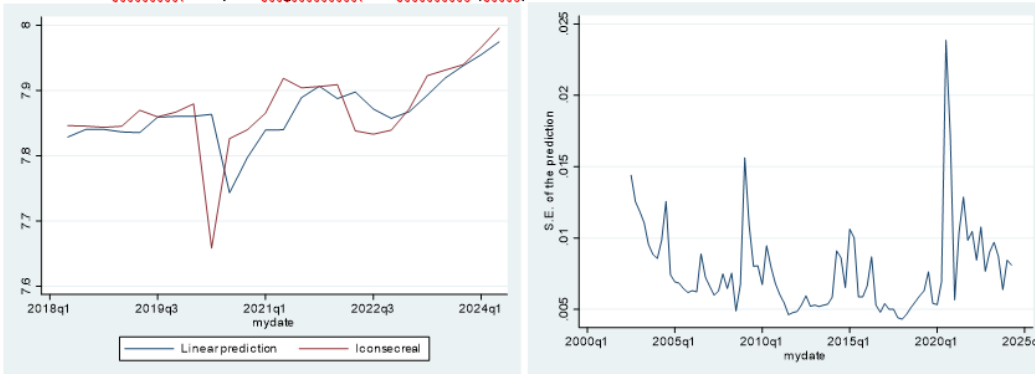
Passenger car production regressed on passenger car sales



Consumer service output regressed on income



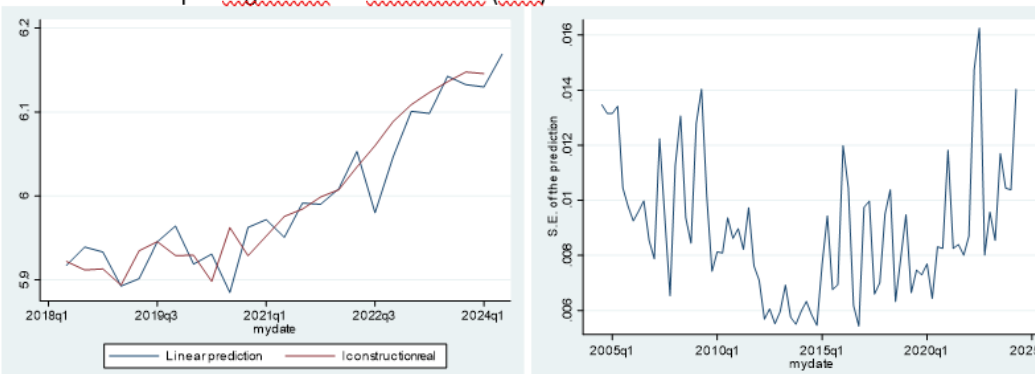
Consumer service output regressed on income (real)



GFCF regressed on investment (real)



Construction output regressed on investment (real)



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