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Financial Sustainable Growth System 2030 Evidence from Russian and Chinese Gas Companies

A.N. Steblyanskaya[a], Zhen Wang[b], G.B. Kleiner[c], Z.V. Bragina[d], A.R. Denisov[e]
[a] Harbin Engineering University, Harbin, China; [b] China University of Petroleum (Beijing), Beijing, China;
[c] Central Economics and Mathematical Institute of RAS, Moscow, Russia; Financial University under the Government of the Russian Federation, Moscow, Russia; [d, e] Kostroma State University, Kostroma, Russia
[a] https://orcid.org/0000-0002-1995-4651; [b] https://orcid.org/ 0000-0002-3359-4103;
[c] https://orcid.org/0000-0003-2747-6159; [d] https://orcid.org/0000-0003-2676-8862;
[e] https://orcid.org/0000-0003-3457-4574

ABSTRACT

The aim of the article is to study the prospects for sustainable financial growth of the gas industry in Russia and China until 2030. Unlike traditional interpretations, the authors consider financial sustainability as a result of the interaction and mutual influence of energy, environmental, economic and social processes grouped into subsystems. The authors analyzed the statistical indicators of the sustainable financial growth system of the largest oil and gas companies in Russia and China from 1996 to 2016. A model for calculating the financial sustainable growth system in the Python programming language was developed. The Lasso regression analysis method and the SARIMA model were used. The sustainable financial growth system index of oil and gas companies was substantiated. By means of the system methodology, the authors identified problems and systematized the contradictions in the organization of the sustainable financial growth in the gas industry of the two countries. As part of the proposed methodological approach, the original SARIMA model was built. The model explains the internal structure of the financial growth sustainability of the oil and gas industry in Russia and China. The authors calculated the sustainable financial growth system forecast for Russia and China until 2030. The calculations showed that in the future the system of sustainable financial growth in China's oil and gas industry may be disrupted. The authors offer ways to prevent the development of these negative trends. Namely: the promotion of social responsibility of state corporations, the development of green and social financing, the study of energy efficiency. In Russia, the stability of the financial growth of the oil and gas industry is characterized by stability over the entire forecast period.

Keywords: Russian and Chinese gas industry; environmental finance; financial sustainable growth; Financial Sustainable Growth Index (FSI); impact of social, energy and environmental factors on sustainable growth

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INTRODUCTION

In 1980s, researchers started a fundamental transvaluation of economic growth. They tried to analyze economic theory with a focus on environmental protection and social responsibility. For the first time, at the UN Conference on Environment and Development, they mainstreamed the importance of maintaining the environmental process and life support systems with the common goal of "sustainable development through conservation of living resources"[1]. "Sustainability" itself is considered in many contexts, including energy, ecology, economics, politics, society, technology, etc. Financial sustainability cannot be discussed outside the context. The new methodology should include interactions and relationships between external and internal factors of the system and be conscientious regarding the entire system as a fundamental touchstone of sustainability [1]. Today, determining the prospects for the financial growth itself is not enough. Sustainability as a holistic concept demands that financial growth be closely linked to social, ecological and wider energy environment.

This study tests the theory of systemic financial sustainable growth of the gas industry, as well as tools for its assessing and forecasting. The authors offer their own interpretation of the financial sustainable growth system which is considered as a result of the interaction and mutual influence of energy, environmental, economic and social indicators. They analyze the challenges of the strategy of financial sustainable growth for Russian and Chinese gas companies until 2030. Calculating the financial indicator to determine the prospects for financial growth is not sufficient. It is necessary to consider the social, ecological and energy environment. It is important to analyze the opportunities for stable growth for the environment and people with no further consequences. Thus, the research priority area is to model financial sustainable growth and to study the interaction between the financial, social, energy and environmental subsystems.

Research hypothesis: there is a relationship between financial factors and the social, energy and environmental subsystems of the gas industry in Russia and China whose nature affects financial sustainable growth. The authors try to confirm or deny transversal relationships between the subsystems.

The financial sustainable growth system is the most important prerequisite not only for the economic development of the countries as a whole, but also for individual industries and companies [1]. By means of the system methodology, the authors identified problems and systematized the contradictions in the organization of the financial sustainable growth in the gas industry of the two countries.

A lot of studies by both domestic and foreign authors are devoted to financial sustainable growth. There, the phenomenon of financial sustainable growth appears to be a managerial function oriented towards a competitive market. However, non-financial factors of sustainable growth in the oil and gas industry were not institutionalized. This hindered its adaptation to the rapidly changing competitive environment.

There is no exact and generally accepted definition of the financial sustainable growth system. There are no tools for describing methods to achieve financial sustainable growth.

Thus, R. Higgins, I. Ivashkovskaya, T. Geniberg et al. consider financial sustainable growth only as a financial function of the economic system, focusing on the qualitative characteristics of sustainable growth, though in the area of "corporate governance" [2–4]. A. Sheremet focuses on the need to consider the influence of environmental factors and social responsibility of business on financial sustainable growth [5]. In UN documents, the G20 Green Finance Study Group formulated a similar statement: when assessing the sustainability of financial growth, it is necessary to consider the impact of ecological, energy and social environments[2].

[1] United Nations Conference, 1992, Rio de Janeiro. UNCED. (1992). Earth Summit'92.

[2] European Commission Interim report — Financing a sustainable European economy. 2017:1–72. URL: https://ec.europa.eu/info/sites/info/files/170713-sustainable-finance-report_en.pdf (accessed on 14.06.2019); G20 Green Finance Study

Economic growth is directly linked to the so-called unacceptable costs of declining social welfare. According to Herman Daly, these costs arise as a result of "the social and environmental sacrifices made necessary by that growing encroachment on the eco-system" [6]. In his works, Herman Daly demonstrates the relationship between sustainable economic growth and environmental protection. Several researchers emphasized the relationship between energy efficiency, social responsibility and company financial performance. For example, Charles A. S. Hall emphasized that there is a "need to reintegrate natural sciences with the economy" and that the EROEI (Energy Return on Energy Invested) indicator should be a fundamental element of the new biophysical economy [7, 8].

METHODOLOGY

Data, software and modelling methodology

The study used publicly available statistical indicators of financial sustainable growth in Russian and Chinese oil and gas companies from 1996 to 2016 (see *Appendix*). The indices for the study were selected according to a stable financial assessment of growth functions. The data are classified according to areas of sustainable development with respect to finance, environmental, energy and social factors. The Department of Informatics and Computer Engineering of the Kostroma State University developed a model for calculating the financial sustainable growth system. The calculations are in the Python programming language[3] [9].

Important parameters of the model were determined by means of the Lasso regression analysis [10]. The authors built a linear regression and estimated confidence intervals for the parameter coefficients. The authors analyzed the parameter intervals not including 0 (a significant parameter with a confidence of 90%). Then, the linear regression of the significant parameters was built and the residuals were estimated. Lasso regression performs L1 regularization which adds a penalty equal to the absolute value of the magnitude of the coefficients. This type of regularization can lead to sparse models with several coefficients. Some coefficients can become zero, and then they are excluded from the model. Large residuals lead to the fact that the values of many coefficients approach zero which is ideal for creating simpler models. The Lasso regression analysis permits to minimize the cross-correlation between the parameters. The SARIMA model [11, 12] reveals autocorrelation in residuals after Lasso. The forecast is made based on the sum of the forecasts by the Lasso and SARIMA models.

Research methodology

The core typology of the systems grounds on their fundamentally different types depending on the characteristics in space and time. In this work, under the financial sustainable growth system the authors understand a complex of financial, social, environmental and energy processes in the economy separated into subsystems [1, 13]. All these subsystems — society, energy, environment and finance — are interconnected. The basis of the system is the financial subsystem [3]. It is a regulator in sustainable growth, since the environmental and social subsystems are developing due to funding. The development of the energy subsystem depends on the financial and social subsystems.

To assess the state of the financial sustainable growth system of the oil and gas industry, the authors offer an indicator that includes indices of all four subsystems: environmental, social, energy and financial [1].

The index of the "financial sustainable growth of the oil and gas industry" system is denoted as FSI; the financial subsystem index is FI; the environmental subsystem index is EnvI; the social subsystem index is SocI; the energy subsystem index is EI.

Group. G20 Green Finance Synthesis Report 2016. URL: http://www.g20.utoronto.ca/2016/P020160815359441639994.pdf (accessed on 14.06.2019).

[3] University of Michigan Coursera (2018) Applied Social Network Analysis in Python URL: https://www.coursera.org/learn/python-social-network-analysis (accessed on 14.06.2019); Sarker DMOF (2014) Python Network Programming book https://rutracker.org/forum/viewtopic.php?t=4987720 (accessed on 14.06.2019).

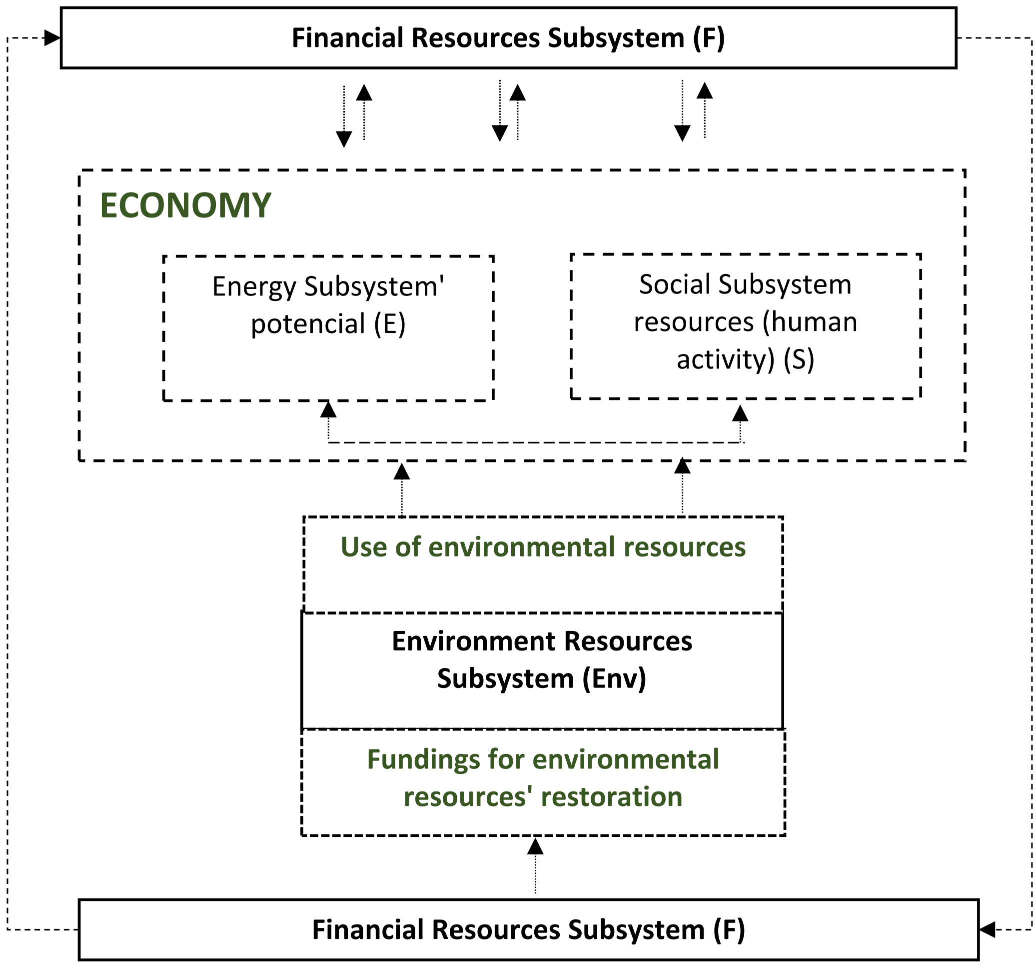

Fig. 1. **Financial subsystem interconnections with energy, environmental and social subsystems within the financial sustainable growth system**

Source: authors' interpretation of the system of financial sustainable growth based on research [14–18].

An individual index has been calculated for each subsystem for each time period characterizing the results of economic processes included in the subsystem [1].

Fig. 1 presents the characteristics of the financial sustainable growth system.

The authors transformed the initial data for each subsystem in the range from 0 to 1 using the following formula:

$$X_{index} = \frac{X - X_{min}}{X_{max} - X_{min}}. \quad (1)$$

The subsystem indices from 0 to 1 are normalized to guarantee the same weight of all variables.

The financial sustainable growth index (FSI) is calculated as the geometric mean of the indices of four subsystems:

$$FSI = \sqrt[4]{FI \times EI \times SocI \times EnvI}. \quad (2)$$

If the FSI is less than 0.2, then the system has a low level of transversal links between the subsystems. If 0.5 <FSI> 0.2, the interactions of the systems are poor. If the FSI is more than 0.5, but less than 0.7, the system is normally interconnected. If the FSI is more than 0.7, then the system is well interconnected [1].

RESULTS

Modelling results of financial sustainable growth index (FSI) for Russian oil and gas companies

The authors determined the parameters that most affect the financial sustainable growth index by means of Lasso regression. We con-

Table 1

Linear regression results (factors influencing SGI Higgins)

OLS Regression Results

Dep. Variable:	FSI	R-squared:	0.892
Model:	OLS	Adj. R-squared:	0.878
Method:	Least Squares	F-statistic:	122.8
Date:	Sun, 03 Feb 2019	Prob (F-statistic):	8.56e-41
Time:	12:53:48	Log-Likelihood:	278.45
No. Observations:	84	AIC:	-536.9
Df Residuals:	74	BIC:	-512.6
Df Model:	9		
Covariance Type:	HC1		

	coef	std err	z	P>|z|	[0.025	0.975]
Intercept	-0.2762	0.053	-5.224	0.000	-0.380	-0.173
PRP	-0.0254	0.013	-1.985	0.047	-0.050	-0.000
ROEnv	0.1532	0.008	18.047	0.000	0.137	0.170
FOORPRINT	0.1698	0.029	5.764	0.000	0.112	0.228
BIOCAPACITY	0.2860	0.074	3.865	0.000	0.141	0.431
CR	0.1037	0.013	7.787	0.000	0.078	0.130
ROS	0.0439	0.008	5.232	0.000	0.027	0.060
ROCE	-0.0535	0.011	-4.755	0.000	-0.075	-0.031
ROE	0.0740	0.014	5.470	0.000	0.048	0.101
EBIT	-0.0481	0.006	-8.121	0.000	-0.060	-0.036

Omnibus:	1.814	Durbin-Watson:	1.257
Prob(Omnibus):	0.404	Jarque-Bera (JB):	1.415
Skew:	-0.119	Prob(JB):	0.493
Kurtosis:	2.411	Cond. No.	199.

Source: authors' calculations based on Python 3.4 program.

structed a linear regression and estimated the coefficients by choosing only the parameters whose admissible interval did not include 0 with a probability of 90% (*Table 1*).

$$FSI = F\,(PRP + ROEnv + FOORPRINT + \\ + BIOCAPACITY + CR + ROS + ROCE + ROE + \\ + EBIT).$$

The following factors affect the FSI: production-to-reserves ratio (PRP), return on equity, EBIT, environmental footprint, biocapacity, costs concerning environmental protection and decision of pollution question/production, current assets / current liabilities, return on sales, and return on capital employed.

The authors found the residuals and built autoregression. You can see the actual data reduced by the modelling data (*Fig. 2*). Then, the authors checked the residuals of the data not recognized after Lasso regression. Autoregression is applicable for stationary residuals. We consider the Dickey-Fuller tests for the hypothesis that the data (residuals) are non-stationary. The authors intend to apply the SARIMA model to the residuals, and therefore, the simulation should show that the data in the form of noise fluctuate around zero. If not, the data are not stationary, and the SARIMA model will not show consistent results.

The Dickey-Fuller tests suggest that the observed series is described by a finite-order autoregressive model. The Dickey-Fuller test is: $p = 0.000098$. If the Dickey-Fuller test p is less than 0.05, then the residuals are random and we can use the SARIMA model (*Fig. 3*).

We will do a visual search for autocorrelations and correlations in differences. The division on the right is an offset by one period back. If the black rod goes beyond the blue zone (error), then autocorrelation in the data is possible for this period. Thus, we made sure that we have autocorrelation in the data, and we can analyze the

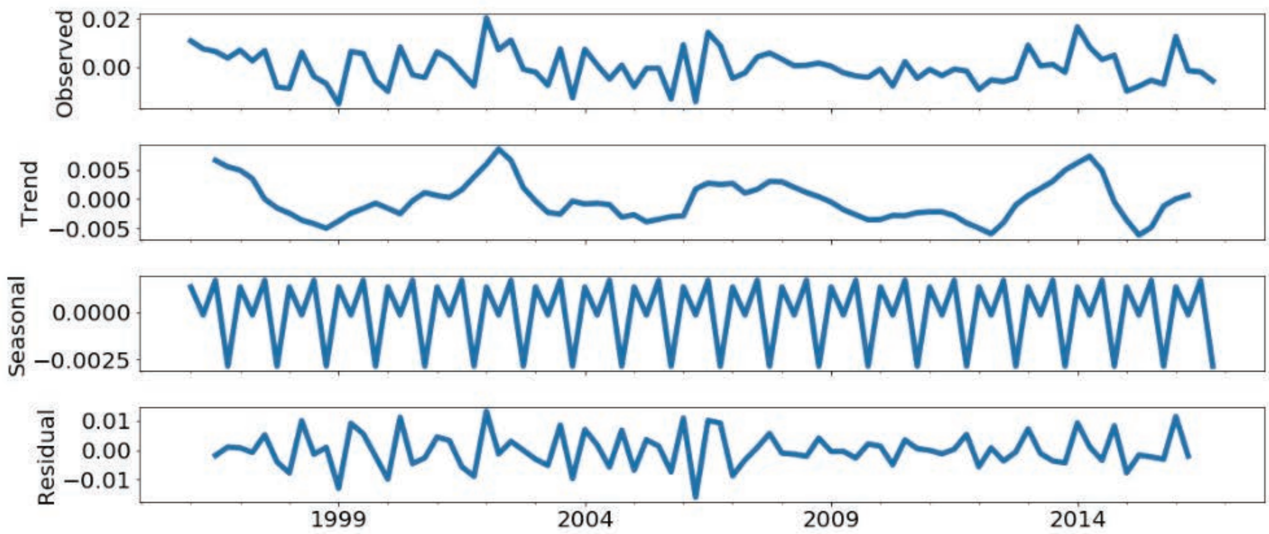

Fig. 2. **Structure of residuals after regression analysis**

Source: authors' calculations based on Python 3.4 program.

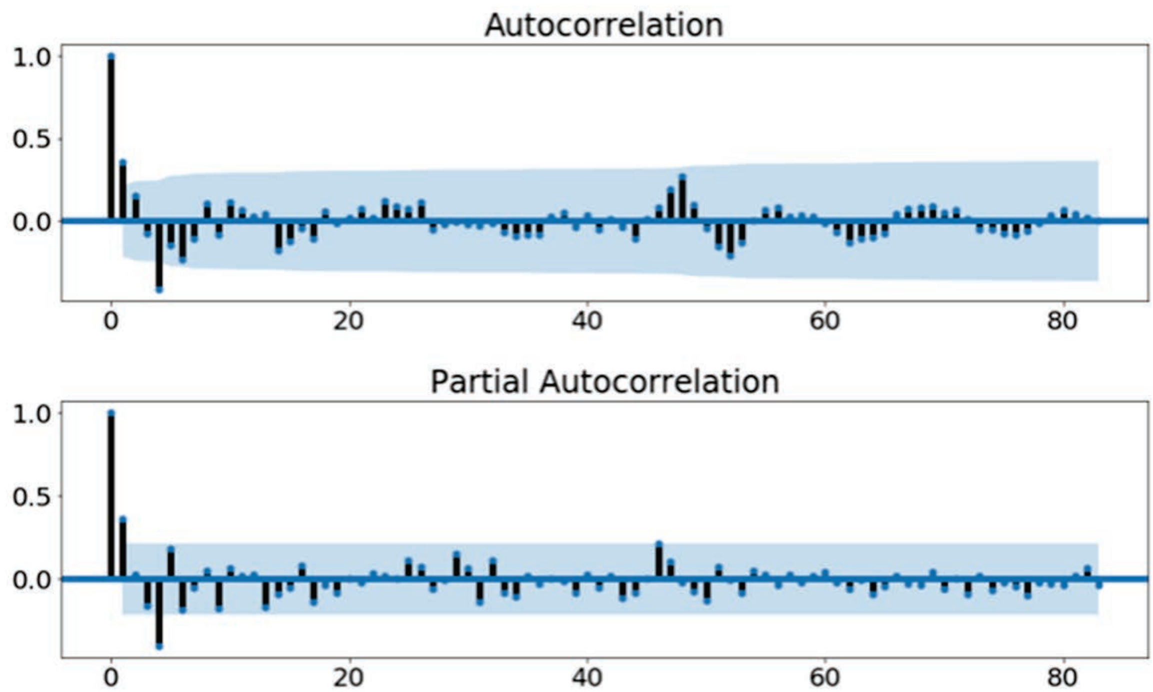

Fig. 3. **Significance of autocorrelation components**

Source: authors' calculations based on Python 3.4 program.

data using autoregressive analysis of residuals. If everything is in the blue zone, SARIMA autoregression will not result in anything.

Next, we select the optimal parameters of the SARIMA model by the Akaike information criterion (AIC). *Fig. 5* shows its parameters. *Table 2* shows the analysis results of the residuals.

Student's t-test: p = 0.907 407.

Dickey-Fuller test: p = 0.000 000.

The residuals are not biased (confirmed by the Student's t-test, p> 0.05 — the hypothesis of unbiased residuals is not rejected), the residuals have a stationary position (confirmed by the Dickey-Fuller test, p <0.05, the hypothesis of non-stationary residuals is rejected), they are not autocorrelated (confirmed by the Ljung-Box test, p> 0.05,— the hypothesis of the absence of autocorrelation is not rejected, there are no

Table 2

SARIMA model parameters for FSI model (Russia)

Statespace Model Results

Dep. Variable:	FSI	No. Observations:	84
Model:	SARIMAX(1, 0, 0)x(0, 0, 2, 4)	Log Likelihood	295.362
Date:	Sun, 03 Feb 2019	AIC	-582.724
Time:	12:57:40	BIC	-573.000
Sample:	01-01-1996 - 10-01-2016	HQIC	-578.815
Covariance Type:	opg		

	coef	std err	z	P>|z|	[0.025	0.975]
ar.L1	0.4852	0.098	4.960	0.000	0.293	0.677
ma.S.L4	-0.5355	0.104	-5.162	0.000	-0.739	-0.332
ma.S.L8	0.3825	0.083	4.604	0.000	0.220	0.545
sigma2	5.032e-05	9.01e-06	5.584	0.000	3.27e-05	6.8e-05

Ljung-Box (Q):	38.06	Jarque-Bera (JB):	1.20
Prob(Q):	0.56	Prob(JB):	0.55
Heteroskedasticity (H):	0.69	Skew:	0.29
Prob(H) (two-sided):	0.34	Kurtosis:	2.90

Source: authors' calculations based on Python 3.4 program.

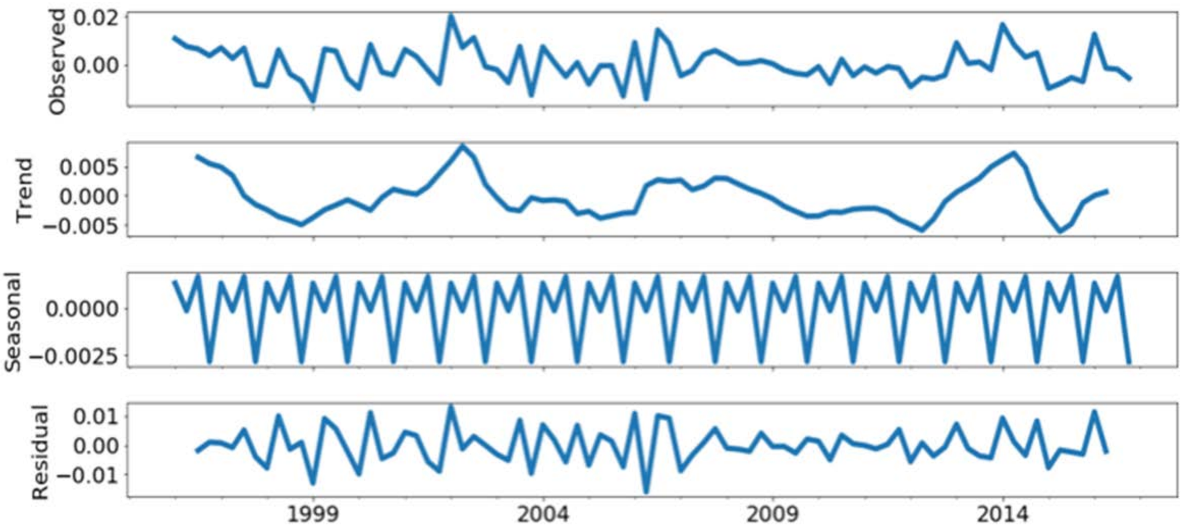

Fig. 4. **Analysis of residuals after the SARIMA model**

Source: authors' calculations based on Python 3.4 program.

significant dependences in the correlogram). We extracted all autoregressions. The residuals are heteroskedastic (*Fig. 4*).

As seen from the diagram, the residual distribution seems to be normal. Therefore, we can conclude that their further analysis will not bring results (*Fig. 5*).

Fig. 6 shows that the FSI is stable throughout the forecast period. However, according to the goals of the Energy Strategy of Russia for the period up to 2030 (ESRF, 2017), the average FSI level in Russian companies should increase to the level of 0.5–0.6. The authors' forecast does not confirm this statement. As we can see, with

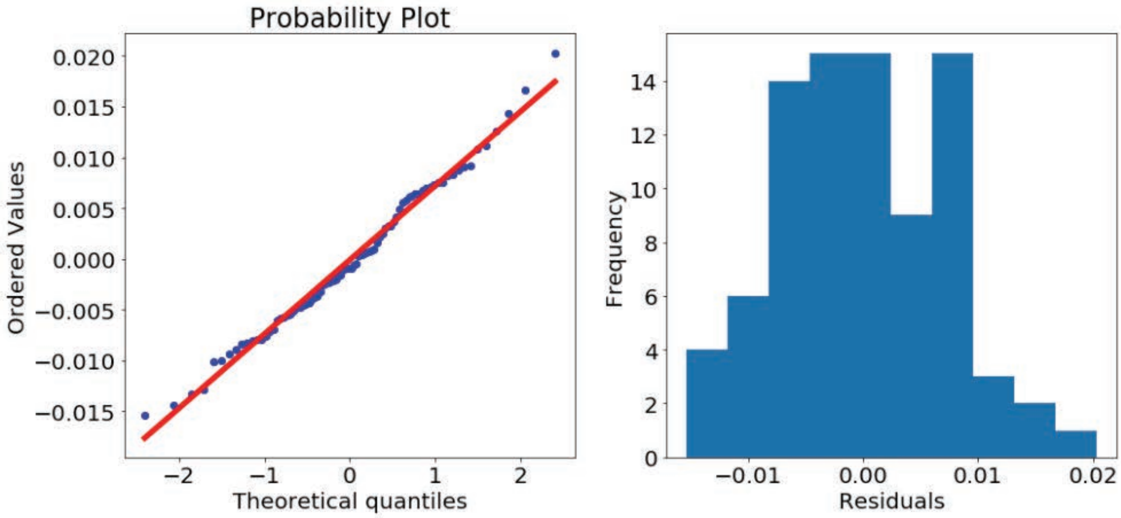

Fig. 5. **Estimated residuals distribution**

Source: authors' calculations based on Python 3.4 program.

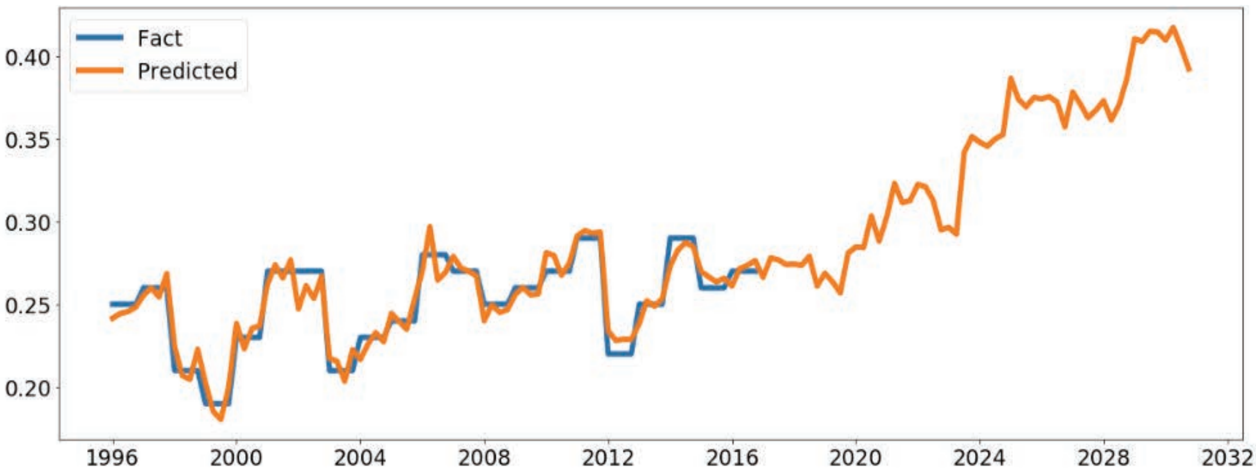

Fig. 6. **Forecast of financial sustainable growth until 2030 (Russian oil and gas industry)**

Source: authors' calculations based on Python 3.4 program.

regard to factors affecting the systemic financial sustainable growth index, there is a 90% probability that financial factors have the greatest impact on the system as a whole.

The authors identified external factors from the list of indicators used in this study to calculate the sustainability of the system.

Yparams = ['PRP','ROEnv','ER','FOORPRINT',' BIOCAPACITY','ROEsr','DER',

xx = list (set. Intersection (set (Xparams), set (Yparams))).

Figure 7 clearly shows that the system is stable (sustainable) throughout the entire period. The value of the FSI criterion is primarily determined by external factors. The internal factors are in the negative zone. This indicates that the system seeks to reduce the value of the criterion, but the external environment does not let to do this. Accordingly, if the environment changes the FSI value can change dramatically. The system is balanced for Russian oil and gas companies.

Modelling results of financial sustainable growth index (FSI) for Chinese oil and gas companies

The authors determined the parameters that most affect the financial sustainable growth index by means of Lasso regression. Then, we constructed

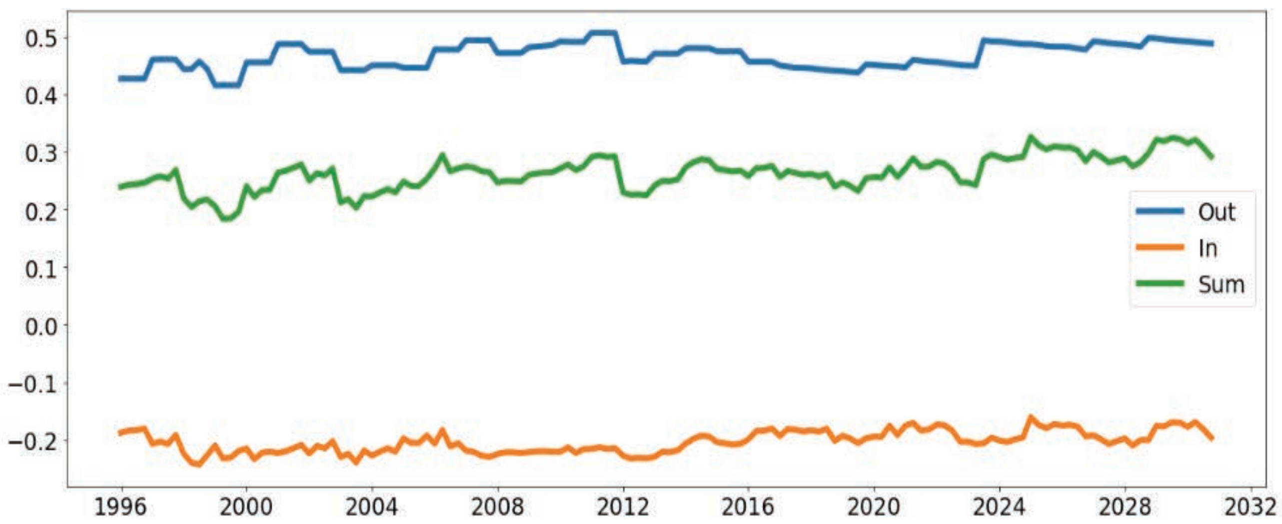

Fig. 7. **Impact of environmental factors (Out) and internal characteristics (In) of the system on the financial sustainable growth index**

Source: authors' calculations based on Python 3.4 program.

Table 3

Linear regression results (factors influencing SGI Higgins)

Dep. Variable:	FSI	R-squared:	0.711
Model:	OLS	Adj. R-squared:	0.671
Method:	Least Squares	F-statistic:	4191.
Date:	Sun, 03 Feb 2019	Prob (F-statistic):	1.62e-97
Time:	21:03:51	Log-Likelihood:	234.01
No. Observations:	84	AIC:	-446.0
Df Residuals:	73	BIC:	-419.3
Df Model:	10		
Covariance Type:	HC1		

	coef	std err	z	P>|z|	[0.025	0.975]
Intercept	0.1013	0.007	13.518	0.000	0.087	0.116
ES	0.0502	0.017	3.040	0.002	0.018	0.083
ROEnv	-0.1683	0.025	-6.652	0.000	-0.218	-0.119
ER	-0.0554	0.013	-4.362	0.000	-0.080	-0.031
BIOCAPACITY	0.1013	0.007	13.518	0.000	0.087	0.116
ROEsr	-0.0380	0.014	-2.635	0.008	-0.066	-0.010
CR	0.1330	0.014	9.290	0.000	0.105	0.161
NWCT	0.0380	0.004	10.247	0.000	0.031	0.045
ROS	-0.1155	0.013	-8.839	0.000	-0.141	-0.090
WACC	-0.1526	0.016	-9.358	0.000	-0.185	-0.121
RG	0.0131	0.005	2.620	0.009	0.003	0.023
NPG	-0.0900	0.007	-12.196	0.000	-0.104	-0.076

Omnibus:	13.858	Durbin-Watson:	1.213
Prob(Omnibus):	0.001	Jarque-Bera (JB):	51.282
Skew:	0.116	Prob(JB):	7.31e-12
Kurtosis:	6.821	Cond. No.	1.54e+16

Source: authors' calculations based on Python 3.4 program.

a linear regression and estimated the coefficients by choosing only the parameters whose admissible interval did not include 0 with a probability of 90% (*Table 3*).

FSI = F (ES + ROEnv + ER + BIOCAPACITY + + ROEsr + CR + NWCT + ROS + WACC + RG + NPG),

Xparams = ['ES', 'ROEnv', 'ER', 'BIOCAPACITY', 'ROEsr', 'CR', 'NWCT', 'ROS', 'WACC', 'RG', 'NPG'].

The following factors affect the FSI: energy savings, environmental costs, current assets / current liabilities, net working capital turnover, return on sales, weighted average cost of capital,

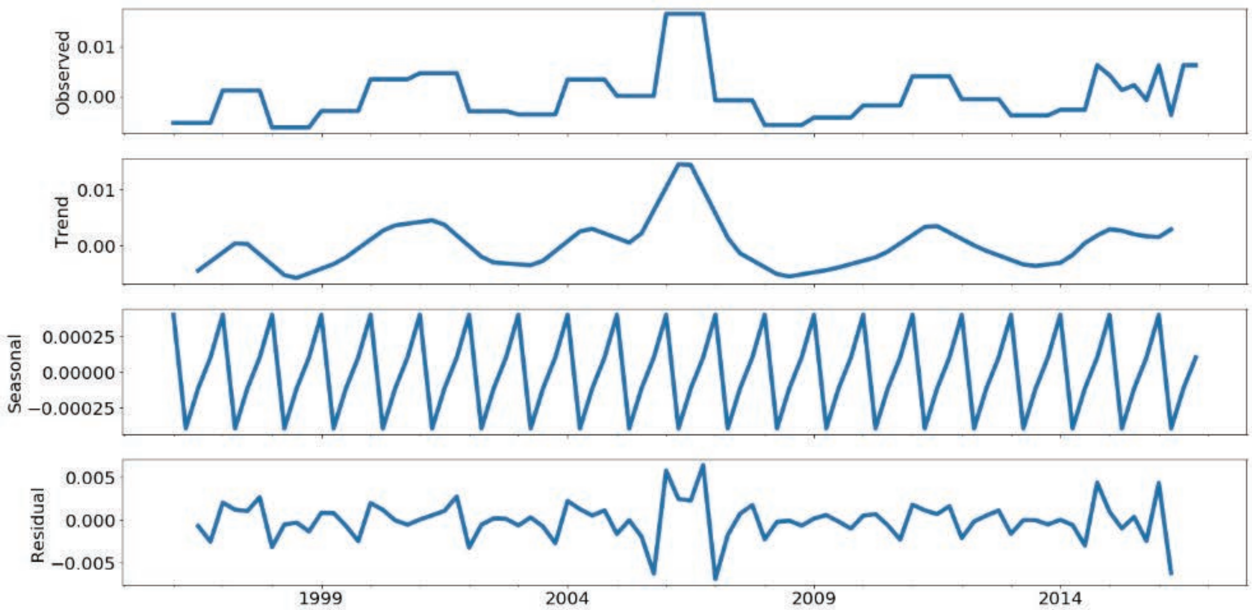

Fig. 8. **The residual structure after regression analysis**

Source: authors' calculations based on Python 3.4 program.

increase of a company's sales when compared to a previous quarter's revenue performance, increase of a company's net profit when compared to a previous quarter's net profit performance, environmental footprint, biocapacity, costs concerning employee benefits / net profit.

The authors found the residuals, built autoregression and revealed the actual data reduced by the modelling data (*Fig. 8*). Then, the authors checked the residuals of the data not recognized after Lasso regression. Autoregression is applicable for stationary residuals. We consider the Dickey-Fuller tests for the hypothesis that the data (residuals) are non-stationary. The authors intend to apply the SARIMA model to the residuals. The model should show that the data in the form of noise fluctuate around zero. If not, the data are not stationary, and the SARIMA model will not be effective.

Dickey-Fuller test: p = 0.000098.

Dickey-Fuller test $p < 0.05$, then the residuals are random and the simulation in SARIMA can be used.

The authors did a visual search for autocorrelations and correlations in differences. The division on the right is an offset by one period back. If the black rod goes beyond the blue zone (error), then autocorrelation in the data is possible for this period. Thus, we made sure that we have autocorrelation in the data, and we can analyze the data using autoregressive analysis of residuals. If everything is in the blue zone, SARIMA autoregression will not result in anything (*Fig. 9*). Next, we select the optimal parameters of the SARIMA model by the Akaike information criterion (AIC). *Fig. 13* shows its parameters. *Table 4* shows the analysis results of the residuals.

Student's t-test: p = 0.998 415.

Dickey-Fuller test: p = 0.000 000.

The residuals are not biased (confirmed by the Student's t-test, $p > 0.05$,— the hypothesis of unbiased residuals is not rejected), the residuals are stationary (confirmed by the Dickey-Fuller test, $p < 0.05$,— the hypothesis of non-stationary residuals is rejected), they are not autocorrelated (confirmed by the Ljung-Box test, $p > 0.05$,— the hypothesis of the absence of autocorrelation is not rejected, there is a slight distant correlation in the correlogram). We extracted all autoregressions. The residuals are homoskedantic (*Fig. 10*).

As seen from the diagram, the residual distribution seems to be normal. Therefore, we can conclude that their further analysis will not bring results (*Fig. 11*).

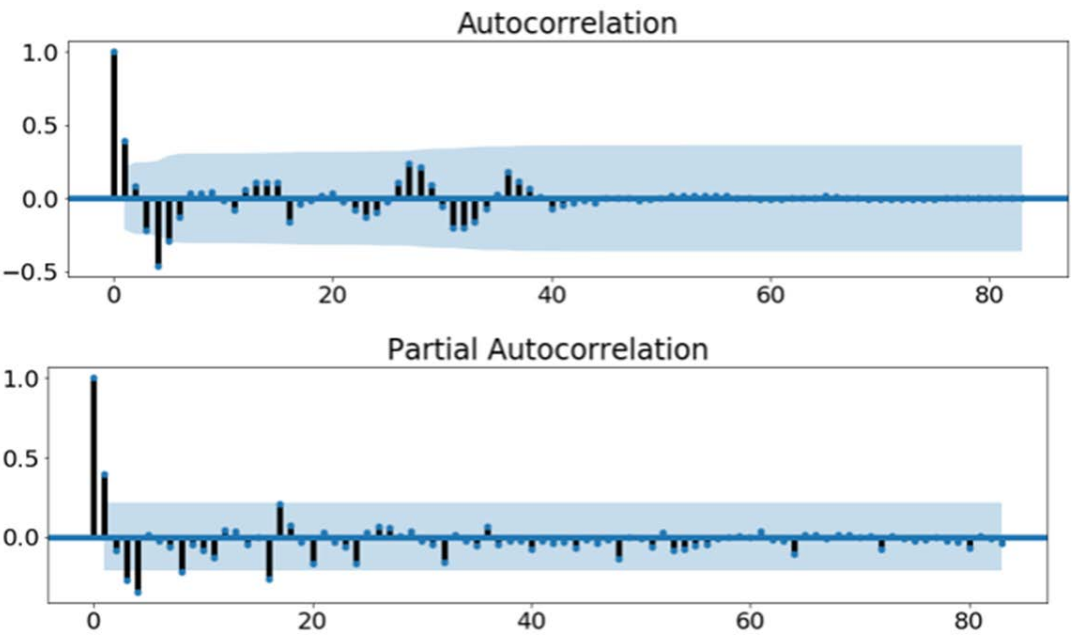

Fig. 9. **Significance of autocorrelation components**

Source: authors' calculations based on Python 3.4 program.

Table 4

SARIMA model parameters for FSI model (China)

Dep. Variable:	FSI	No. Observations:	84
Model:	SARIMAX(1, 0, 0)x(1, 0, 0, 4)	Log Likelihood	247.865
Date:	Sun, 03 Feb 2019	AIC	-489.729
Time:	21:09:40	BIC	-482.437
Sample:	01-01-1996 - 10-01-2016	HQIC	-486.798
Covariance Type:	opg		

	coef	std err	z	P>|z|	[0.025	0.975]
ar.L1	0.3133	0.051	6.195	0.000	0.214	0.412
ar.S.L4	-0.3898	0.106	-3.665	0.000	-0.598	-0.181
sigma2	0.0002	1.17e-05	13.613	0.000	0.000	0.000

Ljung-Box (Q):	36.51	Jarque-Bera (JB):	216.00
Prob(Q):	0.63	Prob(JB):	0.00
Heteroskedasticity (H):	1.20	Skew:	-0.25
Prob(H) (two-sided):	0.63	Kurtosis:	10.84

Source: authors' calculations based on Python 3.4 program.

Fig. 12 shows that the FSI is relatively stable from 2005 to 2017 and can remain at the level of 2017 until 2024. If no prevention measures are taken, the financial sustainability of China's oil and gas complex may be severely destroyed by 2030. The authors suggest developing the environmental and social systems to maintain financial sustainability. It is necessary to give special consideration to such indicators as PRP, ROEnv, ER, FOORPRINT, BIOCAPACITY, ROEsr, DER.

The external environment of the oil and gas complex of China should influence the positive development of the situation.

Yparams = ['PRP', 'ROEnv', 'ER', 'FOORPRINT', 'BIOCAPACITY', 'ROEsr', 'DER'].

xx = list (set. Intersection (set (Xparams), set (Yparams))).

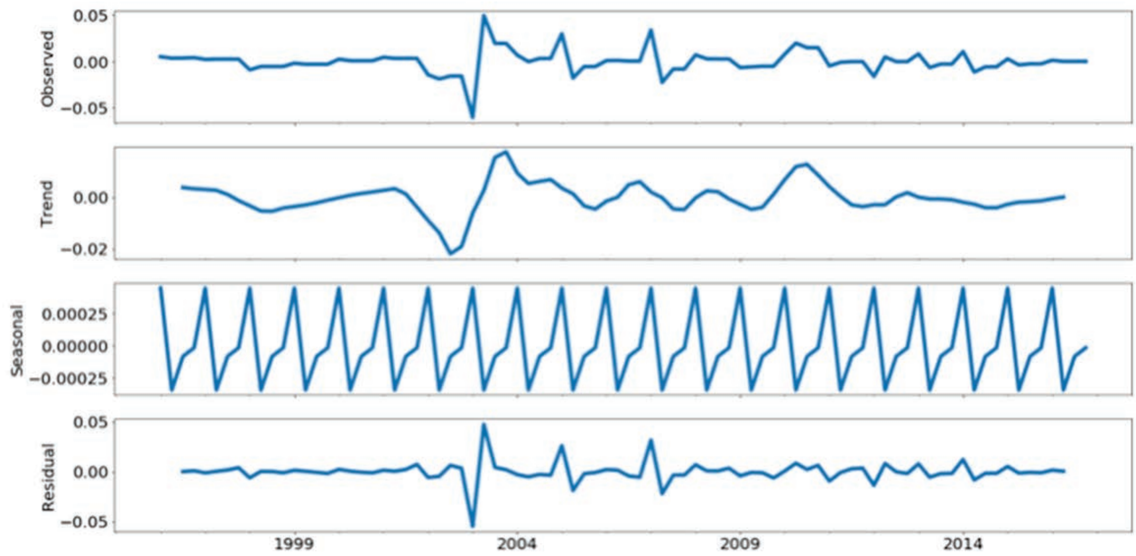

Fig. 10. **Analysis of residuals after the SARIMA model**

Source: authors' calculations based on Python 3.4 program.

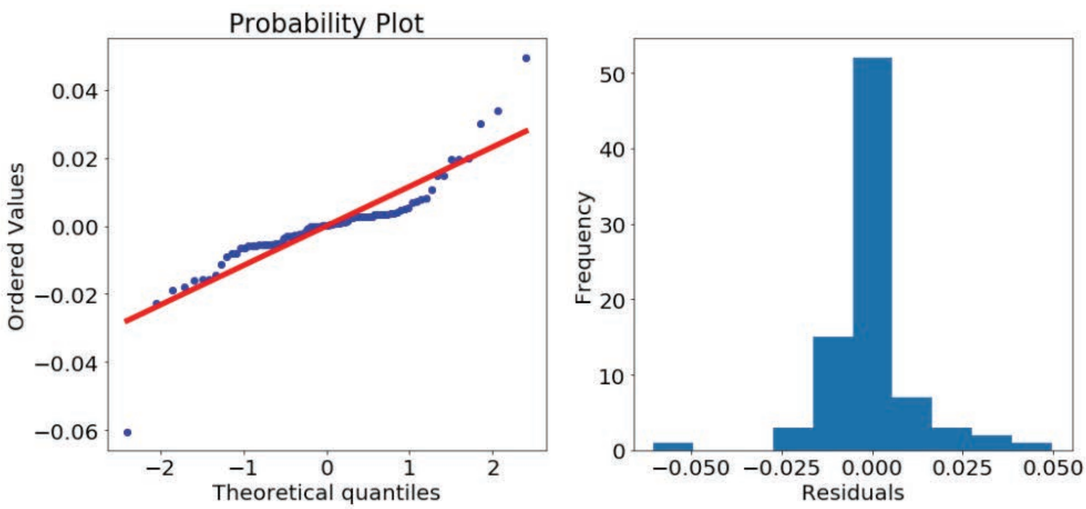

*Fig. 11***. Estimated residuals distribution**

Source: authors' *calculations based on Python 3.4 program.*

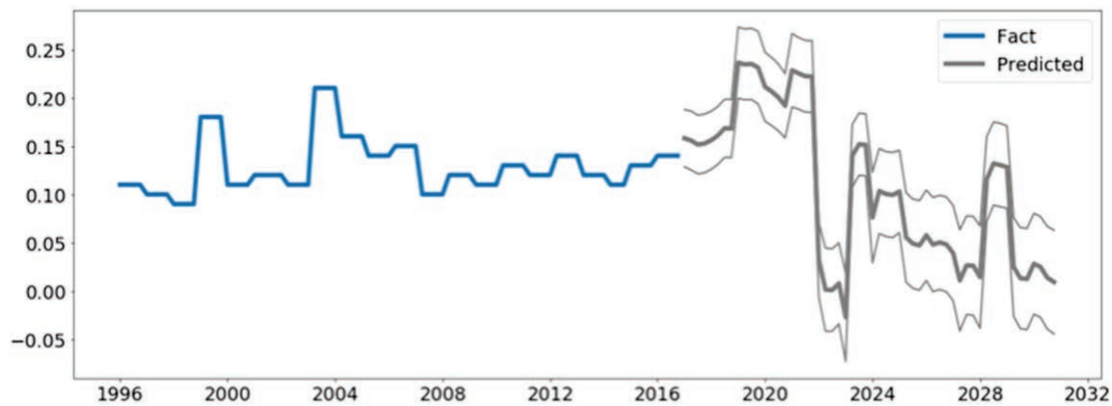

Fig. 12. **FSI forecast until 2030**

Source: authors' calculations based on Python 3.4 program.

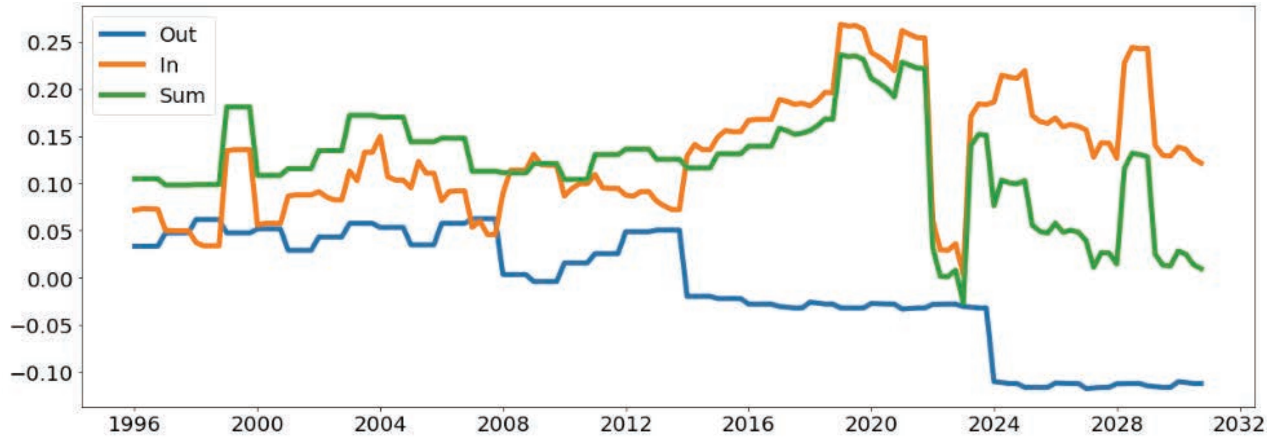

Fig. 13. **Impact of environmental factors (Out) and internal characteristics (In) of the system on the financial sustainable growth index**

Source: authors' *calculations based on Python 3.4 program.*

As follows from the data analysis, the FSI external component compensates for sudden changes of the internal component which ensured sustainability (*Fig. 13*). If the FSI external component does not respond to changes, the entire system will lose its balance. As seen from the figure, at present, the financial sustainable growth system of the oil and gas industry of China is unstable. However, the authors emphasize that this trend will not last long and will be replaced by sustainable growth. President of China Xi Jinping announced "eco-civilization" as a priority for the development of all sectors of the country's economy, including oil and gas. Currently, measures are being taken to introduce green finance at the oil and gas enterprises of the PRC, as well as measures aimed at ensuring green sustainable growth.

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Current priority areas of scientific, technical and sustainable development for the gas industry in Russia and China are multidimensional and polycentric studies. Similarly, financial analysis should base on linear and multidimensional spaces. Multidimensional financial analysis should be especially developed in oil and gas companies, since they are the driver of social progress.

In Russia, the concept of "financial sustainable growth" is associated solely with finance. Western and Chinese researchers also associate it with the welfare of society, environmental protection, and energy efficiency [1, 14–18]. This study proved the influence of the factors on the financial sustainable growth of Russian and Chinese oil and gas companies.

The authors analyzed the impact of the factors on the financial sustainable growth of Russian oil and gas companies whose FSI level is stable until 2030. According to the goals of the Energy Strategy of Russia for the period up to 2030[4], the average FSI level in Russian companies should increase to 0.5–0.6. The authors' forecast does not confirm this. As we can see, there is a 90% chance that in Russia the FSI is only affected by financial factors.

According to the goals of the energy strategy of China, Chinese oil and gas companies should on average achieve the sustainable growth index of 0.4–0.5 by 2030. The authors' forecast does not confirm this either. Chinese oil and gas companies will develop the impact of financial factors on the environment due to the unfavorable environmental situation in China; progress furthers in that direction.

[4] Draft Energy Strategy of the Russian Federation until 2035 (edited on 01.02.2017). URL: https://minenergo.gov.ru/node/1920 (accessed on 24.05.2019).

Since the financial sustainable growth systems of gas companies in the Russian Federation and the PRC have low indicators, it is necessary to identify potential obstacles to high indicators.

The main obstacle in the Chinese gas industry is the low level of social indicators and its dominating financial component. It is necessary to promote the social responsibility of gas corporations, to redistribute and emphasize the growth strategy from finance to "green", "social" and "energy" finance [6].

In the Russian gas industry, insufficient investment in environmental protection prevents high rates of financial sustainable growth [1]. The following needs to be done: to encourage state corporations to purchase from a supplier with an environmental certification, to increase investment in environmental projects. Besides, it is necessary to regulate this issue at the state level and introduce high taxes on manufacturing that can harm the environment.

The content analysis of the developed models made it possible to formulate quantitative assessments of the sustainability factors for the financial growth of the oil and gas industry. The assessments expand the scientific and methodological basis for its developing sustainability prospects, identify major development patterns and replenish the tools for strategic decisions:

- ensuring adequate financing of environmental protection measures, social responsibility and increasing energy efficiency and energy intensity as a condition for financial sustainable growth;
- maintaining financial statements in the context of financial sustainable growth system, focusing on non-financial indicators affecting most on financial sustainable growth;
- using integrated system indicators for assessing financial sustainable growth.

In the future, the authors see a continuation of the research in identifying the directions of the system parameters ensuring financial sustainable growth.

CONCLUSIONS

It is obvious that the relationship between sustainable growth and the financial strategy of gas companies should be closer. Non-financial factors and their impact on the sustainable growth index must be considered as an integral part of the stability analysis of the financial system as a whole. The proposed research hypothesis is based on the interconnection analysis of the financial sustainable growth subsystems. The transversal relationships between subsystems were confirmed.

The article considers the financial sustainable growth system evidenced from the gas companies of the Russian Federation and the PRC. The indicators that most influence and predetermine financial sustainable growth were justified. The relationships between the economic processes included in the subsystems were analyzed. As part of the proposed methodological approach, the original SARIMA model was built. The model explains the internal structure of the financial growth sustainability of the oil and gas industry in Russia and China:

1. Graphic and algebraic visualization in form of dynamic graphs.
2. The financial sustainable growth structure of the gas industry providing a picture of the financial, energy, environmental and energy factors affecting each other.
3. Typical trends in the financial sustainable growth in the oil and gas industry in Russia and China showing similar and different trends.

The research results in Russian gas companies reveal close links between energy, social and financial indicators, and no links between financial and environmental indicators. The situation for Chinese gas companies is the opposite: their financial indicators are more closely related to environmental and energy indicators. The links between financial and social indicators are not visualized.

Due to tobvious environmental problems in China, more attention is paid to ecology. At the 18th Party Congress, Chinese President Xi Jinping announced eco-civilization as a priority for the Chinese society. Russian oil and gas compa-

APPENDIX

Table

Research Indices' List

Subsystem name	Index	Name	Proxy	Calculation method
Sustainable Growth Index	Sustainable Growth Index	Higgins Sustainable Growth Index	SGR(H)	RM×AT×FL×R
Financial Indicators	Earnings before interest and tax	Earnings before tax	EBIT	Earnings before interest and taxing
	Return on Assets	Return on assets ratio	ROA	(EBIT/Total Assets)×100%
	Return on Sales	Return on sales ratio	ROS	Return on sales
	Return on Equity	Return on equity ratio	ROE	Net income/Equity
	Return On Capital Employed	Return on capital employed ratio	ROCE	EBIT / (Total Assets-Current Liabilities)
	Return on Fixed Assets	Return on fixed assets ratio	ROFA	EBIT / Fixed Assets
	Net working capital	Net working capital	NWC	Current assets-current liabilities
	Net working capital turnover	Net working capital turnover	NWCT	Revenue / Current Assets
	Current Ratio	Current ratio	CR	Current assets / current liabilities
	Revenue growth	Revenue growth	RG	An increase of a company s sales when compared to a previous quarter s revenue performance
	Net profit growth	Net profit growth for the period	NPG	An increase of a company s net profit when compared to a previous quarter s net profit performance
	Net assets growth	Net assets growth for the period	NAG	An increase of a company s net assets when compared to a previous quarter s net assets performance. Net assets = Total assets-Total Current liabilities
	Financial leverage	Financial leverage	FL	Total Assets/Equity
	Operation leverage degree	Operation leverage degree	DOL	% change in EBIT / % change in Revenue
	Debt equity ratio	Debt equity	DER	Total liabilities / Equity. Total liabilities = Equity-Assets
	Weighted Average Cost Of Capital	Weighted Average Cost Of Capital	WACC	WACC = rE × kE + rD × × kD × (1 – T)
Energy Indicators	Energy Indicators	Lambert Energy Index	LEI	Lambert Energy Index [13]
		Energy savings	ES	Energy Savings

End of Table

Subsystem name	Index	Name	Proxy	Calculation method
Environmental Indicators	Environmental indicators	Environmental costs	ROEenv	ROEnv = costs concerning environmental protection and decision of pollution question/ production
	Environmental rating	Environmental rating	ER	Rating of oil and gas companies according to the results of environmental policy implementation
	Production/Reserves ratio	Production/Reserves ratio	PRP	Production/Reserves ratio
	Footprint	Environmental footprint	FP	Environmental footprint
	Biocapacity	Biocapacity	BC	Biocapacity
Social Indicators	Revenue per employee ratio	Revenue per employee	RER	Total Revenue / Total Number of Employees
	Return on social expences	Return on social expences	ROEsr	Costs concerning employee benefits / net profit
	Return on Labour	Return on Labour	ROL	Costs concerning employee salary / net profit

nies focus primarily on their social responsibility to society.

The following factors affect the sustainable growth index in Russian oil and gas companies: production-to-reserves ratio (PRP); return on environmental costs (ROEenv), Return on sales (ROS), Return on equity (ROE), Return on fixed assets (ROFA); environmental footprint (FP), biocapacity (BC) current assets / current liabilities (CR), earnings before interests and tax (EBIT). The following factors affect the sustainable growth index in Chinese oil and gas companies: energy savings (ES); production-to-reserves ratio (PRP); return on environmental costs (ROEenv), Return on employees (ROL), Return on sales (ROS); biocapacity (BP); current assets / current liabilities (CR); net working capital capital turnover (NWC); weighted average cost of capital (WACC); revenue growth dynamics (RG) and net profit dynamics (NPG).

Based on the study results, the authors highlight how the sustainable growth system transforms and adapts to the specific needs of Russian and Chinese gas companies. It is a living organism requiring a multi-vector, complex financial analysis. One should carefully analyze non-financial factors that may affect the whole system.

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ABOUT THE AUTHORS

Alina N. Steblyanskaya — PhD, Associate Professor, Harbin Engineering University alinamv@bk.ru.

Zhen Wang — PhD, Professor, China University of Petroleum (Beijing), wangzhen@cup.edu.cn.

Georgy B. Kleiner — Corresponding Member of RAS, Doctor of Economics, Professor, Deputy Director, Central Economics and Mathematical Institute of RAS, Moscow, Russia; Chairman of the Department of System Analysis in Economics, Financial University, Moscow, Russia
george.kleiner@inbox.ru, GKleiner@fa.ru

Zinaida V. Bragina — Dr. Sci. (Eng.), Professor, Kostroma State University, Kostroma, Russia
bragzv@yandex.ru.

Artem Rufimovich Denisov — Dr. Sci. (Eng.), Professor, Kostroma State University
iptema@yandex.ru.

Authors' declared contribution:
Steblyanskaya A.N.— theoretical part, financial sustainable growth index calculations, Russian and China oil and gas company's data analysis.
Wang Zhen — general conclusions and recommendations for improving the Chinese oil and gas companies' sustainable financial growth system.
Kleiner G.B.— general conclusions and recommendations for improving the Russian oil and gas companies' sustainable financial growth system.
Bragina Z.V.— methodological base for the financial sustainable growth system.
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