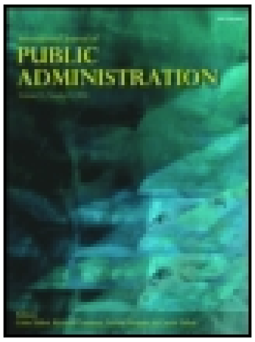

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Russian and Chinese Natural Gas Industries: Perspectives on Sustainable Growth

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Russian and Chinese Natural Gas Industries: Perspectives on Sustainable Growth

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ABSTRACT

The influence of an investment in social well-being and environmental protection on the steady financial growth of the oil and gas industry is studied, and a new interpretation of financial growth is proposed. Unlike traditional approaches to this interpretation, the proposed interpretation views financial growth as a function of energetic, ecological, economic, and social factors. The composition and the structure of steady financial growth are considered for Russian and Chinese oil and gas companies. The Lasso regression, linear regression and SARIMA modelling are used for determining the composition of economic processes affecting or predetermining the Sustainable Growth Rate up to the year 2030. The presence of a close dependence among the dynamics of energetic, social, and financial processes and the absence of a close dependence between the dynamics of financial growth and the values of environmental protection indices are established for Russian oil and gas companies. On the contrary, the close dependence between the dynamics of financial growth and the values of environmental protection indices and energetic activities, and the absence of a close dependence between the financial growth and the social well-being of the personnel are determined for Chinese oil and gas companies.

KEYWORDS

Russian and Chinese gas companies; sustainable growth rate; nonfinancial factors influence on sustainable financial growth; SARIMA model; 2030 sustainable growth index forecast

Introduction and literature review

During the 1980s, researchers began a fundamental reappraisal of thinking on economic growth. It has been articulated, with much supporting evidence, that the "concept of sustainable economic growth is a difficult one to grasp analytically" (Barbier, 1987). Indeed, it is not easy to rewrite economic theory with an emphasis on environmental protection, social responsibility, and energy efficiency, but this must be done. Thus, the World Conservation Strategy (IUCN, 1980) emphasizes "the maintenance" of an essential ecological process and life-support systems with the overall aim of achieving "sustainable development through the conservation of living resources" (Barbier, 1987). The "total development of society" involves not only changes in economic activity but also political, social, and cultural transformations (D'Amato, Henderson, & Florence, 2009). "Sustainability" itself appeals to many contexts including energy, ecology, economics, politics, society, and technology, among many others. In fact, one cannot talk about financial sustainability without referencing all of these contexts. The new methodology must include interactions and interconnections among all of a system's external and internal factors, and be conscientious regarding the "whole" system as a fundamental touchstone of sustainability (Kleiner & Rybachuk, 2016; Kleyner, 2015). Nowadays, to define simply the prospect of financial growth itself is not enough. Sustainability as a holistic concept necessitates that financial growth be closely connected with the social, ecological, and wider energy environment.

Traditionally, companies in the natural gas industry were driven by a narrow set of "sustainable growth" values – namely, that the only factors of relevance to the concept were business risk and financial returns (Steblyanskaya & Wang Zhen, 2019). Fullwiler (2016), in their research, discussed four crucial current trends contributing to the growth of sustainable finance: "Blended value" investing, recognition that sustainability factors can be related to systematic risk, financial innovation to increase sustainability, and the building of infrastructure for sustainable finance (Fullwiler, 2016). Nowadays, the G20 Green Finance Study group's (GFSG) work supports the G20's strategic goal of strong, sustainable and balanced growth. The High-Level Expert Group on sustainable finance, a vehicle of the European Commission, published its interim report on 13 July 2017 (Li et al., 2018). The report sets out the key steps required to create a financial system

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that supports sustainable investment, as well as identifying areas for financial policy reform. The Group will also continue to explore policy areas, such as (i) integrating sustainability considerations in ratings, (ii) improving transparency requirements for listed companies, and (iii) increasing levels of sustainable investment through a stable, long-term policy framework and a robust pipeline of sustainable projects (G20 Green Finance Study Group, 2016).

Economic growth is directly related to the so-called unacceptable costs of declining social welfare. They arise as a result of "social and environmental casualties, with the need for increased pressures on ecosystems"(Daly & Farley, 2004). Husted, Allen, and Kock (2015) argues that literature on corporate social responsibility (CSR) has tended to treat economic benefits to the firm as unintentional spillovers that result from laudable CSR behaviour (Husted et al., 2015). On a similar note, Charles A.S. Hall has stated that there is a "need to reintegrate Natural Science with Economics" (Hall, 2017). In a more declarative gesture, it has also been alleged that this situation heralds the end of faith-based economics (Gowdy & Mesner, 1998; Lindenberger & Kümmel, 2011). Besides, Hall, Lambert, and Balogh (2014) and King and Hall (2011) argue that energy return on investment indicator must be the fundamental part of the new Biophysical Economy sustainable growth (Hall et al., 2014; King & Hall, 2011; Lambert, Hall, Balogh, Poisson, & Gupta, 2012). Daly (2005) shows the interrelation links between economic sustainable growth and environmental protection (Daly, 2005). In the same manner Daly (1992) emphasizes that the practical policy of issuing tradeable permits for depletion and pollution requires for its implementation the clear separation of the three basic economic goals of efficient allocation, equitable distribution, and sustainable scale. Economic theory needs to catch up with policy in recognizing -that scale issues cannot be reduced to either allocation or distribution (Daly, 1992). Chinese scientist Liu, Yang, Bin, Linyu, and Yan (2013) research a fresh perspective focuses on the traditional exergy-based accounting linking the analysis of exergy utilization in the sector of urban socioeconomic system (Liu et al., 2013). Another Chinese researchers argue, that index system covering thermodynamic indicators specialized by eco-exergy and structural eco-exergy could comprehensively characterize the ecological health condition of ecosystems under human disturbances (Xu, Zhao, Yang, & Chen, 2013).

A few researchers have emphasised the interrelation between energy efficiency and social responsibility and financial indicators concerning Russian and Chinese oil and gas companies (Steblyanskaya & Wang, 2019). However, with the formation of integrated reporting, the problem arises of expanding the audit report coverage of new parties to economic activity (specifically in the environmental and social spheres) the indicators of which are reflected in both financial and non-financial contexts (Fullwiler, 2016; Sheremet, 2011). Accountant-analysts are faced with the task of creating a model of the relationship encompassing three different components of a company's sustainable growth. It is advisable, in this context, to group the primary indicators for the rating under the following three categories: characteristics of economic sustainability, characteristics of social sustainability, and attributes of environmental sustainability. Together, environmental, social, financial, and economic sustainability have a synergetic effect on the sustainable growth of the economy as a whole. This position is referred to as the 'triple bottom line' (Elkington, 2013) or 'sustainability' reporting (Bouten & Hoozee, 2013). Given that many researchers in the field of sustainability reporting are motivated by a desire to see improvement in the sustainability performance of organisations (Adams & Frost, 2008), there has been surprisingly little research into sustainability reporting processes and the extent to which the data collected is used in decision-making within organizations.

This paper is devoted to the theory of sustainable financial growth in the natural gas industry with expanded assessment and forecasting tools. The significance of the Research lies in the complex conceptual view on financial sustainable growth. Unlike traditional financial treatments, in this research, financially sustainable growth is treated as a result of the interaction and interconnection among energy, environmental, economic, and social processes. There is a deeper understanding of the essence of sustainability from the standpoint of the system science paradigm (Kleiner & Rybachuk, 2016). Authors are analysed how the system of sustainable financial growth is transforming, adapting to the specific needs of companies. In connection with the problematic environmental situation in China, it is evident that a solid connection of the system of sustainable growth should be with environmental factors. At the 18th party congress, Republic of China President Xi Jin Ping declared the primary goal of Chinese society – the construction of ecoculture as the main element of Chinese society. At the same time, in Russian oil and gas companies, attention is focused on the fact that petroleum companies should be the example of social responsibility. As part of the proposed methodological approach, the original SARIMA model was obtained, explaining the internal structure of the financial growth sustainability in Russian and Chinese oil and gas companies. It is interesting to observe the difference in correlation ratio between the coefficients of Russian and Chinese oil and gas companies. Authors tests factors that can influence on SGR like funds invested in environmental protection, environmental footprint, biocapacity, current liquidity, profitability of sales, return on equity, profitability of fixed capital, profit before tax, energy efficiency, production to reserves ratio, working capital, return on sales, cost of capital, revenue growth, profit growth and others. Potential problems are analyzed concerning sustainable growth strategies for Russian and Chinese gas companies until 2030. Thus, the authors' directions of priority are financial sustainable growth modeling and testing interconnections among financial factors with social, energy and environmental systems.

Theoretical and methodological base

Theoretical approaches to analyzing growth were combined into one large class of strategic theories by Francisco Rosique (Ivashkovskaya, 2014). Further, Ghosal and co-authors (based on their observed relationship between the level of development of the economy and huge companies operating in the market) suggested that this positive correlation is the result of a synthesis of managerial competencies, like managerial decisions and organizational capabilities. While management decisions relate to the cognitive aspects of the perception of potential new combinations of resources and management, organizational capabilities reflect the real opportunity for implementation. The effects of the interaction between these two factors were regarded as the process of creating the company's value (Ivashkovskaya, 2014). John Clark and co-authors, in their research, show that excessive growth in sales can be regarded as a "no growth" point. Since the end of the 1970s, they actively researched the opportunity to use sustainable development growth in management, which in economic literature is posited as the tempo of a balanced, achievable, reasonable example of growth. The concept of sustainable growth was introduced in the 1960s by the Boston Consulting Group and further developed in the works of R. Higgins. Higgins (1977) proposed a model of sustainable growth – an analytical tool indicating effective interaction among operating policies, financing policies, and strategies for growth. The concept of sustainable growth was defined as the maximum rate of profit increase without depletion of the financial resources of the company (Higgins, 1977). The value of this index is that it combines operating elements (profit margin and efficiency of asset management) and financial elements (capital structure and retention rate) into one unit. Using the index of sustainable growth, managers and investors can assess the realism of plans for the future growth of the company (taking into account current performance and strategic policy), thus obtaining the necessary information on the leverage effect on the level of corporate growth. Factors such as industry structure, trends, and position relative to competitors can be analyzed to detect and use special features (Ivashkovskaya, 2014). Higgins' Sustainable Growth Rate (hereby referred to as Higgins' SGR) is expressed as follows:

$$g = f(P, R, A, T) \tag{1}$$

Where –

– is the index of sustainable growth, expressed in percent;

P – profit after taxes;

R – the rate of reinvestment;

A – turnover of assets;

T – the ratio of assets to equity or leverage.

For this research, Higgins' Sustainable Growth Rate is used when the company's sales growth is comparable with its financial resources, and it is used to evaluate the company's overall operational management. For example, if the SGR of the company equals 20%, this means that if the company maintains the growth rate at 20%, its financial growth will remain balanced.

Higgins' SGR is expressed by a reasonably simple equation that can be obtained by expressing the increase of sales through changes in the assets, the liabilities, and the equity of the company. Higgins treats the ratio and sales growth as follows: If the SGR is higher than sales growth, the company needs to invest additional funds; if the SGR is below sales growth, the company will need to attract new sources of funding and/or reduce the actual growth in sales. Subsequently, Higgins has developed several modifications of these models, for example a model of sustainable growth with inflation.

The authors examined growth models and show how to use growth theory in the management of the company. Finally, they propose a model allowing an estimate of the optimal capital structure in consideration of a company's sustainable growth (Ivashkovskaya, 2014). In the framework of this research, it is most interesting to consider a model of sustainable growth and analyze company growth using Higgins' sustainable growth rate calculations.

Methodology and results

Data and samples

This paper takes into consideration Russian and Chinese oil and gas industry financial data. The study focuses on a twenty years period between the years 1996 and 2016. Also, the set of indices for the chosen research is considered according to financial sustainable growth functions assessment. A list of indicators used in the study is included *in Appendix A* (Table A1). Data is classified according to the sustainable areas regarding finance, environmental, energy, and social criteria factors. Calculations were performed with the help of financial sustainable growth model, which was developed by Kostroma State University, Department of Computer Science. Research model was fulfilled in the Python programme (Antoniou et al., 2008; Sarker, 2014).

With the help of Lasso (a least absolute shrinkage and selection operator), the critical parameters of the developed model were identified. Then OLS (simple ordinary least squares model) was constructed. If the parameter intervals do not include zero (an important parameter with 90% confidence), this type of parameter is analyzed. After that, a linear regression of the relevant parameters was constructed, and the residuals were estimated. The Lasso Regression performs L1 regularization, which adds a penalty equal to the absolute value of the coefficients. This type of regularization can lead to sparse models with several coefficients. Some coefficients may become zero and be excluded from the model. Heavy fines lead to the fact that the values of the coefficients are closer to zero, which is ideal for creating simpler models. Using Lasso will minimize the intercorrelation factor among the parameters. The SARIMA model (Etuk, Agbam, & Uchendu, 2015; Oduro-Gyimah, Harris, & Darkwah, 2012) was used to identify autocorrelations in residues after using Lasso and OLS.

SGR russian gas industry modeling results

With the help of Lasso regression, the most important parameters were identified. A linear regression was constructed and the coefficients estimated by selecting only those parameters for which the allowable interval did not include 0 with a probability of 90%.

$$\mathrm{SGR} = \mathrm{F}\,(\mathrm{ROEnv} + \mathrm{FOOTPRINT} + \mathrm{BIOCAPACITY} + \mathrm{RER} + \mathrm{NWCT} + \mathrm{WACC} + \mathrm{DER}),$$

The following factors affect Higgins' SGR: return on expenses invested in environmental protection, environmental footprint, biocapacity, revenue per ruble invested in personnel, working Capital, WACC, and debt-equity ratio.

Then Authors were built OLS (simple ordinary least squares model) regression (see Table 1). The authors found the residues and built an autoregression. Actual data minus modeling simulation data are depicted (see Figure 1), and the residues of those data that are not recognized after the linear regression implementation are checked. Autoregression is applicable at stationary residues. The Dickie-Fuller criterion is considered for testing the data (residuals) which are nonstationary. To apply SARIMA to the residuals, the figure should visually show that the data in the form of noise oscillates around zero. If not, then the data are not stationary, and SARIMA will not work well.

The Dickey-Fuller criterion actually suggests that the observed series is described by a finite-order autoregressive model. The Dickie-Fuller criterion: $p = .000000$. If the Dickey-Fuller criterion is $p < .05$, then the residuals are random, and the SARIMA model can be used. Suggested model parameters:

A visual search for autocorrelations and correlations in differences was simulated. The division on the right is an offset one period back. If the black rod goes beyond the blue zone (error), then autocorrelation for such a period is possible in the data. Thus, the autocorrelation in the data exists, and one can analyze the data using autoregressive residual analysis. If everything is in the blue zone, autoregression of SARIMA will do nothing (see Figure 2).

Table 1. Linear regression results (factors influencing higgins' SGR).

Dep. Variable:	SGR	R-squared:	0.638
Model:	OLS	Adj. R-squared:	0.605
Method:	Least Squares	F-statistic:	24.78
Date:	Tue, 30 Apr 2019	Prob (F-statistic):	3.01e-17
Time:	17:22:40	Log-Likelihood:	227.85
No. Observations:	84	AIC:	−439.7
Df Residuals:	76	BIC:	−420.2
Df Model:	7		
Covariance Type:	HC1		

	coef	std err	z	P > |z|	[0.025	0.975]
Intercept	0.4379	0.110	3.980	0.000	0.222	0.654
ROEnv	0.0538	0.021	2.501	0.012	0.012	0.096
FOORPRINT	0.1197	0.058	2.046	0.041	0.005	0.234
BIOCAPACITY	−0.4678	0.153	−3.066	0.002	−0.767	−0.169
RER	0.0192	0.009	2.041	0.041	0.001	0.038
NWCT	−0.0250	0.007	−3.713	0.000	−0.038	−0.012
WACC	−0.0244	0.009	−2.868	0.004	−0.041	−0.008
DER	0.0952	0.012	7.644	0.000	0.071	0.120

Omnibus:	0.152	Durbin-Watson:	1.597
Prob(Omnibus):	0.927	Jarque-Bera (JB):	0.015
Skew:	−0.032	Prob(JB):	0.992
Kurtosis:	3.011	Cond. No.	159.

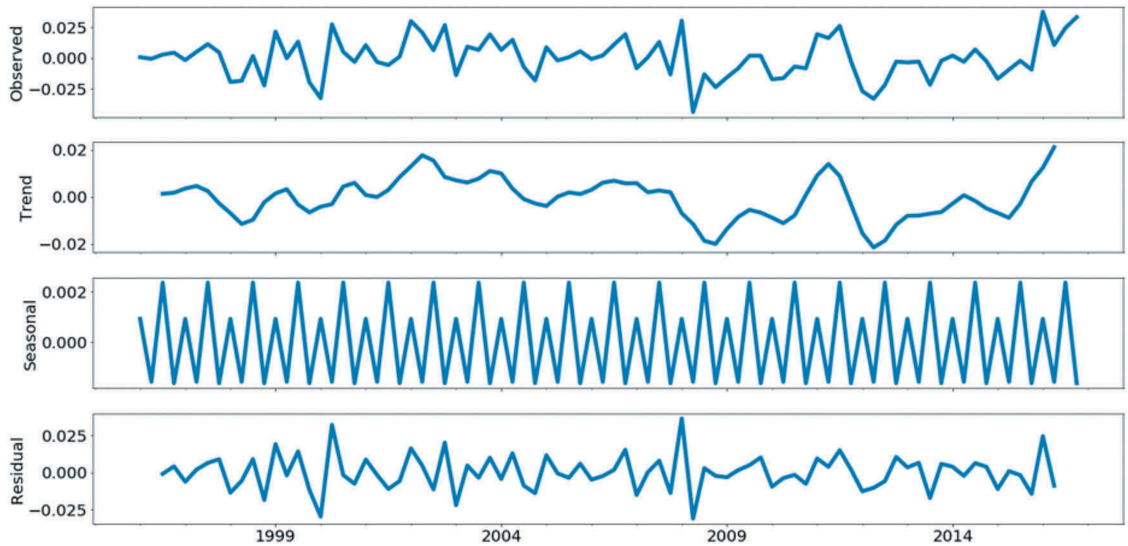

Figure 1. The residual structure after regression analysis.

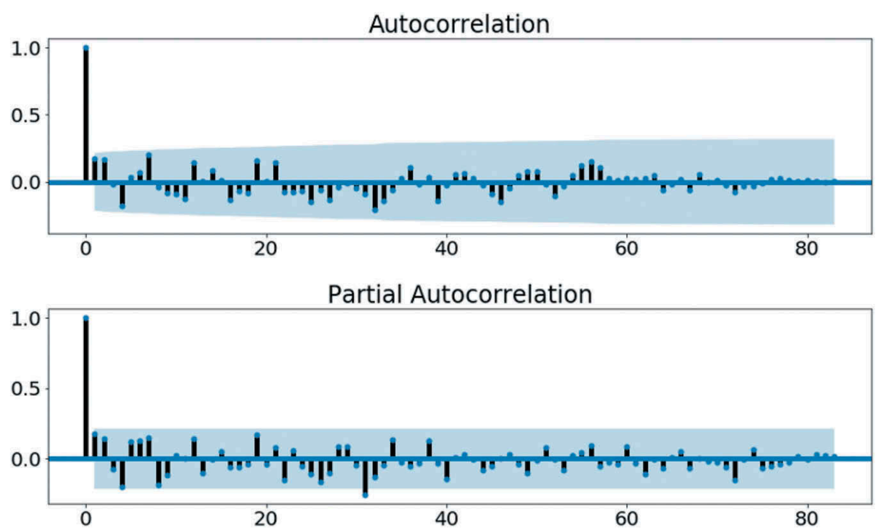

Figure 2. Significance of autocorrelation components.

Further, the optimal parameters of the SARIMA model are selected according to the Akaike criterion (AIC). Its parameters are depicted in Table 2, and the results of the analysis of residues in Figure 3.

The criterion of the study: p = .937141.

The Dickey-Fuller criterion: p = .000000.

The residues are unbiased (confirmed by the proposed criterion, $p > .05$ – the hypothesis of unbiased residues not rejected), stationary (confirmed by the Dickey-Fuller criterion, $p < .05$, the hypothesis of nonstationarity of residues is rejected), non-autocorrelated (confirmed by the Ljung-Box criterion, $p > .05$, – the hypothesis about the absence of autocorrelations is not rejected, in the correlogram there are no significant dependencies). However, heteroscedasticity is present in the residues. All autoregression was extracted. The remains are heteroscedastic. Below, in Figure 4 the residues that are examined:

As one can see at the qqplot diagram, the distribution of residues is similar to normal. Thus, the further analysis of residues will not bring new results (see Figure 6). In Figure 5, the forecast shows that the SGR will stay at a stable level until 2030. But in accordance with the objectives of the Russian energy strategy until 2030 (Steblyanskaya, Zhen, Razmanova, & Iskritskaya, 2018), the average SGR level in Russian companies should increase to the level of 0.5–0.6. The forecast made does not confirm this statement. As one can see with respect to elements affecting the SGR, there is a 90% probability that the influence of those factors is manifested only in the financial context.

Table 2. SARIMA model parameters for financial sustainable growth model (Russia).

Dep. Variable:		SGR		No. Observations:		84
Model:		SARIMAX(0, 0, 2)		Log Likelihood		231.054
Date:		Tue, 30 Apr 2019		AIC		−456.108
Time:		17:23:08		BIC		−448.815
Sample:		01–01-1996 – 10–01-2016		HQIC		−453.176
Covariance Type:		opg				
	coef	std err	z	P > |z|	[0.025	0.975]
ma.L1	0.1351	0.096	1.414	0.157	−0.052	0.322
ma.L2	0.2891	0.111	2.612	0.009	0.072	0.506
sigma2	0.0002	3.61e-05	6.608	0.000	0.000	0.000
Ljung-Box (Q):		38.54		Jarque-Bera (JB):		0.26
Prob(Q):		0.54		Prob(JB):		0.88
Heteroskedasticity (H):		0.97		Skew:		−0.02
Prob(H) (two-sided):		0.93		Kurtosis:		3.27

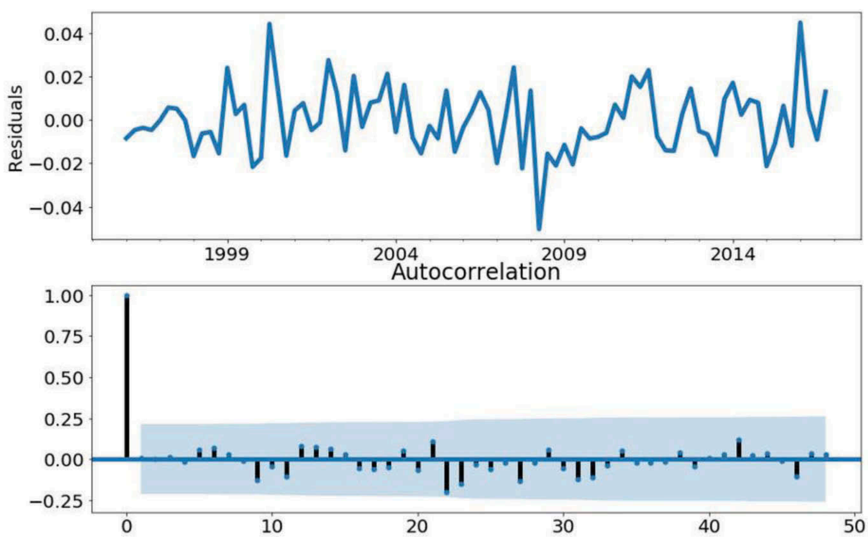

Figure 3. Analysis of residues for the SARIMA model.

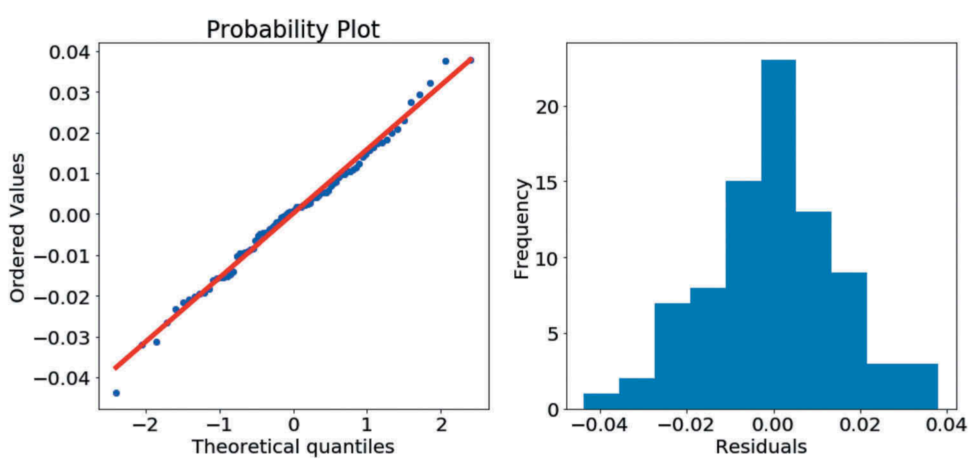

Figure 4. Estimated residue distribution.

To calculate the sustainability of the system of sustainable financial growth, external factors from the list of factors used in the present study were identified (see Figure 6).

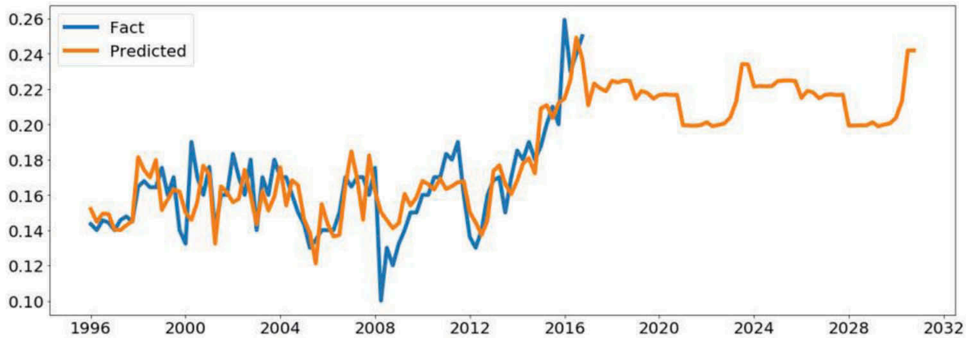

Figure 5. Forecast of the higgins sustainable growth rate to 2030.

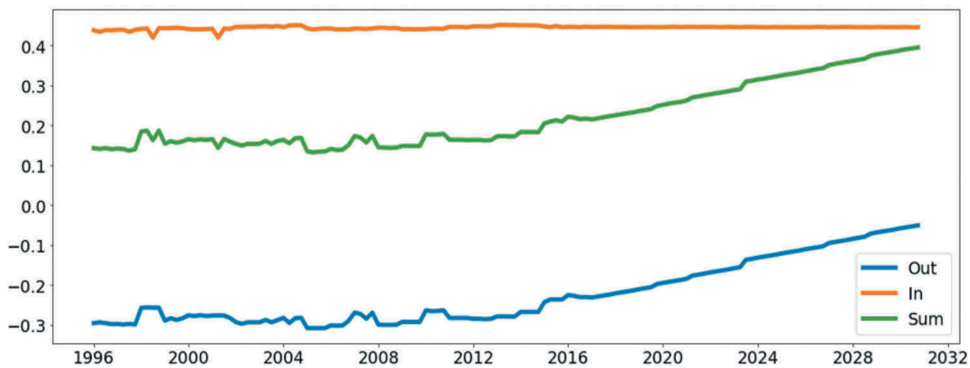

Figure 6. The impact on the sustainable growth rate external factors (Out) and internal characteristics (In) of the system.

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

$$xx = \text{list}(\text{set.intersection}(\text{set}(\text{Xparams}), \text{set}(\text{Yparams})))$$

As one can see, the Russian natural gas industry's sustainable growth rate is stable. External factors have primarily determined the SGR value. Internal factors are in the negative zone, which suggests that the system seeks to reduce the value of the criterion, but this hampers the external environment. Accordingly, in case of a change in the external environment, the value of SGR may undergo drastic changes. The financial area of the sustainable growth system is stable for Russian oil and gas companies.

SGR china gas industry modelling results

With the help of Lasso regression, important parameters have been identified. A linear regression was constructed, the coefficients by selecting were estimated only those parameters for which the allowable interval did not include 0 with a probability of 90%.

$$SGR = F\begin{pmatrix} ES + ROEenv + FOOTPRINT \\ + BIOCAPACITY + ROEsr \\ + NWCT + WACC + FL + DER \end{pmatrix},$$

The following factors affect Higgins' SGR: production/reserve ratio (PRP), energy efficiency (ES), return on expenses invested in environmental protection (ROEenv), footprint, biocapacity, revenue per ruble invested in personnel (ROEsr), working capital, WACC, Debt-Equity ratio.

Then Authors were built OLS (simple ordinary least squares model) regression (see Table 3). The remnants were found and the autoregression was built. Actual data minus modeling simulation data can be seen in Figure 7. After the linear regression implementation the remnants of those data that we could not recognize after the Lasso regression implementation were checked. Autoregression is applicable at stationary residues. The Dickey-Fuller criterion for testing that data (residuals) is considered to be nonstationary. To apply SARIMA to the residuals, it should be visually obvious that the data in the form of noise oscillates at around zero. If not, then the data is not stationary, and SARIMA will not work accurately.

The Dickey-Fuller criteria suggest that a finite-order autoregressive model describes the observed series. Dickiy-Fuller criterion: $p = .000000$. Dickey-Fuller criterion $p < .05$, then the residuals are random, and one can use the SARIMA model. The suggested model parameters are displayed as follows:

Table 3. Linear regression results (factors influencing SGI higgins).

Dep. Variable:	SGR	R-squared:	0.731
Model:	OLS	Adj. R-squared:	0.703
Method:	Least Squares	F-statistic:	920.0
Date:	Tue, 30 Apr 2019	Prob (F-statistic):	5.76e-73
Time:	17:32:23	Log-Likelihood:	323.09
No. Observations:	84	AIC:	−628.2
Df Residuals:	75	BIC:	−606.3
Df Model:	8		
Covariance Type:	HC1		

	coef	std err	z	P>|z|	[0.025	0.975]
Intercept	−0.0546	0.007	−8.120	0.000	−0.068	−0.041
ES	0.0318	0.008	4.195	0.000	0.017	0.047
ER	0.0257	0.005	5.557	0.000	0.017	0.035
FOORPRINT	0.0756	0.010	7.281	0.000	0.055	0.096
BIOCAPACITY	−0.0546	0.007	−8.120	0.000	−0.068	−0.041
ROEsr	0.0612	0.006	10.842	0.000	0.050	0.072
NWCT	−0.0083	0.001	−5.629	0.000	−0.011	−0.005
WACC	0.0243	0.002	11.277	0.000	0.020	0.028
FL	0.0218	0.005	4.834	0.000	0.013	0.031
DER	−0.0372	0.011	−3.385	0.001	−0.059	−0.016

Omnibus:	30.304	Durbin-Watson:	0.578
Prob(Omnibus):	0.000	Jarque-Bera (JB):	51.762
Skew:	1.453	Prob(JB):	5.75e-12
Kurtosis:	5.520	Cond. No.	1.60e+16

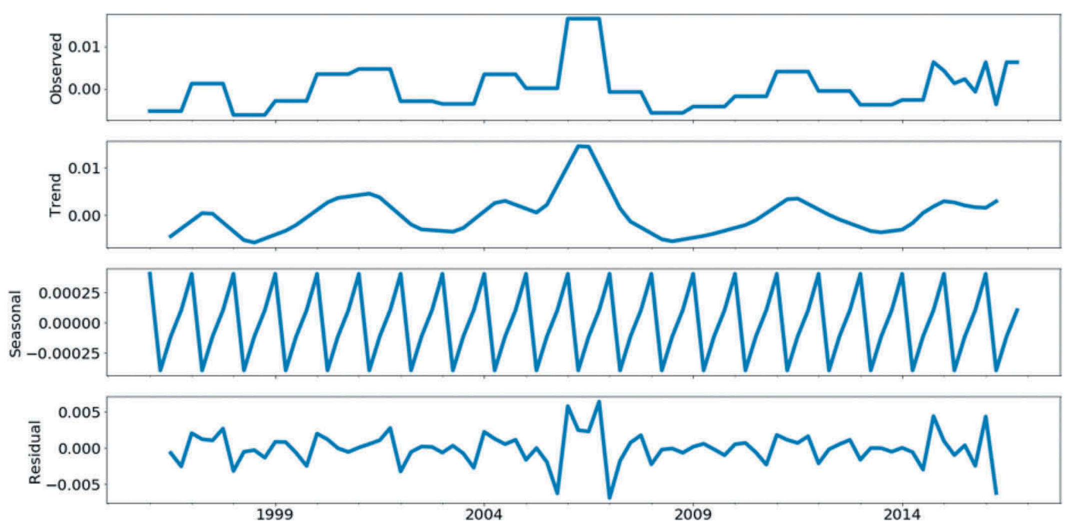

Figure 7. Residual structure after regression analysis.

A visual search for autocorrelations and correlations in differences was simulated. The division on the right is an offset one period back. If the black rod goes beyond the blue zone (error), then autocorrelation for such a period is possible in the data. Thus, we have autocorrelation in the data, and one can analyze the data using an autoregressive residual analysis. If everything is in the blue zone, autoregression of SARIMA will do nothing (see Figure 8).

Further, the optimal parameters of the SARIMA model are selected according to the Aikaki criterion (AIC). Its parameters can be seen in Table 4, and the results of the analysis of residues in Figure 9.

The criterion of Student: p = .896745

Dickey-Fuller criterion: p = .000000

The residues are unbiased (confirmed by Student's criterion, $p > .05$ – the hypothesis of unbiased residues not rejected), stationary (confirmed by the Dickey-Fuller criterion, $p < .05$, the hypothesis of nonstationarity of residues rejected), non-autocorrelated (confirmed by the Ljung-Box criterion, $p > .05$ – the hypothesis about the absence of autocorrelations is not rejected, in the correlogram there are no significant dependencies). However, heteroscedasticity is present in the residues. All autoregression was extracted. The remains are heteroscedastic. Once again, the residues look as follows:

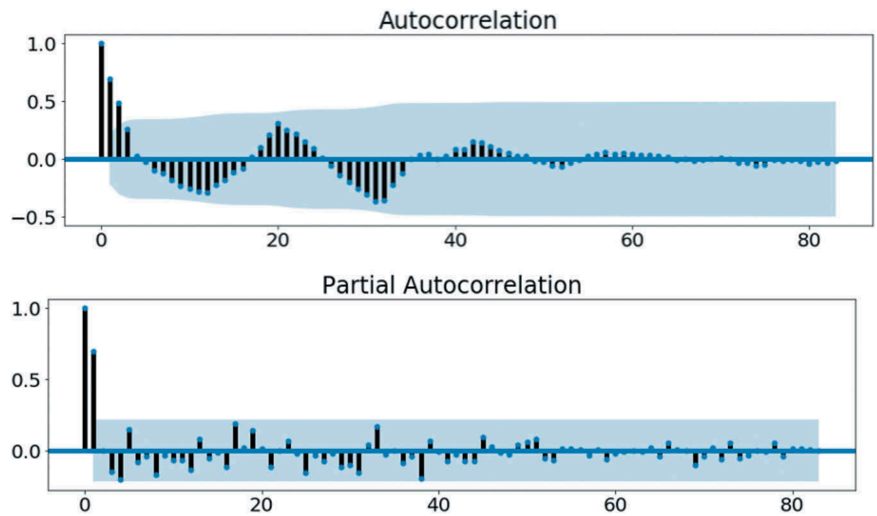

Figure 8. Significance of autocorrelation components.

Table 4. SARIMA model parameters for financial sustainable growth model (Russia).

Dep. Variable:		SGR		No. Observations:		84
Model:		SARIMAX(1, 0, 0)		Log Likelihood		351.780
Date:		Tue, 30 Apr 2019		AIC		−699.560
Time:		17:32:43		BIC		−694.698
Sample:		01–01-1996 – 10–01-2016		HQIC		−697.606
Covariance Type:		opg				
	coef	std err	z	P > |z|	[0.025	0.975]
ar.L1	0.7081	0.055	12.821	0.000	0.600	0.816
sigma2	1.337e-05	1.18e-06	11.365	0.000	1.11e-05	1.57e-05
Ljung-Box (Q):		42.62		Jarque-Bera (JB):	112.49	
Prob(Q):		0.36		Prob(JB):	0.00	
Heteroskedasticity (H):		1.71		Skew:	0.82	
Prob(H) (two-sided):		0.16		Kurtosis:	8.43	

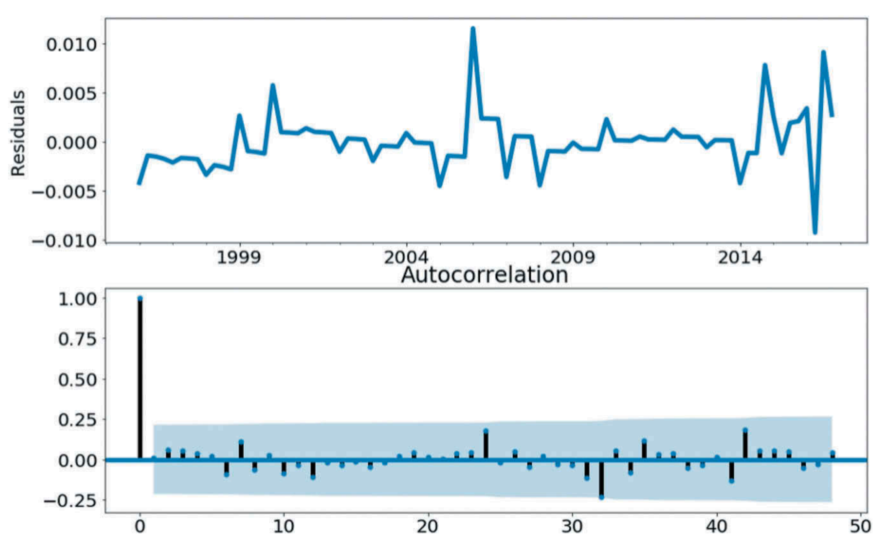

Figure 9. Analysis of residues after the SARIMA model.

As can be seen in the qqplot diagram, the distribution of residues is similar to normal. Thus, one can conclude that further analysis of residues will not bring new results. (see Figure 10).

A prediction made shows the assumption of how the system will behave in the expected conditions. The modeling was done on this basis. In future, the external environment, seeing that the situation is improving,

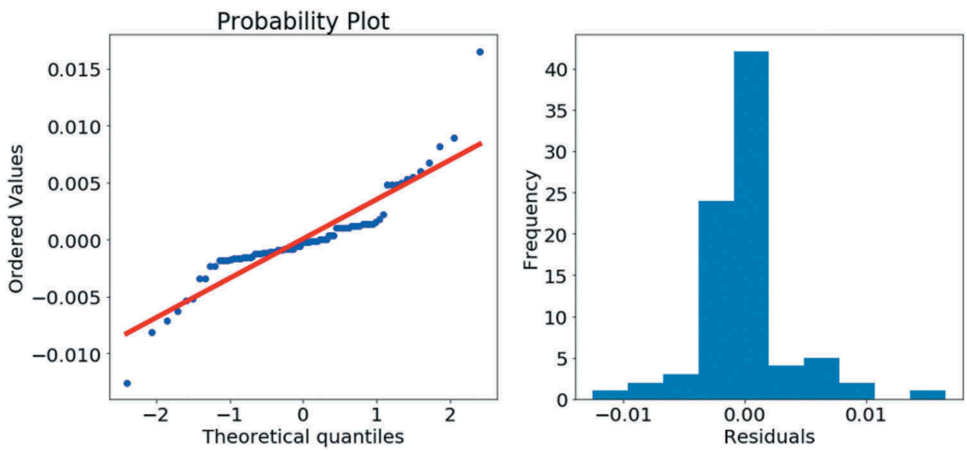

Figure 10. Estimated residue distribution.

will compensate for fluctuations to a stable level, changing the instability of this system to a stable one.

As seen in Figure 11, SGR is projected to remain at a stable level until 2030. However, following the objectives of the Chinese energy strategy until 2030 (Ma, Liu, Fu, Li, & Ni, 2011) (Ma, 2015), the average SGR of Chinese companies should increase to the level of 0.4–0.5. The forecast made does not confirm this statement. To calculate the sustainability of the system of sustainable financial growth, relevant external factors from the list of factors used in present study were identified.

To calculate the sustainability of the financial growth system, we identified external factors from the list of factors used in our study (see Figure 12).

Yparams = [‘PRP’,‘ROEnv’,‘ER’,‘FOORPRINT’, ‘BIOCAPACITY’,‘ROEsr’,‘DER’]

$$xx = \mathrm{list}(\mathrm{set.intersection}(\mathrm{set}(Xparams), \mathrm{set}(Yparams)))$$

One can see that the external component in the SGR compensates for abrupt changes in the internal component, thereby ensuring stability. In the eventuality that the external component of the SGR stops reacting this way, the whole system will go out of balance. One can conclude from this projection that the system is extremely unstable.

Financially sustainable growth strategy recommendation

Nowadays, the priorities for scientific and gas industry technical and sustainable development are both multidimensional and polycentric kinds of research. In a similar vein, financial analysis must also derive from linear and multidimensional spaces. Oil and gas companies can also be seen as a driver of societal progress (Niu, 2011). The same way, Russian oil and gas companies sustain the Russian economy and sustainable growth as a whole (receipts from oil and gas companies account for about 60% of the Russian budget). SGR research results were analyzed, and SGR is projected to remain at a stable level till 2030. However, according to the goals of the Russian Energy Strategy 2030 (Steblyanskaya et al., 2018), Russian companies’ average sustainable growth rate must increase

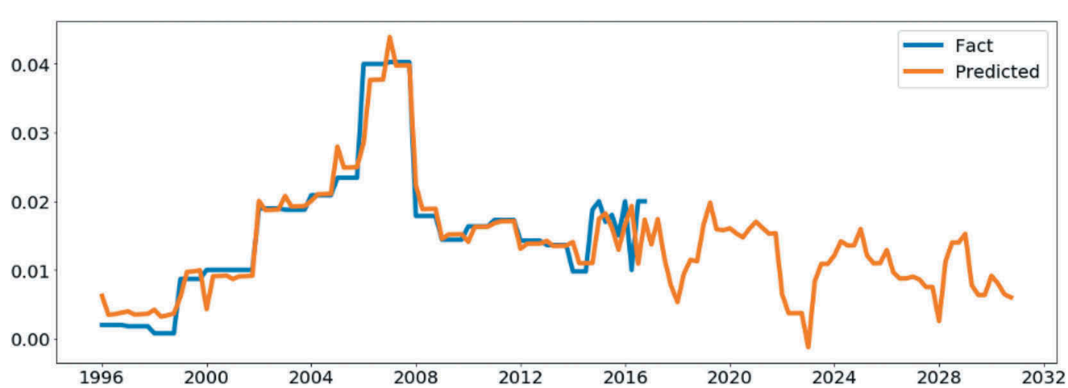

Figure 11. Forecast of the higgins sustainable growth rate to 2030.

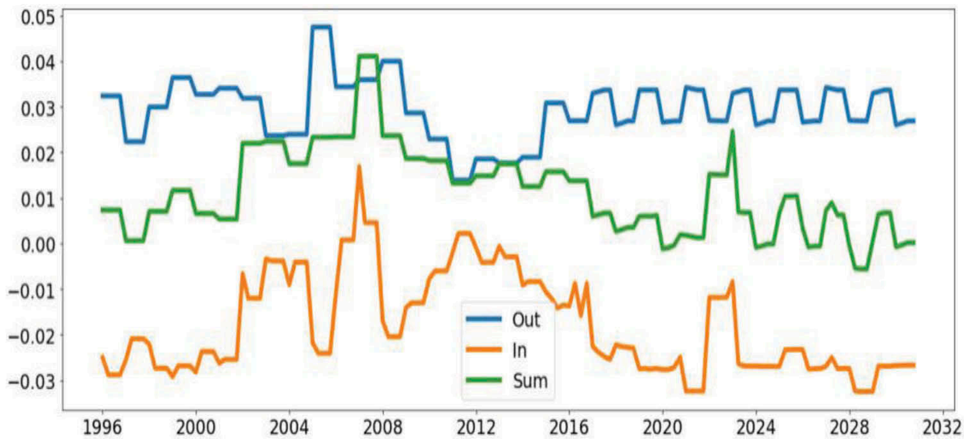

Figure 12. The impact on the sustainable growth rate external factors (Out) and internal characteristics (In) of the system.

to the 0.5–0.6 level. The research forecast did not confirm this observation. Concerning those factors which influence the sustainable growth rate with 90% probability, for Russian gas companies it is mostly financial factors. Sustainable growth is often construed as a modern social pattern which implies meeting the needs of the present without compromising the ability of future generations to meet their own needs. The Russian government has declared that the ideas and principles of sustainable growth as concerns Russian natural gas companies are outlined in the UN Action Plan for Sustainable Development known as Agenda 21(Mitrova, Boersma, & Galkina, 2016; UNCED, 1992). Unfortunately, in fact, the primary goal for Russian gas companies is to bring money into the national economy of the Russian Federation, and not to develop a sustainable or ecologically responsible corporate environment.

The opposite situation exists to some degree in Chinese gas companies, where financial indicators are more related to environmental, energy, and social indicators. However, the relationship between financial indicators and the social sector's indicators are minimal. According to the goals of the Chinese Energy Strategy 2030, companies must increase their SGR level to the 0.4–0.5 level. The presented forecast does not confirm this observation. However, for the Chinese natural gas market, their companies' primary goal is to develop environmentally protected activities too. The stated intent of Chinese companies is to maintain conscientiousness with regards to the impact of the financial factors on the external environmental situation. Progress will likely be made in this direction. In connection with the problematic current environmental situation in China, it is evident that the sustainable growth system should be more aligned towards complimenting. At the 18th National Congress, Xi Jinping declared that the primary purpose of Chinese society is the construction of eco-culture as the central element of Chinese society.

As has been outlined, in the future, there will be four major directions of sustainable growth analysis methods that need to be developed. The first direction is the development of social, environmental, and energy indicator systems, and how they influence and interact with the pertinent financial factors. The second direction is developing stochastic analysis methods related to how nonfinancial factors impact financial factors. The third direction for comprehensive analysis is the creation of a "system of methods" for analyzing the reverse impact of financial and economic indicators on environmental and social indicators. Finally, the fourth direction is necessary to solve the problem of the SGI system of comprehensive assessment and statements (Sheremet, 2017). Pursuant to these extensive goals, the authors encourage further research to examine how financial sustainability influences sustainability as a whole (and nonfinancial impacts on financial factors in particular). Future research could be continued in the "sustainability- harmonic" point of view, and should question, e.g. "can sustainability be balanced?", or "can harmonic growth be sustainable?". The authors would recommend calculating different variants of the disposal structures, or factors that can be regarded as a part of the financially sustainable growth system. An especially noteworthy project would be to continue this research and focus on energy sustainability and energy balance factors.

Conclusion

It is evident that the relationship between sustainable growth and natural gas companies' financial strategy must be closer and more interrelated. Non-financial factors and their influence on the sustainable growth index were seen to become an essential part of the financial system sustainability analysis as a whole. The research hypothesis offered, was proved regarding the analysis of financially sustainable growth interrelations and interconnections (which refers to sustainable growth which takes into account social, energy and environmental factors). Also, the existence of transversal communications between subsystems was confirmed.

With the help of Lasso regression, the essential parameters for analysing Russian gas industry companies in the context of SGR were identified. Then, OLS regression was constructed, and its coefficients were estimated. If one did not specify 0 (a significant parameter with 90% confidence), one should studied these parameters. With a 90% probability of influence on Higgins' SGR, these parameters were identified as relevant: Return on expenses invested in environmental protection (ROEenv), environmental footprint (Footprint), biocapacity (Biocapacity), revenue per ruble invested in personnel (RER), working capital (NWC), cost of capital (WACC), and the ratio of borrowed funds to total funds (DER). The forecast till the year 2030 shows that the Russian gas industry sustainable growth rate is stable. One can confirm that external factors also have a significant determining effect on the value of the SGR criteria. In case of changes in external factors, the SGR value will change a lot, but more hamper could be internal factors behavior, because of they seek diminution in their values that can harmfully influence on the companies'environment. Nevertheless, the financially sustainable growth system is stable for Russian oil and gas companies, but we suppose that this stable situation will be settled not so long time. Chinese gas companies' parameters influencing on Higgins' SGR were identified the same way as for Russian companies, however, we obtained a little bit different result. The most essential parameters are: production/reserve ratio (PRP), energy efficiency (ES), return on equity invested in environmental protection (ROEenv), footprint (Footprint), biocapacity (Biocapacity), revenue per ruble invested in personnel (ROEsr), working capital (NWC), cost of capital (WACC), and the ratio of borrowed funds to total funds (DER). Chinese gas company's financial growth system has strong instability due to the sharp fluctuations in the internal component. However, Authors emphasize attention that Chinese gas company's instability has temporary character because of because great efforts are being made to overcome this situation.

It is interesting to observe such a significantly different correlation ratio between coefficients calculated for Russian and Chinese gas companies. According to the results of this research, one can see how the financial growth system must transform to adapt towards sustainability. The authors explained the composition and structure of the sustainable growth system in the gas industry in Russia and China. They explained the composition of the influence of economic processes on predetermining sustainable growth. An analysis of the relationship included in the economic processes in the relevant identified subsystems was completed. The results of this research established that the Higgins' SGR of Russian gas companies is more interconnected with the relevant financial factors, and has a minimum interconnection with the related external social and energy indicators. The relationship between financial indicators and environmental indicators is quite deficient. At the same time, with both Chinese and Russian companies, attention is focused on the fact that energy companies should be an example of social responsibility to society.

The authors have also explained the current sustainability status of the Russian and Chinese gas industries by means of the SARIMA model. As one can see, the Russian gas industry sustainable growth rate is stable. External factors primarily determine the values of the SGR criteria. Internal factors are in the negative zone, which suggests that the system seeks to reduce the value of the criteria, but this negatively affects the external environment. Accordingly, in case of a change in the external environment, the value of the SGR may undergo drastic changes. The financial sustainable growth system is stable for Russian oil and gas companies. In Chinese gas companies, one can see that the changes in the SGR occur due to sharp fluctuations of the internal components, which indicates a strong instability of the system.

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Appendix A

Table A1. Full list of indicators used in study.

Factors	Indices	Proxy	Calculation' method
Sustainability Indicator	Higgins' Sustainable Growth Rate	SGR(H)	RM*AT*FL*R
Financial Factors	Earnings before interest and taxing	EBIT	Earnings before interest and taxing
	Return on Assets	ROA	(EBIT/Total Assets)*100%
	Return on Sales	ROS	Return on sales
	Return on Equity	ROE	Net income/Equity
	Return On Capital Employed	ROCE	EBIT/(Total Assets-Current Liabilities)
	Return on Fixed Assets	ROFA	EBIT/Fixed Assets
	Net working capital	NWC	Current assets-current liabilities
	Net working capital Turnover	NWCT	Revenue/Current Assets
	Current Ratio	CR	Current assets/current liabilities
	Revenue growth	RG	An increase of a company s sales when compared to a previous quarter s revenue performance
	Net profit growth	NPG	An increase of a company s net profit when compared to a previous quarter s net profit performance
	Net assets growth	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	FL	Total Assets/Equity
	Operation leverage degree	DOL	% change in EBIT/% change in Revenue
	Debt equity ratio	DER	Total liabilities/Equity. Total liabilities = Equity-Assets
	Weighted Average Cost Of Capital	WACC	$WACC = rE \times kE + rD \times kD \times (1 - T)$
Energy factors	Energy Indicators	LEI	Lambert Energy Index
		ES	Energy Savings
Environmental factors	Return on environmental expences	ROEenv	costs concerning environmental protection and decision of pollution question/production
	Environmental ratings	ER	Gazprom' environmental ranking
	Production/Reserves ratio	PRP	Production/Reserves
	Footprint	FP	Footprint
	Biocapacity	BC	Biocapacity (биоёмкость)
Social factors	Revenue per employee ratio	RER	Total Revenue/Total Number of Employees.
	Return on social expences	ROEsr	Costs concerning employee benefits/net profit
	Return on Labour	ROL	Net Profit/Number of employees