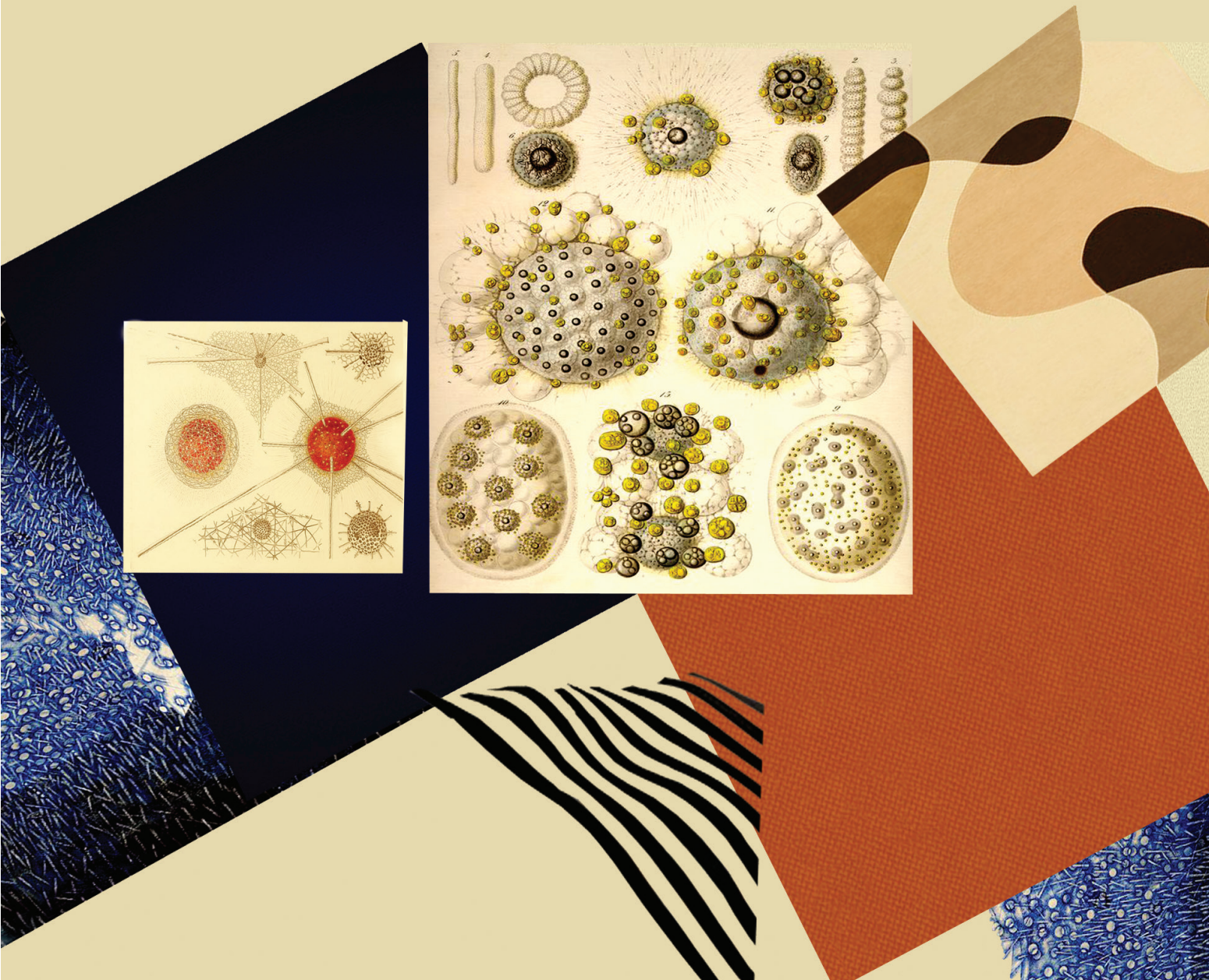
ISSN 2500-2597
2020
Vol.14 No 2

FORESIGHT AND STI GOVERNANCE

JOURNAL OF THE NATIONAL RESEARCH UNIVERSITY HIGHER SCHOOL OF ECONOMICS

IN THIS ISSUE



ABOUT THE JOURNAL

Foresight and STI Governance is an international interdisciplinary peer-reviewed open-access journal. It publishes original research articles, offering new theoretical insights and practice-oriented knowledge in important areas of strategic planning and the creation of science, technology, and innovation (STI) policy, and it examines possible and alternative futures in all human endeavors in order to make such insights available to the right person at the right time to ensure the right decision.

The journal acts as a scientific forum, contributing to the interaction between researchers, policy makers, and other actors involved in innovation processes. It encompasses all facets of STI policy and the creation of technological, managerial, product, and social innovations. *Foresight and STI Governance* welcomes works from scholars based in all parts of the world.

Topics covered include:

- Foresight methodologies and best practices;
- Long-term socioeconomic priorities for strategic planning and policy making;
- Innovative strategies at the national, regional, sectoral, and corporate levels;
- The development of National Innovation Systems;
- The exploration of the innovation lifecycle from idea to market;
- Technological trends, breakthroughs, and grand challenges;
- Technological change and its implications for economy, policy-making, and society;
- Corporate innovation management;
- Human capital in STI;

and many others.

The target audience of the journal comprises research scholars, university professors, post-graduates, policy-makers, business people, the expert community, undergraduates, and others who are interested in S&T and innovation analyses, foresight studies, and policy issues.

Foresight and STI Governance is published quarterly and distributed worldwide. It is an open-access electronic journal and is available online for free via:
https://foresight-journal.hse.ru/en/

The journal is included into the 1st quartile (Q1) of the Scopus Cite Score Rank in the fields:

- **Economics, Econometrics and Finance** (miscellaneous)
- **Decision Sciences** (miscellaneous)

INDEXING AND ABSTRACTING

WEB OF SCIENCE™ CORE COLLECTION EMERGING SOURCES CITATION INDEX

SCOPUS™

RePEc RESEARCH PAPERS IN ECONOMICS

SSRN ProQuest Start here.

GENAMICS™ JOURNALSEEK

EBSCO Academic Search Premier

OAJI .net Open Academic Journals Index

ECONSTOR

DOAJ DIRECTORY OF OPEN ACCESS JOURNALS

FOREIGHT AND STI GOVERNANCE

National Research University
Higher School of Economics

Institute for Statistical Studies
and Economics of Knowledge

Address:
National Research University Higher School of Economics
20, Myasnitskaya str., Moscow, 101000, Russia
Tel: +7 (495) 621-40-38
E-mail: foresight-journal@hse.ru

http://foresight-journal.hse.ru/en/

Periodicity — quarterly

ISSN 2500-2597
ISSN 2312-9972 (online)
ISSN 1995-459X (Russian print version)

Publisher:
National Research University
Higher School of Economics

NOTES FOR AUTHORS

Before submitting your article, please prepare your manuscript using the following guidelines:

Articles should be topical and original, should outline tasks (issues), describe the key results of the author's research and his/her conclusions;

Manuscripts are to be submitted via e-mail: foresight-journal@hse.ru

Format

All files should be submitted as a Word document.

The text should be in Times New Roman 14 pt, 1.5 spaced and fit to the width, all margins should be 20 mm.

Article Length

Articles should be between 20000 and 60000 characters (incl. spaces). Optimal size is 40 000 characters.

Article Title

To be submitted in native language and English. A title of not more than eight words should be provided.

Author Details (in English and native language)

Details should be supplied on the Article Title Page, including:

- Full name of each author
- Position, rank, academic degree
- Affiliation of each author, at the time the research was completed
- Full postal address of the affiliation
- E-mail address of each author

Abstract

An abstract should be: informative (no general words), original, relevant (reflects your paper's key content and research findings); structured (follows the logics of the results presented in the paper), concise (between 250 and 300 words).

- Purpose (mandatory)
- Design/methodology/approach (mandatory)
- Findings (mandatory)
- Research limitations/implications (if applicable)
- Practical implications (if applicable)
- Social implications (if applicable)
- Originality/value (mandatory)

It is appropriate to describe the research methods/methodology if they are original or of interest for this particular research. For papers concerned with experimental work describe your data sources and data processing techniques.

Describe your results as precisely and informatively as possible. Include your key theoretical and experimental results, factual information, and any interconnections and patterns shown. Give special priority in your abstract to new results and data with long-term impact, important discoveries and verified findings that contradict previous theories as well as data that you think have practical value.

Conclusions could be associated with recommendations, estimates, suggestions, and hypotheses described in the paper.

Information contained in the title should not be dublicated in the abstract . Try to avoid unnecessary introductory phrases (e.g. 'the author of the paper considers…').

Use language typical of research and technical documents to compile your abstract and avoid complex grammatical constructions.

The text of the abstract should include the key words of the paper.

Keywords

Please provide up to 10 keywords on the Article Title Page, which encapsulate the principal topics of the paper.

Headings

Headings must be concise, with a clear indication of the distinction between the hierarchy of headings.

Figures

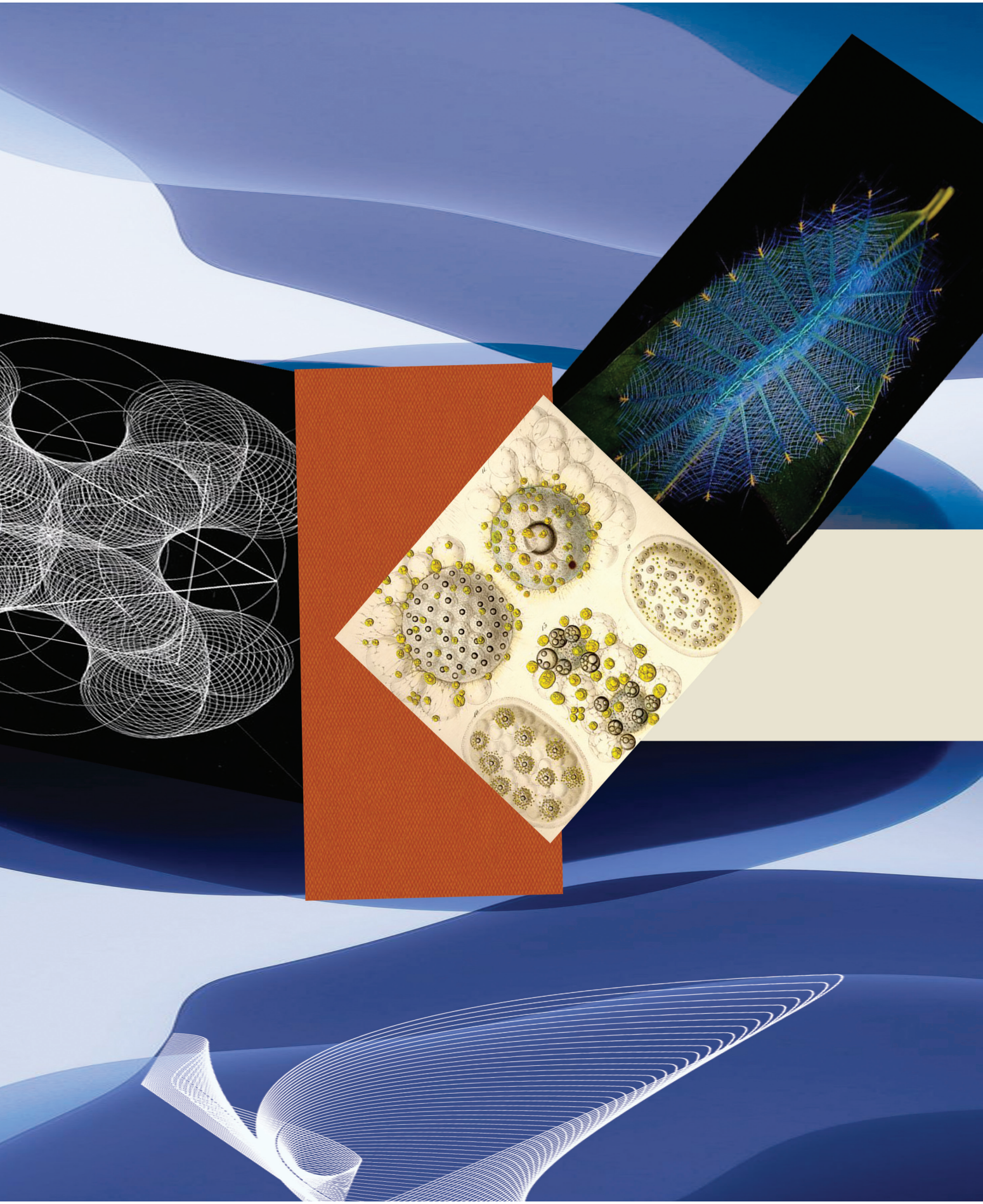
All figures should be of high quality, legible, and numbered consecutively with arabic numerals. All figures (charts, diagrams, line drawings, web pages/screenshots, and photographic images) should be submitted in electronic form preferably in color as separate files, that match the following parameters:

Photo images — JPEG or TIFF format. Minimum resolution 300 dpi, image size not less than 1000x1000 pix

Charts, diagrams, line drawings — EXCEL or EPS format

CONTENTS

STRATEGIES



How COVID-19 Pandemics Influences Chinese Economic Sustainability

Maksim Vasiev
PhD student, School of Economics and Management, vasievmp@yandex.ru

Kexin Bi*
Professor of Management Science and Engineering, School of Economics and Management, bikexin@hrbeu.edu.cn

Harbin Engineering University, Nangang district, Nantongdajie 149, 150001, Heilongjiang Province, Harbin, China

Artem Denisov
Professor, Department of Computer Science, iptema@yandex.ru

Kostroma State University, 17, Dzerzhinskogo St., 156005, Kostroma, Russian Federation

Vladimir Bocharnikov
Professor, Wildlife Ecology and Conservation Laboratory, vbocharnikov@mail.ru

Pacific Geographical Institute, Far East Branch of the Russian Academy of Science, 7, Radio St., Vladivostok, 690041, Russian Federation

Abstract

China was the first country to face the COVID-19 coronavirus pandemic. Owing to the prompt and decisive actions of the authorities, and the consolidation of society, the country has passed the peak of infection and economic activity is gradually recovering.

The paper shows how COVID-19 affects key industries and the work of supply and transportation networks. Using input-output spatial data, migration index indicators, and pandemic spread statistics, we modeled different scenarios for changes in Chinese provinces' production and consumption following the COVID-19 pandemic. Calculations were made for 31 provinces and 42 sectors of the Chinese economy. We obtained a model that shows how the coronavirus outbreak influences carbon dioxide emission, levels of hazardous waste, and the Energy-Resource Efficiency Rating. Based on the financial and migration flows between Chinese provinces, we chose the most effective post-outbreak model. Our main recommendation is that one does not need to segregate consumers. It is necessary to distribute the damage as evenly as possible between all provinces equally. We believe that such an approach will allow the Chinese economy to suffer the least possible amount of damage and facilitate a faster recovery. Finally, we analyzed the development of bilateral post-epidemic financial flows between China and Russia until 2025. In all scenarios, a temporary decline is expected.

The results of the study may be useful for other countries in developing policies to overcome the post-epidemic crisis.

Keywords: coronavirus (COVID-19); strategies; forecasting; sustainable development; post-coronavirus scenarios; SARIMA; input-output analysis; development programmes.

Citation: Vasiev M., Bi K., Denisov A., Bocharnikov V. (2020) How COVID-19 Pandemics Influences Chinese Economic Sustainability. *Foresight and STI Governance*, vol. 14, no 2, pp. 7–22. DOI: 10.17323/2500-2597.2020.2.7.22

* Correspondence author

The world is experiencing social and economic turmoil. Humanity is faced with environmental degradation, new viral outbreaks, and an uncontrollable decline in GDP [*Ward et al.*, 2016]. Nowadays, it is essential not only to maximize profits, but to maintain economic stability and protect bio-diversity [*Chou et al.*, 2018]. The most critical thing is to find a way to maintain balanced socioeconomic development and overcome post-epidemic crises [*Cao,* 2019].

Since the widescale reforms in 1978, China has made remarkable progress in economic development [*Yan et al.*, 2020]. After the financial crisis in 2008, the global economy entered a downward trend, but China's economic development maintained a medium-low growth rate. The high resilience of China's economic growth provides ample room for coping with external shocks in order to achieve high-quality development. The Chinese government put forward a sustainable development plan that considers not only quantitative growth, but also qualitative improvement in the quality of life [*Bei,* 2018; *Pan et al.*, 2019; *Yan et al.,* 2020].

The COVID-19 coronavirus outbreak in Wuhan, China sparked a global epidemic at the end of 2019. As a result, on January 31, 2020 the World Health Organization declared an international emergency [WHO, 2020]. As with several crises, the repercussions of coronavirus can also be felt in the global economy and on financial markets. Many analysts compared coronavirus to the 2003 SARS outbreak. Even though this can offer useful information, there are radical differences between the two events. China controls a much larger part of the global economy and markets than it did 17 years ago. According to World Bank statistics, China's share of global trade increased to approximately 14% in 2019 compared to 5% in 2003. Furthermore, its share of the MSCI Emerging Markets Index rose to almost 35% in 2019 from 8% in 2003 [*Bouoiyour, Selmi,* 2020; *Wen et al.,* 2020]. Thus, China's economy is taking a significant hit from the COVID-19 coronavirus outbreak [*Allam, Jones,* 2020].

Recent years have seen growing interest in studying the prospects for economic development in post-epidemic periods. This interest has arisen along with the emergence of many new infectious diseases (over 30 in the past 25 years, including HIV/AIDS and severe acute respiratory syndrome (SARS)) as well as the return of old threats such as pandemic influenza [*Wen et al.,* 2020]. In the same way, attention was turned to the new coronavirus in 2019. The exponential increase in the confirmed number of COVID-19 cases is of great concern to the global community [*Wong et al.,* 2020]. The recent dynamics of the coronavirus outbreak allow one to suggest that this virus is more contagious than SARS was in 2003 [*Lippi, Plebani,* 2020]. Now the great challenge is for China to overcome the coronavirus outbreak. One of the opinions is that the influence of coronavirus upon major projects such as China One Belt – One Road (OBOR) is limited and that delays will only impact them in the short term. Delays and the cessation of work on OBOR projects revealed, or rather, once again emphasized the growing dependence upon China' new infrastructure. Even though the epidemic has declined in China itself, the governments of other countries such as the US, Italy, Spain, Germany, the UK, Iran, South Korea, and others are terrified of new outbreaks.

Even before the outbreak of the coronavirus epidemic, the Chinese government made dramatic adjustments to OBOR development plans. For example, it decided to slightly lower the tasks set for OBOR due to the severe slowdown in the development of the Chinese economy and an increasing wave of criticism in partner countries, who were dissatisfied with the conditions set by Beijing and, in particular, financial ones. However, China is convinced that the country would be able to fulfill the tasks set for the economy despite the pandemic and the OBOR project is a key task. China's inexhaustible resources and the stubbornness with which the Chinese people achieve their goals give reason to say that sometimes they can even do the impossible. China was the first to be impacted by the pandemic and now can use this opportunity to build the international community's confidence in it and show the world that it is a reliable partner capable of stabilizing the global situation.

In this paper, we compare situation in China's provinces and industries in order to identify which ones are most vulnerable. We perform a systematic analysis of the current position of and prospects for the Chinese economy, considering the estimated level of financial exchanges between China and Russia. Changes in production and consumption for each province of China are modeled. Historic input-output data serve as the information base as well as the latest statistics on migration and infection rates for COVID-19 coronavirus.

Literature Review

The Pandemic's Impact upon the Global Economy

China's economy is globally connected through trade, investment, and tourism, and any slowdown or persistent travel and transportation restrictions are likely to put pressure on global supply chains and potentially create worldwide economic fallout. Measures undertaken to hold the outbreak have significantly curtailed domestic and global transportation links, thus preventing the transportation of many products and decline of manufacturing inputs.

Production has slowed across China, with sharp slowdowns in sectors concentrated in Hubei, such as auto parts, LCD panels, and pharmaceuticals. Manufacturing that recently shifted offshore to other parts of Asia still often depends upon intermediate inputs from China and thus is not insulated from China's production slowdown. At the firm level, companies in sectors such as hi-tech and automobiles or those that are exposed to China's tourism, retail, or other service sectors could take a significant hit. According to the United Nations World Tourism Organization, in 2018, China's outbound tourism sector spent $277 billion, of which an estimated $36 billion was in the United States[1]. US business will probably be affected by China's slowdown, including through shortages of inputs, the cancellation of some commercial activity, and potential increased costs related to an appreciating US dollar [CRS, 2020].

The major outbreaks can have a substantial economic impact upon the affected country, which is illustrated by the cases of SARS, MERS, and Ebola. According to some estimates, if the current epidemic is overcome within three months, it will likely lead a 0.8% drop in real GDP. In case of it lasting for nine months, the coronavirus outbreak will result in a 1.9% decline in GDP. GDP may fall more substantially if there are extended restrictions on movement and therefore upon trade and commerce [*Smith et al.,* 2019]. Preliminary input-output data suggest that China's countermeasures and suppressed demand could limit the long-term economic impact of the COVID-19 outbreak [*Duan et al.,* 2020]. In the short-term period, unfortunately, industrial production is expected to drop 18%. China hosts more than 18 million small and medium enterprises that account for almost 80% of jobs and 50% of private firms' exports. These businesses have been severely affected by the coronavirus outbreak. Widespread disruptions in production, surging inventory costs from depressed domestic consumption, and rigid expenditures upon rents, wages, and interest altogether have impacted the fragile capital chain of SMEs, thus probably leading to numerous bankruptcies. The Chinese government has made swift and decisive efforts to control the spread of the virus. Depending upon the time taken for the outbreak to peak, measures able to mitigate short-term economic risks include campaigns for supporting small companies, policy incentives such as subsidies, delayed tax payments, reduced mortgage interest rates, and restoring market confidence through greater publicity and public scrutiny.

SARS is believed to be the first deadly infectious disease of the 21st century. Starting in the Chinese province of Guangdong in November 2002, by August 2003 it had spread to 29 countries and three regions, leading to 8,422 infections, of which there were 916 deaths. SARS was an unexpected negative shock in Hong Kong. The major adverse effects were on the demand side, with local consumption, tourism, and air travel services severely affected in the short term. The manufacturing base in the Pearl River Delta was unaffected, so the economy did not experience a supply shock, as the export of goods via Hong Kong continued. Initial alarmist estimates on the negative economic impacts were not borne out. After taking control of the outbreak, fear and panic quickly subsided and the economy rapidly rebounded [*Siu, Wong,* 2004].

The COVID-19 coronavirus outbreak has a much wider scale, thus illustrating the fact that infectious disease outbreaks can lead to severe economic disruptions [*Brahmbhatt, Dutta,* 2008]. The pandemics has already affected international trade as a whole. As World Trade Organization emphasized: "World trade is expected to fall by between 13% and 32% in 2020 as the COVID 19 pandemic disrupts normal economic activity and life around the world" [WTO, 2020].

Ways to Find a New Sustainable Economy

The Chinese government recognized the problems and undertook several steps, which resulted in some improvements. These reactions, however, were criticized as insufficient. In recent years, the Chinese public has realized the dangers of government environmental policies. The economic boom in China dramatically accelerated the destruction of country's resources since decisions were not made with rational and economic use of said resources in mind. The result was the severe depletion and imbalance of ecosystems, and as a result, an increase in pandemics.

The current environmental situation in China is not only the result of today's political choices, but also of the approaches, attitudes, and institutions that are brought forward over the centuries. Over the last few decades scientists have been trying to find a path towards a new sustainable economy. Emphasis has been placed upon the transition to a green economy by researchers such as Herman Daly [*Daly, Farley,* 2004; *Daly,* 2007], Cuttler J. Cleverland [*Cleveland,* 1999], Robert Costanza [*Costanza et al.,* 2015], and others. Other researchers focus on quality of life and energy efficiency economy, such as Charles Hall in his work "EROI and Wealth of Nations" [*Hall et al.,* 2014] and Jessica Lambert in the paper "Energy, EROI and quality of life" [*Lambert et al.*, 2014]. In the new post-pandemic model of the economy, profit-making should not be the paramount task, but efforts

[1] Available at: https://www.e-unwto.org/doi/pdf/10.18111/9789284421138, accessed 19.04.2020.

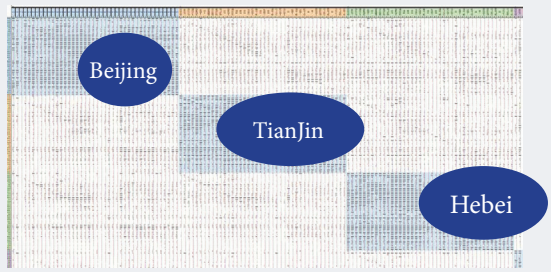
to ensure balanced development should be emphasized. However, sustainability is a critical factor.[2] Achieving the sustainable, green development of human civilization is the most important and ambitious program of the international community aimed at ensuring a better future. Nevertheless, the implementation of this paradigm in all countries is far from perfect, despite the unprecedented efforts made over the past three decades [*Bocharnikov,* 2018a, 2018b].

It is now well-known that regions in Russian and China develop in a disproportionate manner. The level of economic development of regions and provinces is characterized by the gross regional product, the ratio of cash income to the subsistence level of the population, poverty level, and population density. Statistics for these indicators showed the areas for the most probable anthropogenic "penetration" of various forms of economic activity. The limits of the previous model of economic growth have been achieved, as a result, extraordinary public health challenges have arisen [*Bocharnikov,* 2012]. Thus, it is precisely in these areas of increased anthropogenic activity where various diseases and catastrophes suddenly arise. Scientists unanimously argue that the post-viral economy should be green as well as socially, ecologically, and environmentally oriented.

Data

Our research is based upon publicly available inter-provincial input-output tables which have been published by the China's National Bureau of Statistics every five years since 1992. We use the most recent officially published data for 2017. Research has been done on the basis of China's thirty-one provinces. Russia input–output data for 2014 is from the WIND economic database[3]. Environmental, economic, and social data were used from the China Environmental Statistical Books and the EPS database[4]. Statistics on the spread of COVID-19 in China, including for Hubei province, for the period of January-March 2020, is presented the health section of the WeChat health platform. An inter-province migration index is contained on the Baidu Qianxi database[5]. Python code and calculation results as well as the data are available on the GitHub website[6]. A full list of data sources is represented in Table 1. The Chinese industry abbreviation sheet is available in the Table 2. All data were cross-checked for consistency before processing, with the use of overlay tools and visual comparison.

Figure 1. **Example of a Chinese Regional Input-Output Matrix**



Source: [*Yan et al.,* 2020].

Methodology

Input-Output Efficiency Analysis

Input and output analysis can systematically reveal not only the direct and obvious, but also the indirect, tacit links between various industries in the production process [*Chen,* 1990; *Yan et al.*, 2020]. Input-output analysis provides a basis for studying the industrial structure and carrying out multiple quantitative analyses [*Leontief,* 2008]. The construction and usage of Input-Output Tables has been part of the analysis of China's economy since 1960. In 1973, Chen Xikang together with his colleagues constructed the first experimental input-output table for evaluating the national economy. Since then, the technologies of preparation, research, and application of input-output tables in China have rapidly improved [*Yan et al.*, 2020].

The modeling of public Interprovincial Input-Output Tables [*Oliveira, Antunes,* 2011] and the Migration Index process is as follows:

Step 1: Calculate the closeness of links between the financial and migration flows for every province. Beijing, Tianjin, and other provinces (31 in total) are considered as separate subsystems, with their boundaries, and calculations made for every Subsystem-Province. Figure 1 shows an example of the China provinces' input-output table.

Step 2: Calculate input production efficiency and the potential reliable transportation channels, which are playing an essential role in each of the provinces. For example, the authors ranked the transfers of products between provinces (thirty-one provinces multiplied by forty-two sectors' in-

[2] Available at: https://www.wbcsd.org/COVID-19, accessed 13.04.2020.
[3] Available at: https://www.wind.com.cn/en/edb.html, accessed 13.04.2020.
[4] Available at: http://olap.epsnet.com.cn/, accessed 13.04.2020.
[5] Available at: http://qianxi.baidu.com/, accessed 13.04.2020)
[6] Available at: https://github.com/rufimich/Virus_prov, accessed 13.04.2020.

Table 1. **List of Research Indicators**

Area	Indicator	Code	Measure
Social	Population	P	bln
	Unemployment rate	UR	%
	Urban Land area, sq. km	LA	thousands of hectares
	Highway density	HD	The ratio of the total length of all roads of the province to the province's area (Km roads / 100 km ^ 2 of the total area of the province (km / 100km ^ 2))
	Passenger traffic	PT	10000 p
	Average number of trips per person	TPP	units
	Number of employed persons	EP	10000
Economic	GDP	GDP	bln
	GDP/person	GDP—P	bln
	Total investments in environmental pollution control	TIEPC	bln
	Energy Efficiency Rating *	ENR	index
	Energy consumption (10,000 tons of standard coal)	EC	ga/population
	Technological Efficiency Rartiong *	TE	index
Environmental	Ratio of wilderness areas	RWA	%
	Ratio of protected wilderness areas	RPWA	%
	Ratio wilderness area/population	RWP	%
	Total water consumption	TWC	hundred mln.cub.m
	Consumption of gasoline	GC	hundred mln.cub.m
	Hazardous waste*	HW	ten th tons
	Waste water discharge	WW	thousand meters cub
	CO2 emissions	CO2	kg per kg of oil equivalent energy use
	Eco-Efficiency Rating *	ERE	index

Note: Indicators marked by (*) are calculated using the ERA- Interfax methodology [Interfax, 2010]. Other indicators are taken from the EPS database (http://olap.epsnet.com.cn/).
Source: authors.

put) from Hubei to other provinces. At the same time, the calculation results could show deliveries from Hubei (forty-two industrial sectors) to other provinces (thirty-one provinces *forty-two sectors input). Thus, on the basis of the input-output data, financial flows between Chinese provinces were modeled.

Step 3: On the basis of the migration index data, interprovince migration flows were modeled.

Step 4: On the basis of the Chinese and Russian input-output data, Sino-Russia financial flows after the coronavirus outbreak were forecast.

SARIMA Analysis

The authors used Python 3.4 modeling [*Sarker,* 2014; *Scellato,* 2013][7] to show how COVID-19 influences China's economic, social, and environmental factors. The authors tested twenty-three sustainable factors. The testing methodology consists of the following steps: (1) the authors employed factor analysis; (2) the authors identified the most influential factors for Chinese provinces' sustainable indices; (3) the authors built the SARIMA (seasonal autoregressive integrated moving average) regression model.

Scenario Modeling

The authors calculated four different scenarios for the provinces' post-coronavirus economy by using the net-science methodology [*Suarez et al.,* 2015]. In the end, the authors analyzed post-crisis financial flows between China and Russia. The scenario decision–making scheme is illustrated in Figure 2.

After determining the set of parameters for lowering the production level in Hubei province in accordance with each scenario, the reallocation of

[7] See also: Applied Social Network Analysis in Python (University of Michigan online course). Available at: https://www.coursera.org/learn/python-social-network-analysis/lecture/ZhNvi/clustering-coefficient, accessed 11.01.2020.

Table 2. **Abbreviation Sheet for Chinese Industries**

Industry	Code
Agriculture	Agri
Coal mining products	CoalM
Oil and gas production products	OilgasM
Metal mineral products	MetM
Non-metallic minerals and other mineral products	NMetM
Food and tobacco	Food
Textile	Tex
Textile clothing shoes and hats leather down and its products	Cloth
Wood work and furniture	Wood
Papermaking	Paper
Petroleum	Fuel
Chemical products	Chemi
Non-metallic mineral products	NonMetP
Metal smelting and calendering products	MetSm
Metal products	MetInd
General equipment	General
Special equipment	Special
Transportation equipment	TransEq
Electrical machinery and equipment	Electri
Communications equipment	ComEq
Instrument and meter	Instr
Other manufactured products	OtherM
Scrap waste	Waste
Metal products	EquiRepair
Production and supply of electricity and heat	ElectriH
Gas production and supply	GasPS
Water production and supply	WaterPS
Building	Building
Wholesale and retail	WhSR
Transportation	Trans
Accommodation and catering	Accom
Information transmission	Inform
Financial	Fin
The real estate	Estate
Rental and business services	Rental
Scientific research and technical services	Science
Management of water conservancy	Cons
Resident services	ResS
Education	Edu
Health and social work	Health
Culture	Culture
Public administration	PublA

Source: authors.

the resource deficit level of each region were forecasted. Then, according to the four scenarios, the authors forecast resource distribution for every province.

Results

Regression Modeling Results

The authors analyzed the input–output financial flows and the migration index between China provinces. In Table 3 and Figure 3 it is possible to see the mutual correlation between regional product from X- province and Y-migration index.

OLS regression results show that the minimum relationship between financial flows and the migration index is 1.099147 e+06, which is very close. It can be concluded that when migration flows are blocked in Hubei province, production will completely stop. Figure 3 clearly shows that when any virus spreads from a particular region, the regions that are closely connected to the source of the viruswill suffer the first.

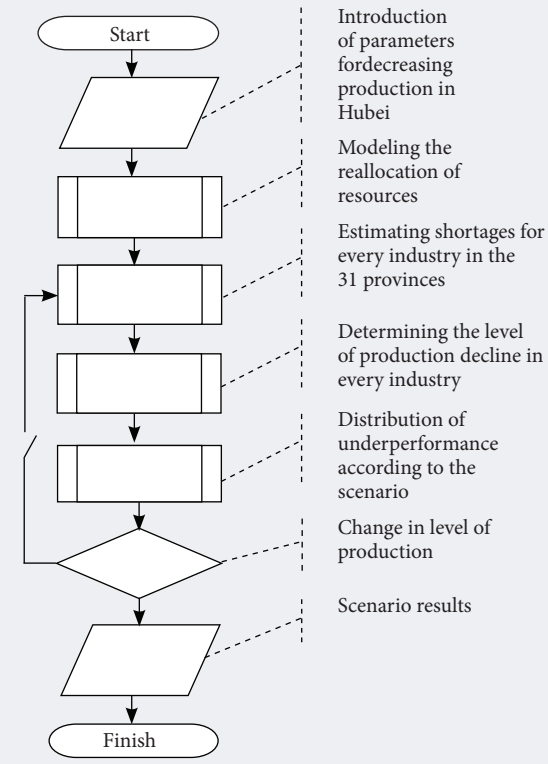
The authors assumed that quarantine in the Hubei province would be six months. That situation would reduce annual production by half and reduce consumption by a quarter. How much would production in other regions be impacted?

The authors tested whether or not the financial flows between China provinces and industries would fall by 25%. If the supply of raw materials and parts from Hubei to other provinces ceases, production plans would be interrupted and this would impact all regions within the supply chain.

We can conclude that during the epidemic, economic activity is declining in all provinces. Mainly coronavirus spreads due to close economic ties and population flows. There is a very high correlation between them. If a source of the virus appears in a particular region, the regions that are economically connected to it will be the first to suffer. The authors evaluated the quality of the regression. If the government stimulates economic activity in all provinces proportionally, then in accordance with the principle of entropy, it will be possible to achieve the smallest reduction in China's GDP.

We used Python 3.4 to calculate the flows between provinces. Considering Beijing, Tianjinand, and the other provinces (31 in total) as particular closed subsystems, we made calculations for every province. Our calculations revealed that that all the regions have an efficiency value near 1.5 and a potential value of about 5.8, with minimal differences. Nevertheless, in terms of open systems, when considering the input and output from other provinces, the results are completely different. Figure 4 shows the financial flows between provinces. The most substantial flows are between Guangdong, Zhejiang,

Figure 2. **Decision Making Scheme for Scenario Modeling**



Source: Authors methodology.

Jiangsu, Yunnan, Shanghai, Hebei, Shandong, Beijing, Tianjin, and Inner Mongolia. Moreover, the flows illustrate the increasing links between China's central and western provinces such as those between Hubei and the Anhui and Jiangxi provinces.

The cross-regional entropy of the migration index closeness was measured amid the pandemic and in the post-crisis period. The higher the economic entropy of a region, the more stable the region is, the more interconnected it is, and the more susceptible it is to coronavirus. The effect of entropy also extends to migration flows. The most vulnerable areas are Jiangsu, Zhejiang, Guandong, and Shandong. The graph shows that financial flows are directly proportional to migration flows. As a result, regions with the highest migration indexes are the most susceptible to viral outbreaks.

SARIMA Model Results

The authors found dependencies between cases of infection and death from COVID-19 coronavirus and socioecologial and economic indicators for Chinese provinces (see Table 4). As a result, the authors obtained a model illustrating how the COVID-19 coronavirus outbreak influences carbon dioxide emissions, the level of hazardous waste, and the Energy-Resource Efficiency Rating (ERE)[8]. The model is as follows (see Table 1 for definitions of variables):

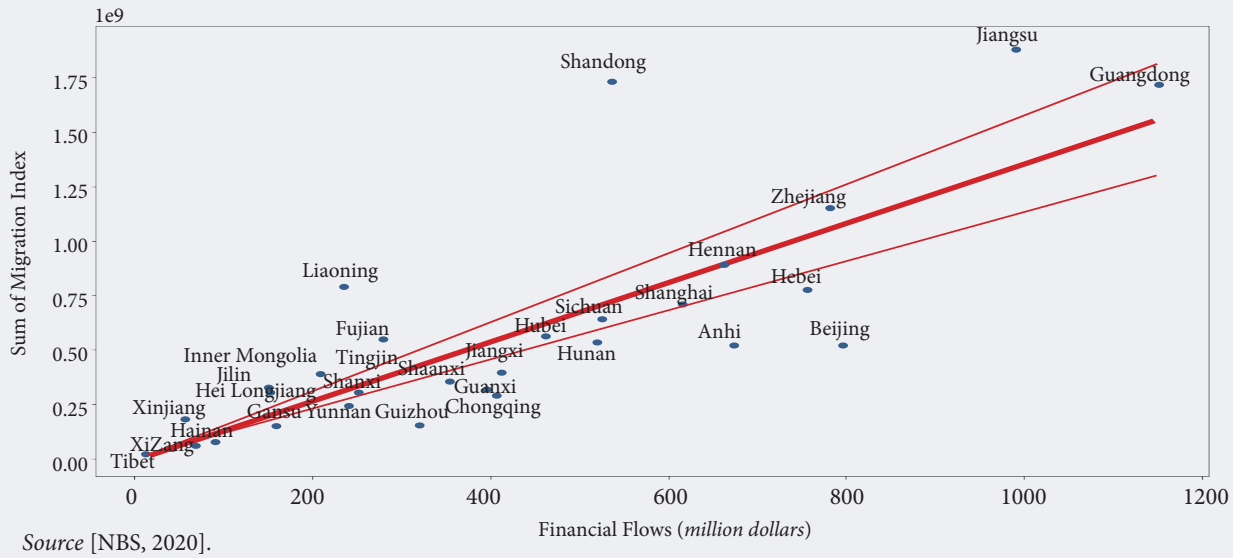
dfg1.columns=['P', 'UR', 'EP/P', 'UL/P', 'HD/GDP', 'PT/P', 'TR', 'WAR', 'HW', 'TWD','ESE', 'WA_P', 'GA', 'CO2_P', 'GDP', 'EC/P', 'ERE_GDP', 'TE/GDP"TIEPC', 'PGR_GDP', 'Proc_D']

m1 = smf.ols('Proc_D ~ CO2_P + HW + ERE_GDP',data=dfg1)

Scenario Modeling for Chinese Provinces

By analyzing cross-sectional data on the industries in the provinces and the sustainability of their transportation channels, the authors compiled four scenarios. Figures 5-10 show the modeling results of the drop in production in the provinces in the

Figure 3. **Interprovincial flows (*million dollars*) and the level of migration**



Source [NBS, 2020].

[8] The index was calculated by using the Interfax-ERA methodology [Interfax, 2010].

Table 3. **OLS Regression Results**

Dep. Variable	FinancialFlow	R^2	0.850
Model	OLS	Adjusted R^2	0.845
Method	Least Squares	F-statistics	104.7
Date	Sun, 12 Apr 2020	Prob (F-statistics)	2.68e-11
Time	06:45:49	Log-Likelihood	-647.35
No. Observations	31	AIC	1297.
Df Residuals	30	BIC	1298.
Df Model	1	Covariance Type	HC1
Omnibus	18.892	Durbin-Watson	2.013
Prob(Omnibus)	0.000	Jarque-Bera (JB)	28.197
Skew	1.443	Prob(JB)	7.53e-07
Kurtosis	6.674	Cond. No.	1.00

	coef	std err	z	P>|z|	[0.025	0.975]
MigrationIndex	1.36e+06	1.33e+05	10.231	0.000	1.1e+06	1.62e+06

Note: in this and further tables and figures, unless indicated otherwise, the source is the authors' results obtained from the Python calculation: https://github.com/rufimich/Virus_prov., accessed17.04.2020.

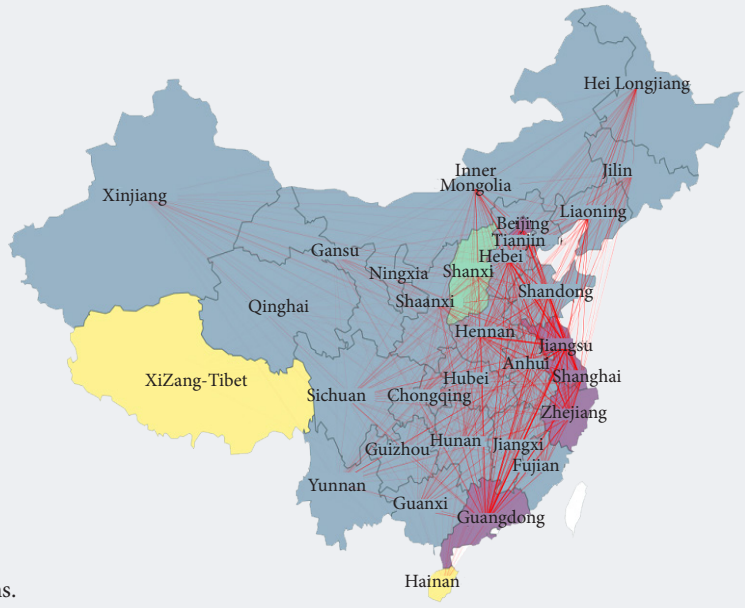
case of a six-month shutdown in Hubei for both regions and industries.

Scenario 1. Economic activity in Hubei falls by 25% and product supplies to other regions are halted. The shortfall is distributed proportionally among all Chinese provinces that, due to a lack of resources, stop production and, as a result, stop supplying products to other regions. In this scenario, production in all provinces would drop 25%.

Scenario 2. Products are delivered primarily under small contacts. Contracts for large amounts would be delayed for as long as possible (see Figures 5 and 6). In this case, the provinces and industries would suffer moderate damage. However, the poorly developed regions would most likely face a longer recovery period. The results of scenario modeling showed that not all unused resources in Hubei would be redistributed between other provinces.

If the extensive travel restrictions and quarantine policies continue, offline services including retail, catering, tourism, hospitality, transportation, and education and entertainment services would suffer the most [*McCloskey, Heymann,* 2020]. Government measures to cushion the shock such as loan payment deferments, social security contribution deferments, tax payment deferments, emergency credit facilities, and so on may be insuf-

Figure 4. **Financial Flows between Chinese Provinces**



Source: authors' calculations.

Table 4. **OLS Regression Results**

Dep. Variable	Proc_D	R^2	0.770
Model	OLS	Adjusted R^2	0.744
Method	Least Squares	F-statistics	25.17
Date	Tue, 17 Mar 2020	P(F-statistics)	5.58e-08
Time	01:38:57	Log-Likelihood	87.049
No. Observations	31	AIC	-166.1
Df Residuals	27	BIC	-160.4
Df Model	3	Covariance Type	HC1
Omnibus	7.226	Durbin-Watson	1.952
Prob(Omnibus)	0.027	Jarque-Bera (JB)	6.013
Skew	0.724	Prob(JB)	0.0495
Kurtosis	4.599	Cond. No.	1.38

	coef	std err	z	P>|z|	[0.025	0.975]
Intercept	0.0138	0.003	4.924	0.000	0.008	0.019
CO2_P	0.0039	0.002	2.166	0.030	0.000	0.008
HW	0.0277	0.003	8.546	0.000	0.021	0.034
ERE_GDP	0.0072	0.003	2.691	0.007	0.002	0.012

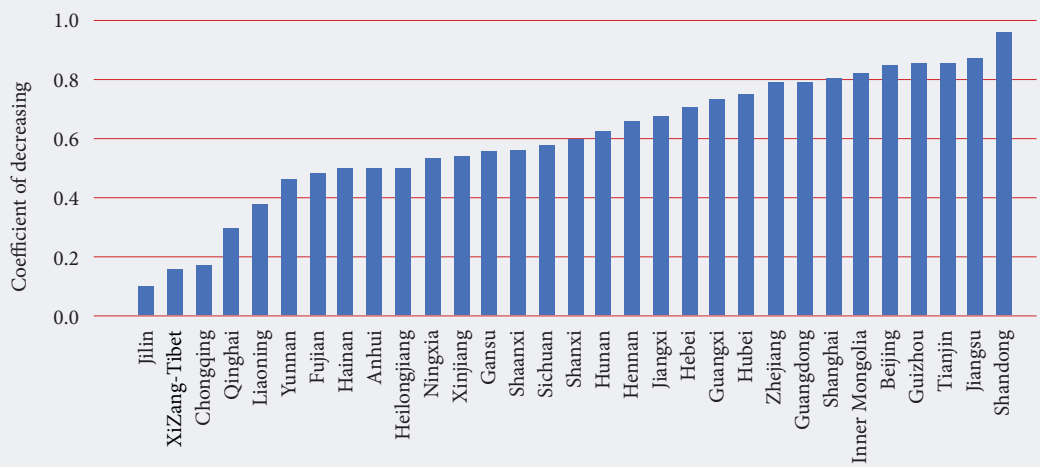
ficient to prevent the widespread bankruptcy of an enormous amount of Chinese SMEs, most of which probably do not have many months of operating cash on hand. It is highly uncertain whether the aforementioned government measures will effectively contribute to the survival of such companies.

Well before the COVID-19 crisis, directives from central leadership for state banks to increase lending to SMEs largely fell flat. If the outbreak continues into Q2 2020 and significant travel restrictions remain in place, the cash flows for many SME services firms will inevitably be crushed. Defaults on loans and commercial payments will surge, as will layoffs. This will weigh heavily on consumption, which will in turn hurt goods manufacturers. If bankruptcies become widespread, the recovery will necessarily take much longer.

Scenario 3. This is similar to Scenario 2, however this scenario takes into account state support for the most affected provinces (see Figures 7 and 8). This is the worst case scenario. If this came to pass, all provinces would suffer, but the most poorly developed regions would be even more affected. Henan, Hubei, and Zhejiang would sustain the greatest losses because they are the leaders in terms of cumulative confirmed infections among all the provinces. All sectors would be damaged, more significantly than in other scenarios. At the same time the rating of each industry is similar to that in the first scenario.

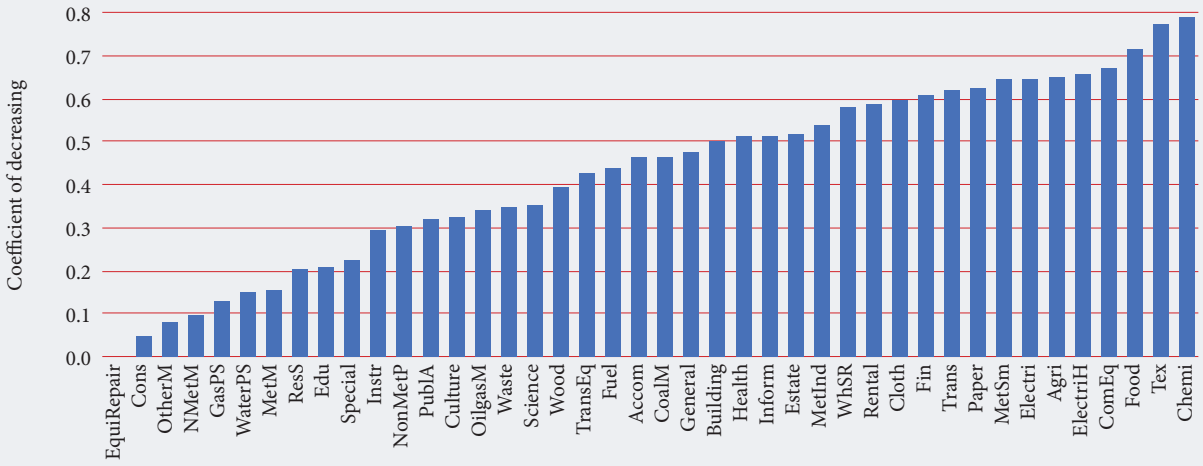
Scenario 4. First, China provinces would give priority to contracts for orders from neighboring regions based on existing partnerships. The closer the customer is to the manufacturer, the more like-

Figure 5. **Effects of the Drop in Production by Region (Scenario II)**



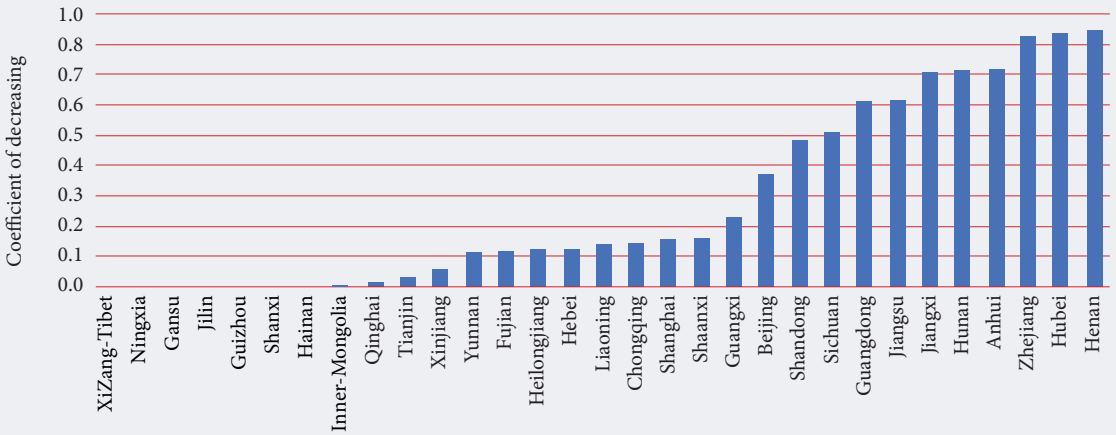
Source: authors' calculations.

Figure 6. **Effects of the Drop in Production by Industry (Scenario II)**



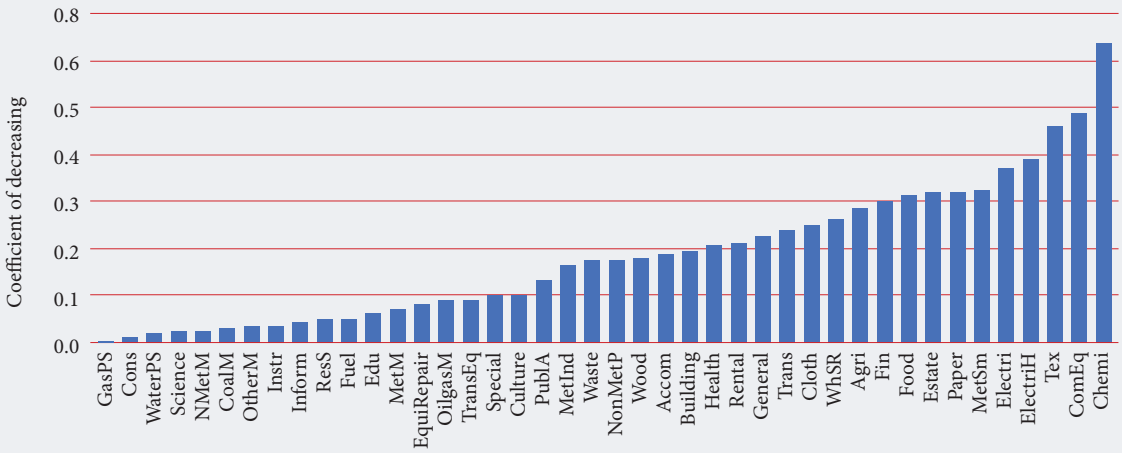
Note: for the definitions of industry abbreviations see Table 2.
Source: authors' calculations.

Figure 7. **Effects of the Drop in Production by Region (Scenario III)**



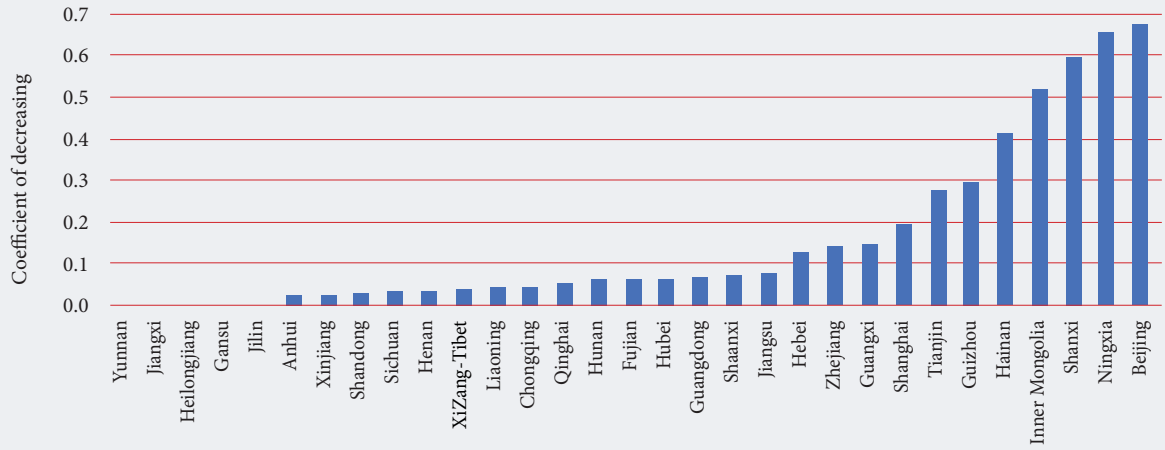
Source: authors' calculations.

Figure 8. **Effects of the Drop in Production by Industry (Scenario III)**



Note: for the definitions of industry abbreviations see Table 2.
Source: authors' calculations.

Figure 9. **Effects of the Drop in Production by Region (Scenario IV)**



Source: authors' calculations.

ly it is that the obligations to the company would be fulfilled (see Figures 9 and 10).

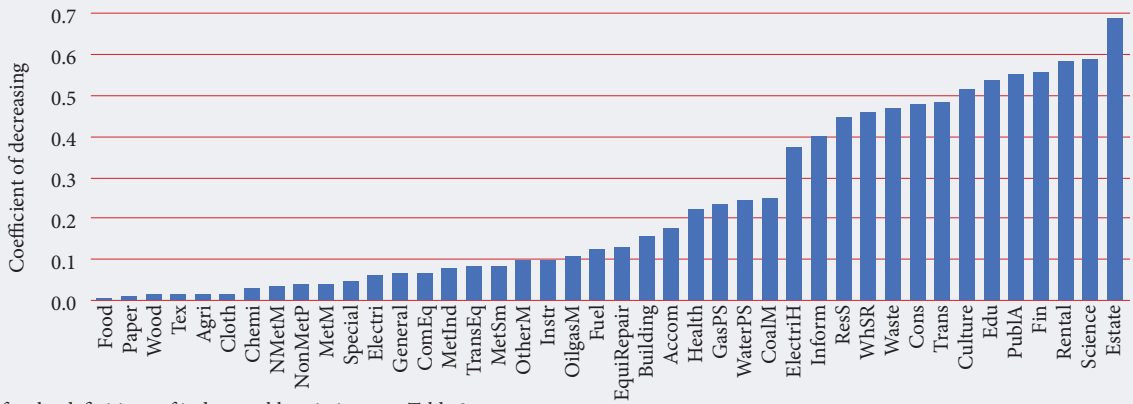
In the last scenario, greatest amount of inequality is seen between the provinces. The higher the inequality, the more the province is more affected by the outbreak. A government decision to support only the strong sustainable provinces seems unethical. On the other hand, only allocating aid to the weakest and most impacted provinces is also not enough. It is advisable to choose a damage mitigation policy on a consolidated basis. The even distribution of risks and losses between all regions seems to be the best scenario for overcoming the crisis.

The pandemic has made some mainstays of economic theory obsolete. The pressing needs are "to provide critical care and to break the chain of transmission of COVID-19, while keeping the population supplied and calm, for as long as it takes to get the job done"[9].

Analysis of Financial Relations between China and Russia

At present, the One Belt, One Road (OBOR) initiative is among the main priorities for China's foreign policy [*Weidong*, 2019]. At first glance, it distinguished by enough flexibility and openness for use on existing regional and multilateral platforms. Despite this, there has been little discussion about the compatibility of the OBOR objectives with existing Russian and Chinese foreign direct investment (further — FDI) projects [*Ma et al.*, 2011; *Liu et al.*, 2018]. In April 2019, the Second International Forum on OBOR took place in

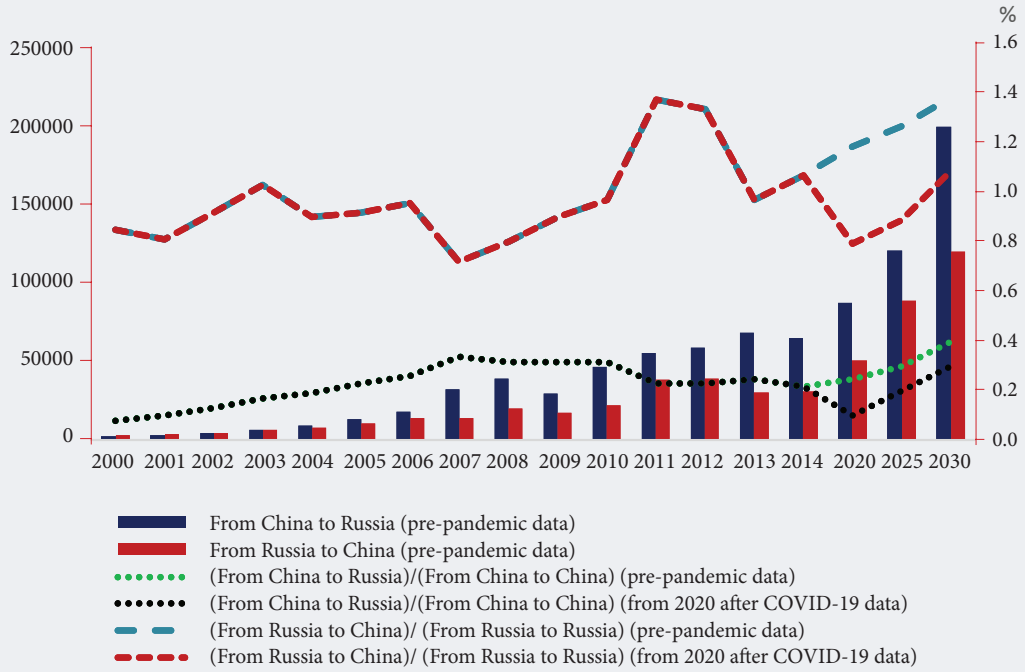
Figure 10. **Effects of the Drop in Production by Industry (Scenario IV)**



Note: for the definitions of industry abbreviations see Table 2.
Source: authors' calculations.

[9] Available at: https://lbj.utexas.edu/bad-economic-theory-and-practice-demolished, accessed 10.04.2020.

Figure 11. **Financial Flows between Russia and China: 2000-2030** (*millions of dollars*)



Sources: Historical dynamics are reflected in the statistical compilation "China Statistical Yearbook, 2019" [NBS, 2020]. The forecast has been compiled according to the CIC Advisor agency [CIC Advisor, 2020].

Beijing. About 40 leaders of the countries along the OBOR route and more than 1,000 experts and journalists participated. Chinese President Xi Jinping made the keynote speech at this forum. More than 140 cooperation agreements were signed there. The volume of Chinese investments in the projects of the countries along the route amounted to more than $80 billion while the volume of tax and other kinds of payments exceeded $2 billion. Russia is the one of the strategic partners in the OBOR project [*Svetlicinii,* 2018; *Lanjian, Wei,* 2016; *Malle,* 2017] Before the coronavirus outbreak, there were four prospective areas for Russian-Chinese trade and investment cooperation: energy resources, transportation, investments, and banking. It should be noted that development dynamics depend directly upon the intensity of trade [*Steblyanskaya, Wang,* 2019].

Figure 11 illustrates the bilateral Chinese-Russian financial flows from a historical point of view and a forecast until 2030. Financial flows from Russia to China were two to three times less intense than flows from China to Russia (Table 5). However, if we analyze the situation from another point of view, we can see that flows from China to Russia make up only 0.29% of Chinese turnover, which is a very small share. At the same time, the share of financial flows from Russia to China amounts to 1.08% of Russia's domestic turnover, respectively Chinese investments hold a higher share in the Russian economy. In absolute terms, China's activity in bilateral trade flows is notably higher than Russia's. Russia, despite its limited budget, tries to invest more funds to decrease this imbalance. Before the pandemic, Russia did not play a significant role in supporting China's trade balance. Is it possible that Russian-Chinese trade will grow in the future? Previous forecasts (before the COVID-19 outbreak) suggested that Russia would actively increase investments in China, reaching an FDI share of 2.49% in comparison with China's 0.28% by 2030. However, following the coronavirus outbreak, the authors expect financial flows between the two countries to decline until 2022–2025. Since the COVID-19 crisis is characterized by many unpredictable factors, it is impossible to forecast the situation with any reasonable degree of feasibility.

In connection with the decline in oil prices and COVID-19 coronavirus, a drop in demand for fuel and metals is expected. However, fuel and metallurgical industries provide the bulk of exports from Russia to China.

It must be emphasized that a wide range of options for the forecast decrease in trade turnover between the two countries can be explained by the unprecedented nature of the current health crisis and the uncertainty surrounding its precise economic impact. Estimates for the expected recovery in 2021 are equally uncertain, while the outcomes would

Table 5. **Forecasted Bilateral Financial Flows between Russia and China for the 1st Half of 2020**

Scenarios	Imports from Russia to China		Exports from China to Russia	
	Mln USD	% of the pre-crisis level	Mln USD	% of the pre-crisis level
1	12884.5	75.0	22218.7	75.0
2	8761.1	51.0	15554.0	52.5
3	4281.1	24.9	3830.1	23.0
4	3717.9	21.6	3830.1	12.9

Note: According to the [CIC Advisor, 2020], the sum of imported products from Russia to China for the 1st half of 2020 was planned at the level of $18 bln; the total amount of exported products from China to Russia at the level of $29.625 bln.

Source: authors.

depend mainly upon the duration of the outbreak as well as the efficiency of policy responses.

Conclusion

China's economy has taken a significant hit from the COVID-19 coronavirus outbreak [*Redding et al.*, 2019; *Wen et al.*, 2020]. In this paper, the authors analyzed the post-coronavirus economy in China by employing systematic approaches using input-output data for 31 provinces and 42 industries and new data on COVID-19 for winter 2019-2020.

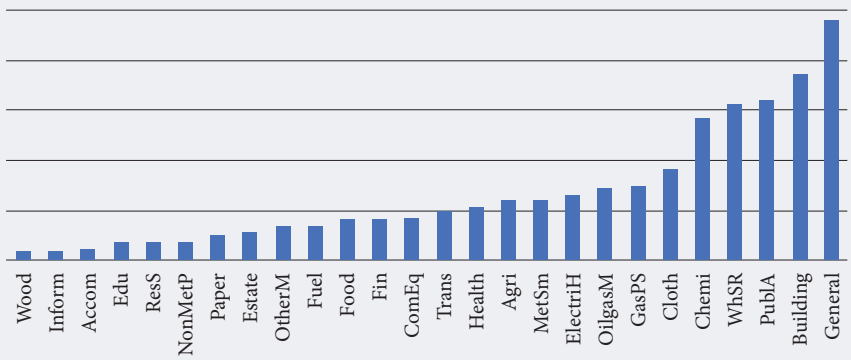
The authors used input-output analysis, SARIMA analysis, four scenario modeling, and modeling of the Chinese-Russian financial flows. First, the authors calculated the migration index and financial flows model to obtain insight into the migration flows between China provinces. Second, the authors obtained a model that showed how the infection and mortality rates of coronavirus influences carbon dioxide emissions, level of hazardous waste, and the Energy-Resource Efficiency Rating (ERE). Then, four scenarios were developed to show how a three-month halt in production in Hubei would impact industry behavior in other provinces. This approach was applied in order to identify economic imbalances in the provinces and prevent the worst-case scenario.

OLS regression results show that the minimum relationship between financial flows and the migration index is 1.099147 e+06, which is very close. It could be concluded that when migration flows are blocked in the Hubei province, production will completely stop. Indeed, with the spread of any virus from a certain province, the first that will be impacted are those regions closely tied to the source of the virus. To determine the impact of the COVID-19 infection and death rates upon Chinese regional development, 23 sustainable factors were tested. The obtained model attests to the pandemic's strong effect upon on carbon dioxide emissions, the level of hazardous waste, and the level of the Energy-Resource Efficiency Rating (ERE). We analyzed four scenarios for provinces' production and supply flows after the coronavirus outbreak.

Our main recommendation is that there is no need to segregate consumers. It is necessary to distribute the damage as evenly as possible. This will allow for minimizing the impact upon the Chinese economy and accelerating its recovery. If aid is provided to only certain provinces, the economic downturn will be more substantial as will harm from the drop in production (Scenarios 2-4).

Before the crisis, financial flows between China and Russia increased and growth was planned in the coming years. However, in the post-coronavirus period, it is difficult to make any forecasts about the level of trade. The situation may develop unpredictably. Besides, it is now a real challenge for the Chinese economy to stop importing cases of coronavirus from abroad, as there are more coronavirus cases and deaths in the US and Europe than in China. It is expected that due to the falling

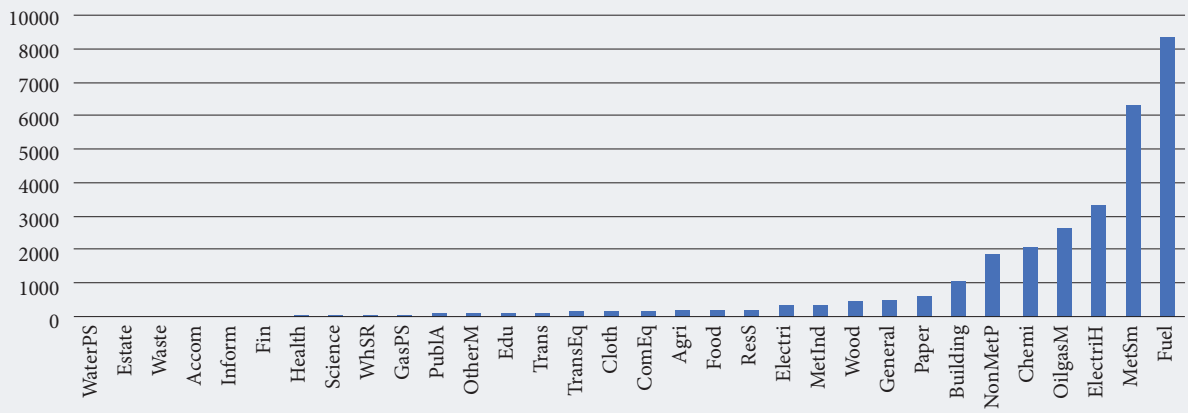
Figure 12. **Structure of Imports from China to Russia, 2018 (*millions of dollars*)**



Note: for the definitions of industry abbreviations see Table 2.

Source: [NBS, 2020].

Figure 13. **Structure of Exports from Russia to China, 2018 (*millions of dollars*)**



Note: for the definitions of industry abbreviations see Table 2.
Source: [NBS, 2020].

prices of oil and other resources, China will buy up assets in the Russian Federation, which will affect the promotion of Chinese cultural and business standards. It is expected that relations between China and Russia will grow stronger in the future. Due to the growing interest in the transition to a green economy, digitalization technologies conducive to this initiative will developed as part of the OBOR project.

The impact of the post-coronavirus situation on the Chinese and wider global economy must be considered for further study. In order to thoroughly study macroeconomic trends for the development of China and Russia, the consequences of emergency situations (epidemics, strikes, unemployment, etc.) must be evaluated. With this in mind, a neural network model could be created that provides a basis for decision-making and the formation of sustainable development strategies for responding to crises.

The research was accomplished with the support of the Fundamental Research Fund for the Central Universities within the projects "Sustainable Development of Green Silk Road from a Complex Network Perspective" (Project No. 3072020CFJ0901), and "Digitally Driven Green Intelligent Manufacturing and Energy Ecological Governance Research" (Project Number: 3072020CFW0903).

References

Allam Z., Jones D.S. (2020) On the Coronavirus (COVID-19) Outbreak and the Smart City Network: Universal Data Sharing Standards Coupled with Artificial Intelligence (AI) to Benefit Urban Health Monitoring and Management. *Healthcare*, vol. 8, no 1, art. 46. Available at: https://doi.org/10.3390/healthcare8010046, accessed 17.04.2020.

Bei J. (2018) Study on the "high-quality development" economics. *China Political Economy*, vol. 1, no 2, pp. 163–180. DOI 10.1108/CPE-10-2018-016.

Bocharnikov V. (2012) K geograficheskoi probleme sokhraneniya bioraznoobraziya i ekosistemnykh uslug rossiiskogo Dal'nego Vostoka [On the Issue of Geographic Problem of Biodiversity and Ecosystem Services Preservation in the Russian Far East]. *Zashchita okruzhayushchei sredy v neftegazovom komplekse* [Environmental Protection in Oil and Gas Complex], vol. 1, pp. 62–66 (in Russian).

Bocharnikov V. (2018a) Geokod tsivilizatsii i «glubinnaya ekologiya» v epokhu globalizatsii [Geocode of the Civilization and "Deep Ecology" in the Globalization]. *Pskovskii regionologicheskii zhurnal* [Pskov Regional Studies], no 1(33), pp. 1–15. DOI: 10.3109/08830185.2014.902452 (in Russian).

Bocharnikov V. (2018b) *Kontsept Ojkumeny i vizualizatsiya poznaniya v sovremennom diskurse geografii* [The Concept of the Populated Universe and the Visualization of Knowledge in the Discourse of Geography]. *Gumanitarnyj vektor* [Humanitarian Vector], vol. 13, no 2, pp. 132–141. DOI: 10.21209/1996-7853-2018-13-2-132-141 (in Russian).

Bouoiyour J., Selmi R. (2020) *Coronavirus Spreads and Bitcoin's 2020 Rally: Is There a Link?* (HAL Working Paper hal-02493309). DOI: 10.13140/RG.2.2.16003.86561. Available at: https://hal.archives-ouvertes.fr/hal-02493309, accessed 13.04.2020.

Brahmbhatt M., Dutta A. (2008) *Economic Effects during Outbreaks of Infectious Disease*, Washington, D.C.: WorldBank.Availableat:http://siteresources.worldbank.org/DEC/Resources/84797-1154354760266/2807421-1194369100631/4361465-1202937271771/Economic-Effects-during-Outbreaks.pdf, accessed 11.04.2020.

Cao Y., Carver S., Yang R. (2019) Mapping Wilderness in China: Comparing and Integrating Boolean and WLC approaches. *Landscape and Urban Planning*, vol. 192, art. 103636. Available at: https://doi.org/10.1016/j.landurbplan.2019.103636, accessed 02.03.2020.

Chen X. (1990) Input-Occupancy-Output Analysis and Its Application in China. *Dynamics and Conflict in Regional Structural Change: Essays in Honour of Walter Isard*, vol. 2 (eds. M. Chatterji, R.E. Kuenne), Heidelberg, New York, Dordrecht, London: Springer, pp.267–278. DOI: 10.1007/978-1-349-10636-3.

Chou S.K., Costanza R., Earis P., Hubacek K., Li L.B., Lu Y., Span R., Wang H., Wu J., Wu Y., Yan J.J. (2018) Priority areas at the frontiers of ecology and energy. *Ecosystem Health and Sustainability*, vol. 4, no 10, pp. 243–246. DOI: 10.1080/20964129.2018.1538665.

Cleveland C.J. (1999) Biophysical economics: From physiocracy to ecological economics and industrial ecology. *Bioeconomics and Sustainability: Essays in Honor of Nicholas Gerogescu-Roegen* (eds. J. Gowdy, K. Mayumi), Cheltenham: Edward Elgar, pp. 125–154.

Costanza R., Kubiszewski I., Giovannini E., Lovins L.H., Mcglade J., Pickett K.E., Ragnarsdottir K.V., Roberts D.C., De Vogli R., Wilkinson R. (2015) Time to leave GDP behind. *Nature*, vol. 505, no 3, pp. 283–285.

CIC Advisor (2020) *Investment Climate in Russia – Current State and Outlook for 2020–2024*. Available at: http://www.ocn.com.cn/2012/1089eluositouzihuanjing.shtml, accessed 23.04.2020 (in Chinese).

CRS (2020) *COVID-19: US-China Economic Considerations*, Washington, D.C.: Congressional Research Service. Available at: https://crsreports.congress.gov/product/pdf/IF/IF11434, accessed 13.04.2020.

Daly H.E. (2007) *Ecological Economics and Sustainable Development, Selected Essays of Herman Daly*, Cheltenham (UK), Northampton, MA: Edward Elgar.

Daly H.E., Farley J. (2004) Ecological economics: Principles and applications. *Ecological Economics*, vol. 55, no 1, pp. 538–541. DOI: 10.1017/CBO9781107415324.004.

Duan H., Wang S., Yang C. (2020) Coronavirus: Limit short-term economic damage. *Nature,* vol. 578, p. 515. Available at: https://www.nature.com/articles/d41586-020-00522-6, accessed 07.03.2020.

Hall C.A.S., Lambert J.G., Balogh S.B. (2014) EROI of different fuels and the implications for society. *Energy Policy*, vol. 64, pp. 141–152. DOI: 10.1016/j.enpol.2013.05.049.

Interfax (2010) *Metodika otsenki ekologicheskoi i energeticheskoi effektivnosti ekonomiki Rossii* [Methodology for the estimation of ecological and energy efficiency of Russian economy]*, M*oscow: Interfax. Available at: https://interfax-era.ru/metodologiya/kniga, accessed 23.04.2020 (in Russian).

Lambert J.G., Hall C.A.S., Balogh S., Gupta A., Arnold M. (2014) Energy, EROI and quality of life. *Energy Policy*, vol. 64, pp. 153–167. DOI: 10.1016/j.enpol.2013.07.001.

Lanjian C., Wei Z. (2016) China energy resources oriented OBOR: Research on OBOR growth strategy of China. *Basic Research Journal of Social and Political Science*, vol. 4, no 1, pp. 1–14. Available at: https://www.basicresearchjournals.org/social%20political%20science/pdf/Lanjian%20and%20Wei.pdf, accessed 12.03.2020.

Leontief W. (2008) *Input-output analysis*, Heidelberg, New York, Dordrecht, London: Springer.

Lippi G., Plebani M. (2020) The novel coronavirus (2019-nCoV) outbreak: Think the unthinkable and be prepared to face the challenge. *Diagnosis*, vol. 7, no 1, pp. 8–10. DOI: 10.1515/dx-2020-0015. Available at: https://www.degruyter.com/view/journals/dx/ahead-of-print/article-10.1515-dx-2020-0015/article-10.1515-dx-2020-0015.xml, accessed 23.02.2020.

Liu W., Dunford M., Gao B. (2018) A discursive construction of the Belt and Road Initiative: From neo-liberal to inclusive globalization. *Journal of Geographical Sciences*, vol. 28, no 9, pp. 1199–1214. DOI: 10.1007/s11442-018-1520-y.

Ma L., Liu P., Fu F., Li Z., Ni W. (2011) Integrated energy strategy for the sustainable development of China. *Energy*, vol. 36, no 2, pp. 1143–1154. DOI: 10.1016/j.energy.2010.11.035.

Malle S. (2017) Russia and China in the 21st century. Moving towards cooperative behaviour. *Journal of Eurasian Studies*, vol. 8, no 2, pp. 136–150. DOI: 10.1016/j.euras.2017.02.003.

McCloskey B., Heymann D.L. (2020) SARS to novel coronavirus — Old lessons and new lessons. *Epidemiology and Infection*, vol. 148, art. e22. DOI: 10.1017/S0950268820000254. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7026896/, accessed 16.04.2020.

NBS (2020) *China Statistical Yearbook, 2019*, Beijing: National Bureas of Statistics. Available at: http://www.stats.gov.cn/tjsj/ndsj/2019/indexch.htm, accessed 23.04.2020 (in Chinese).

Oliveira C., Antunes C.H. (2011) A multi-objective multi-sectoral economy-energy-environment model: Application to Portugal. *Energy*, vol. 36, no 5, pp. 2856–2866. DOI: 10.1016/j.energy.2011.02.028.

Pan W., Wu P., Hu C., Tu H. (2019) Assessing the green economy in China: An improved framework. *Journal of Cleaner Production*, vol. 209, pp. 680–691. DOI: 10.1016/j.jclepro.2018.10.267.

Redding D.W., Atkinson P.M., Cunningham A.A., Lo Iacono G., Moses L.M., James L., Wood N., Jones K.E. (2019) Impacts of environmental and socio-economic factors on emergence and epidemic potential of Ebola in Africa. *Nature Communications*, vol. 10, no 1, art. 4531. DOI: 10.1038/s41467-019-12499-6. Available at https://www.nature.com/articles/s41467-019-12499-6, accessed 10.04.2020.

Sarker M.O.F. (2014) *Python Network Programming*, Birmingham (UK): Packt Publishing. Available at: http://it-ebooks.info/book/3515, accessed 14.01.2020.

Scellato S. (2013) *NetworkX : Network Analysis with Python Today's Outline*. Available at: https://www.cl.cam.ac.uk/~cm542/teaching/2011/stna-pdfs/stna-lecture11.pdf, accessed 17.03.2020.

Siu A. (2004) The Economic Impact of SARS: The Case of Hong Kong. *At the Epicentre: Hong Kong and the SARS Outbreak 2004* (ed. C. Loh), Hong Kong: Hong Kong University Press, pp. 179–193.

Smith K.M., Machalaba C.C., Seifman R., Feferholtz Y., Karesh W.B. (2019) Infectious disease and economics: The case for considering multi-sectoral impacts. *One Health*, art. 100080. DOI: 10.1016/j.onehlt.2018.100080. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6330263/, accessed 04.03.2020.

Steblyanskaya A., Wang Z. (2019) Are Sustainable Growth Indicators in Gas Market Companies Comparable ? The Evidence from China and Russia. *Journal of Corporate Finance Research*, vol. 13, no 1, pp. 76–92. Available at: https://doi.org/10.17323/j.jcfr.2073-0438.13.1.2019.76-92, accessed 02.03.2020.

Svetlicinii A. (2018) China's Belt and Road Initiative and the Eurasian Economic Union: Integrating the Integrations. *Public Administration Issues*, no 5, pp. 7–20. DOI: 10.17323/1999-5431-2018-0-5-7-20.

Suarez F., Nuno, P., Granda G., Garcia F.D. (2015), Computer networks performance modeling and simulation. *Modeling and Simulation of Computer Networks and Systems – Methodologies and Applications* (eds. M.S. Obaidat, P. Nicopolitidis, F. Zarai), Amsterdam: Elsevier – Morgan Kaufmann, pp.187–223. DOI: 10.1016/B978-0-12-800887-4.00007-9.

Ward J.D., Sutton P.C., Werner A.D., Costanza R., Mohr S.H., Simmons C.T. (2016) Is Decoupling GDP Growth from Environmental Impact Possible? *PLoS One*, vol. 11, no 10, art. e0164733. Available at: https://doi.org/10.1371/journal.pone.0164733, accessed 09.02.2020.

Weidong L. (2019) *Joint Construction of Green Silk Roads: Social, Economic and Environmental Context*, Beijing: The Commercial Press.

Wen J., Aston J., Liu X., Ying T. (2020) Effects of misleading media coverage on public health crisis: A case of the 2019 novel coronavirus outbreak in China. *Anatolia*, vol. 31. DOI: 10.1080/13032917.2020.1730621. Available at: https://www.tandfonline.com/doi/full/10.1080/13032917.2020.1730621, accessed 07.04.2020.

WHO (2020) *Preparing for large-scale community transmission of 2019-nCoV. Guidance for countries and areas in the WHO Western Pacific Region*, Geneva: World Health Organization.

Wong L., Wu Q., Chen X., Chen Z., Alias H., Shen M., Hu J., Duan S., Zhang J., Han L. (2020) *The role of institutional trust in preventive and treatment-seeking behaviours during the 2019 novel coronavirus (2019-nCoV) outbreak among residents in Hubei, China*. Available at: https://www.medrxiv.org/content/10.1101/2020.02.15.20023333v1, accessed 03.04.2020.

WTO (2020) *Trade set to plunge as COVID-19 pandemic upends global economy* (press release), Geneva: World Trade Organization. Available at: https://www.wto.org/english/news_e/pres20_e/pr855_e.htm, accessed 13.04.2020.

Yan J., Feng L., Denisov A., Steblyanskaya A., Oosterom J.P. (2020) Correction: Complexity theory for the modern Chinese economy from an information entropy perspective: Modeling of economic efficiency and growth potential. *PloS One*, vol. 15, no 3, art. e0230165. DOI: 10.1371/journal.pone.0230165.

Fintech as a Precondition for Transformations on Global Financial Markets

Sergey Belozyorov

Chief Researcher, Laboratory of Asian Economic Studies; Head, Department of Risk Management and Insurance, s.belozerov@spbu.ru

Olena Sokolovska

Leading Researcher, Laboratory of Asian Economic Studies, e.sokolovskaya@spbu.ru

St. Petersburg State University, 7–9 Universitetskaya Embankment., St. Petersburg 199034, Russian Federation

Young Sik Kim

Professor, Department of International Commerce and Area Studies, yskim@gwnu.ac.kr

Gangneung-Wonju National University, 25457l, 7 Jukheon-gil, Gangneung-si, Gangwon-do, Republic of Korea

Abstract

The article considers the opportunities, risks, and challenges associated with the development of digital financial technologies. To identify them, we used the scenario approach. We determined three main development scenarios for the market of innovative financial technologies — "domination of traditional financial companies", "segmentation of market of new financial technologies', and "domination of digital financial companies" in terms of their probability and possible consequences for the global financial markets. The results of analysis allowed us to suggest that among main scenarios of fintech development the most probable is the splitting of existing market, which in the future may turn into a market of digital transnational financial corporations, which will squeeze out both small companies and traditional financial giants. However, although the scenario of capturing the financial market by large players is currently unlikely, it is certainly more important in terms of the consequences for global markets.

The main prerequisite for the latter scenario is the promotion of international cooperation in the regulation of digital financial companies. Such a condition requires new models of country-level interaction in the regulation of innovative financial companies in order to address the risks and challenges of different scenarios of fintech development on global financial markets. This article includes a comparative analysis of digital development in Russia and the Republic of Korea, which is one of the key players on the Asian fintech market, as a possible benchmark that can be used to shape the policies of intergovernmental cooperation on global financial markets. These policies include 1) regulatory cooperation that reduces risks due to growing experience in the regulation of innovative financial companies; 2) cooperation in investments that allow one to acquire additional experience in regulatory practices and to develop infrastructure, which meets the new requirements of digital finance; and 3) cooperation in the taxation of fintech companies that reduces cross-border regulatory arbitrage.

Keywords: fintech; digital economy; scenario approach; global financial markets; financial inclusion; international cooperation; regulation; finance; investment; regulation; risks; Russian Federation; Republic of Korea; comparative analysis

Citation: Belozyorov S., Sokolovska O., Kim Y. (2020) Fintech as a Precondition for Transformations on Global Financial Markets. *Foresight and STI Governance*, vol. 14, no 2, pp. 23–35. DOI: 10.17323/2500-2597.2020.2.23.35

With the development of global digital communication technologies, various forms of international cooperation have become exceptionally important. They allow one to efficiently exploit opportunities, bypass limitations, and balance the risks arising from differences between countries, mainly in the legal field. Sharing experience and disseminating more effective practices in the private and public sectors alike contributes to identifying the best tools for regulating the international financial market taking into account national specifics while ensuring global consensus. Countries' cooperation in the field of financial technology (fintech) is actively discussed by the World Bank and the International Monetary Fund (IMF). At the end of 2018, these organizations proposed the Bali Fintech Agenda which reflects the main objectives of cooperation on relevant markets [IMF, World Bank, 2018]:

- promoting competition;
- extending coverage of the public;
- promoting the development of financial markets;
- monitoring changes in financial systems;
- creating a sustainable financial and information infrastructure to maintain the benefits of using fintech tools;
- promoting international exchanges of information.

Since the main cooperation mechanisms in the field of innovation remain local, national, or regional in nature, most of the relevant studies tend to be of a practical type, focused on preparing economic policy recommendations for national and regional authorities. However, some authors turn to the conceptual aspects of such cooperation[*Lundquist, Trippl*, 2011; OECD, 2013; *Makkonen et al.*, 2017; *Meissner et al.*, 2013] or to specific features of digital economic development in the regional and sectoral contexts (Table 1).

The mass adoption of digital financial tools is due to advances in electronic payment systems, governments' new regulatory policies, and the emergence of next-generation financial services available via mobile devices with internet access, that is, everything collectively referred to as "fintech".

The goal of this study of the current state of the fintech market is identify a potential scenario for its development, assess the results of this scenario's implementation, and evaluate the risks and challenges associated with the proliferation of fintech tools. This will help identify the most promising areas for countries' cooperation to alleviate the risks of implementing financial technologies on global markets.

Methodology of the Study

The methodology of this study is based on the scenario approach. The tools presented in [*van Notten*, 2006] were applied to build the scenarios. Adapting this approach in line with the available statistical data and assessments of the factors under consideration allowed us to identify the following scenario development stages: determining the object; describing the development drivers; building a scenario; assessing the likelihood of its implementation; and assessing relevant opportunities and risks.

The object of the study being the development of fintech on global financial markets, the following major drivers were identified:

- the emergence of new (digital) technologies;
- the costs of, and the time required for, new companies entering the market;
- the rate of new technologies' and companies' proliferation (cross-border flows and cooperation);
- market "rules of the game";
- companies' operating costs (which depend upon the coverage of the population and small and medium businesses (SMEs) by financial services and the application of cheaper technologies).

The following techniques were used to actually build scenarios:

- trend-based scenario techniques;
- creative-narrative scenario techniques.

Both these approaches belong in the predictive scenarios category (*Börjeson et al.*, 2006) closely related to the probability and credibility concept, since any attempt to predict anything one way or another comes down to assessing, sometimes subjectively, the chances of certain events' taking place. Other classifications do not distinguish predictive scenarios but include them in the explorative scenarios group [*Alcamo*, 2001; *Greeuw et al.*, 2000; *van Notten et al.*, 2003; Eurofound 2003; *Kosow, Gaßner*, 2008; etc.].

The trend extrapolation technique involves building the most likely (reference, trend) scenarios (typically just one) to compare them and range on a "low-high" scale. Qualitative trend analysis and "soft data"[1] are used to describe the development paths. Such scenarios are more often called "forecasts" (prognoses) or outlooks rather than "scenarios" proper [*Kosow, Gaßner*, 2008].

[1] "Soft data" is data which cannot be measured quantitatively.

Also, certain elements of the creative and descriptive approach to scenario building were applied, in particular the assessment on the scales "implementation probability – impact strength", "low – high probability", and "significant – insignificant consequences" of the scenario implementation for the development of the system [*Kosow , Gaßner*, 2008] (Figure 1).

Depending on the research object, the likelihood/impact balance allows one to range scenarios along the following system of coordinates:

- significant market trends (high probability, high impact);
- shaping the market context (high probability, low impact);
- potential for unexpected problems (low probability, low impact);
- uncertainty factors play a major role (low probability, high impact).

Scenarios in this category are built to assess forecasting potential, implementation probability, key factors affecting the development of the system under consideration, and directions for its development [*Alcamo*, 2001; *Kosow, Gaßner*, 2008; *Sokolov et al.*, 2019]. The following predictive scenarios' features determined the application of this technique in our study:

- suitability for the conceptual assessment and analysis of anticipated challenges, opportunities, and prospects, along with the identification of potential problems subject to certain conditions of the system's development;
- the opportunity to build scenarios for individual system structures;
- suitability for stable trends, that is, those which can be extrapolated confidently enough.

Let us take a look at the current state and development trends of the global fintech market.

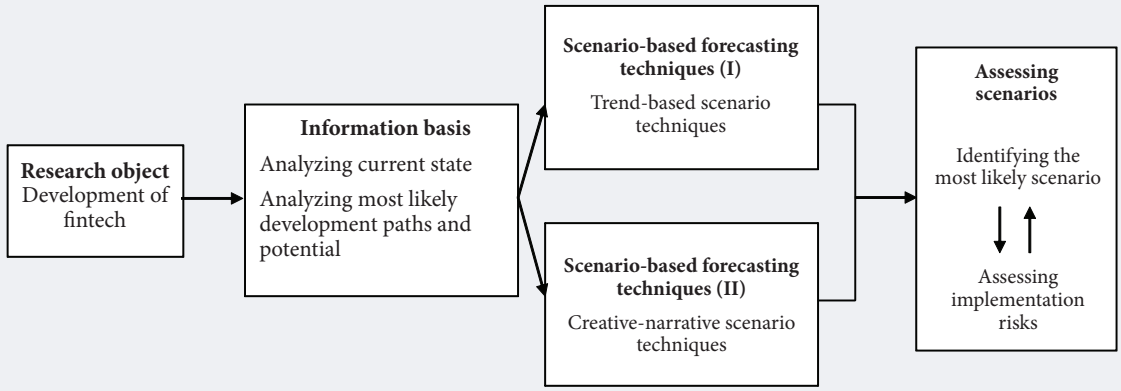
Proliferation of Fintech

Various innovations, including in the service sector, are a major factor of increasing social prosperity, while the state traditionally plays a key role in regulating relevant issues [*Meissner et al.*, 2013; *Miles*, 2016; *Mention*, 2019]. Today many countries pursue policies designed to extend the public's access to financial services (financial inclusion), at the national and international levels alike. Such inclusion (first of all use of electronic transfers and payment cards) can turn into an economic growth driver due to the democratization of investment instruments through mobile banking and lower transaction costs, thus leading to increased income [*Demirguc-Kunt et al.*, 2018]. These aspects are especially critical for Russia, where low purchasing power is one of the main obstacles hindering the development of digital financial services. Financial inclusion will not only allow one to optimize individual risk management but will also contribute to increased savings and the reduction of the shadow economy and corruption due to the transition from cash to electronic payments.

Figure 2 compares fintech coverage and the level of the sector's development in various countries.

In most high-income countries the difference between these two indicators is not significant. In the regional context, the largest gap is observed in Asian countries, which are the world leaders in terms of the rate of development for fintech. Although North America, especially the US, remains the world's leading player (experts expect the regional market to reach $80.85 billion by 2023), it is in Asia that the fintech market is expected to

Figure 1. **Building and Assessing Scenarios: Flow Chart**



Source: compiled by the authors basing on: [*Börjeson et al.*, 2006; *Alcamo*, 2001; *van Notten et al.*, 2003; *Xiang, Clarke*, 2003; *Jäger et al.*, 2007; *Kosow, Gaßner*, 2008; *Wodak, Neale*, 2015].

Table 1. **Studies of International Cooperation in the Field of Digital Economy: Regional and Sectoral Contexts**

Context	Research Topic	Literature
Regional	Asian countries	[*Zhang*, 2018; *Yoon*, 2019]
	Latin American and Caribbean countries	[*Patiño et al.*, 2018]
	South American and African countries (South-South cooperation)	[*Banga, Kozul-Wright*, 2018]
	BRICS countries	[*Banga, Singh*, 2019]
	European countries	[*Heimerl, Raza*, 2018]
Sectoral	International trade	[*Ascencio*, 2016]
	Higher education and the development of human potential	[*Grimm et al.*, 2018; *Lavrinenko, Shmatko*, 2019]
	Tax administration and tax information sharing	[*Heikura*, 2018]

Source: compiled by the authors.

achieve the highest growth rates, at 43.3% in 2018-2023 [Netscribes, 2019]. This will be due to the increased number of start-ups in various segments of the financial market, primarily the banking, insurance, and asset management sectors in countries such as India, China, the Republic of Korea, and Japan. For example, the headquarters of the world's largest fintech company, Ant Financial Services Group (formerly Alipay), with more than 10,000 employees and assets in excess of $150 billion is located in China. Latin America is gradually becoming one of the most promising regions in terms of fintech development, mainly due to Mexican and Brazilian efforts [Netscribes, 2019].

Various combinations of the aforementioned drivers allow for building the following scenarios for financial markets' development:

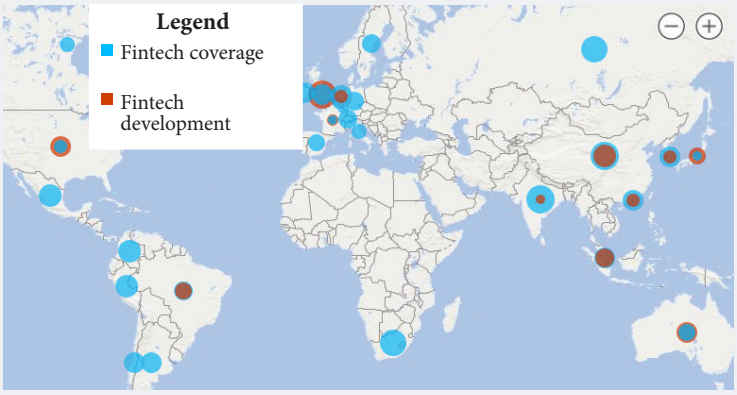
1. Conventional financial companies, primarily banks, insurance companies, and other intermediaries retain market control by accumulating cutting-edge advances in the innovative fintech industry.
2. The market is split into numerous narrow segments and niches that provide financial services focusing on consumers' specific social, psychological, economic, and geographical needs, with the traditional major players maintaining their positions.
3. The rapid growth of multinational digital corporations pushes back the traditional financial market players.

The implementation of these scenarios not only implies certain risks, but opens a number of opportunities, the analysis of which is presented below. Each scenario's content is described taking into account the following quality criteria: no unfounded (erroneous) assumptions; credibility (reliability); fullness; description of development paths; and a causal relationship [*Mietzner, Reger*, 2005].

Scenario 1

Traditional financial intermediaries may be able to maintain their strong positions despite the growing pressure from new players due to the combined effect of various factors such as consumers' inertia, excessive regulation of the sector, and complex market mechanisms. Under such circumstances, traditional financial market players will have enough time to develop effective competitive strategies.

Figure 2. **Fintech Development Indicators by Country, 2018**



Notes:

a) fintech coverage reflects the share of users among the country's residents, i.e. those who have actually used two or more relevant tools over the past six months.

b) the fintech sector's development was calculated by the Cambridge Center for Alternative Finance on the basis of expert assessment; relevant data is available only for a limited number of countries.

Source: compiled by the authors based on [Ernst & Young, 2019; Cambridge Center for Alternative Finance, 2018].

Given the rate of and the development forecasts for new fintech tools, the likelihood of this scenario seems to be low. As to its positive aspects, one of them is the absence of (or very small) need for regulatory changes.

Scenario 2

The current trends for and the rate of fintech development give grounds to see this scenario as very likely in the short term. The traditionally high costs of companies' entering the financial services markets are limited by the increased number of new players, while large dominant firms maintain their positions. At the same time, the costs of entering the market and the time new companies need to do so and obtain a foothold there are rapidly decreasing due to the digitalization of technologies and regulatory changes. Accordingly, new start-ups are taking over certain segments and niches, including those previously unclaimed due to high costs and technological limitations.

The key result of this scenario's implementation will be increased coverage of the public and SMEs by financial services. The following measures will help achieve this:

1. Reduced or zero costs of receiving and providing financial services, which is particularly important for residents of remote rural areas and more vulnerable social groups such as women, the poorest segments of the urban population, and migrants.

2. Simplified customer due diligence (CDD) procedures.

3. The diversification of financial services including the development of financial products for low-income groups.

4. Reduced information asymmetry between parties to transactions, which is particularly important for consumers with no previous access to banking services as they lack the information required to adequately assess the risks.

The likelihood of this scenario's implementation can be assessed by analyzing the example of the lending segment and distribution platforms. Online lending, P2P lending[2], and crowdfunding can increase financial services' coverage by granting loans to people with insufficient (by the "conventional" intermediaries' standards) credit histories, while securing them (loans) using new data sources such as, for example, clients' smartphone applications or online sale and shopping histories.

For SMEs, such platforms provide access to funding even if the former's credit histories are insufficient or their credentials incomplete. These platforms provide specialized services using cloud technologies that reduce small businesses' operational costs. At the preparatory stage of supply chain formation, lending platforms can increase long-term funding, the securing of which on conventional financial markets tends to be problematic for SMEs. For very small or newly created enterprises, donations and crowdfunding can be an important and, frequently, the only source of initial capital.

Distribution platforms, yet another highly specialized market segment that has been actively developing in recent years, may prove useful both for the wholesale distribution of goods (product distribution platforms) and the distribution of financial resources (funds distribution platforms)[3]. Platforms of this type give investors, financial advisors, or private asset managers access to a wide range of third-party products and services at specialized venues. The application of algorithms can reduce products' or services' costs and increase customers' awareness when they are looking for the best solution. Most of the distribution platforms have emerged in mature economies (primarily in the US), but are now actively developing on emerging markets too, including on the basis of robo-advising technologies (e.g., in India, the Republic of Korea, Mexico, China, and Brazil, or even in low-income countries such as Kenya).

Muslim countries and regions whose fintech markets are segmented in accordance with so-called Islamic finance principles, stand somewhat apart. According to the Global Findex Database, in 40 out of 56 members of the Organisation of Islamic Cooperation (OIC), the proportion of the population who have accounts with financial institutions (50%) does not exceed the world average [*Demirguc-Kunt et al.,* 2018]. The proliferation of "Islamic" financial services can be an effective tool for increasing the share of the "covered" population. Some fintech instruments match the Islamic finance principles quite well such as the ones designed for asset-backed transactions and risk sharing. IMF research shows that about 70% of all currently operating Islamic fintech companies are focused on supporting businesses and providing funding to clients through equity-based crowdfunding and P2P lending [IMF, 2019].

The use of digital financial tools guarantees the security of sukuk transactions[4]. In 2018, blockchain

[2] P2P lending is providing loans to persons unrelated to each other through specialized online platforms without involving conventional financial intermediaries such as banks or other credit institutions.

[3] Fund distribution platforms act as intermediaries between securities brokers and asset management companies (or individual managers), providing administrative services such as distribution agreements, order routing, and discount calculation.

[4] Sukuk is a financial instrument popular in Sharia countries, the Islamic equivalent of bonds. A sukuk provides non-guaranteed income from profits generated by the funded activity.

technologies were used for the secondary sale and placement of sukuk in the amount of $500 million by one of the UAE private banks, due in September 2023. A project that allows retail investors to buy sukuk using blockchain technology has also been launched in Indonesia [IMF, 2019].

Scenario 3

Digital financial companies' advancing to leading positions in regional rankings suggests that the trends described in *Scenario 3* are a natural continuation of those presented in *Scenario 2*. A key factor in this scenario's implementation is stronger international cooperation in regulating the activities of digital financial companies, while the expected result is the emergence of new cross-border financial flow formats due to the development of innovative fintech. These include new capital market transaction tools (among others, for cross-border transactions) such as tokenized securities – a digital analogue of classic stock market shares - and securities purchased using blockchain technologies. Cross-border crowdfunding will also become possible in the near future. All these developments can gradually change the role of conventional centralized intermediaries, transform the nature and characteristics of cross-border capital flows in global financial markets, and, as a result, diversify and decentralize the very model of international finance.

The above analysis allows one to make a qualitative assessment of various scenarios' likelihood. We will distribute them along the proposed coordinate axes: the implementation probability as such and the impact upon financial markets. Of particular interest are the scenarios with potentially serious consequences and different likelihoods (or, alternatively, certainty) of actually taking place.

The current global fintech development trends can be projected into the future in the framework of the suggested scenarios (Figure 3).

Scenario 1. Taking into account the development rate of new fintech tools and relevant forecasts, this scenario's likelihood can be assessed as low.

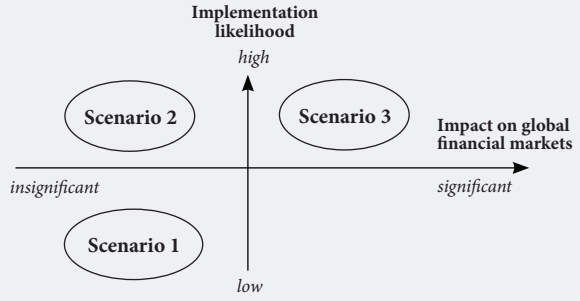
Scenario 2. The current trends and the rate of development of new fintech tools allow one to assess the short-term likelihood of this scenario as very high.

Scenario 3. Given the digital financial companies' advancing to leading positions in regional rankings, this scenario can be implemented as the result of the gradual transformation from the previous scenario.

Each of these scenarios implies certain risks.

Scenario 1. Fintech coverage grows at a slower rate and the overall development of innovative financial tools also slows down.

Figure 3. **Possible Fintech Development Scenarios on Global Financial Markets**



Source: compiled by the authors.

Scenario 2. Conventional financial intermediaries gradually lose most of their customers because the latter go to companies whose services better meet their needs.

Other risks are associated with the limited scope for the implementation of the scenario, first of all because the infrastructure does not meet the new digital finance requirements such as high transaction speed, deferred interaction, automated decision-making, widespread use of data, reduced use of paper media for storage of transaction and account records, and the involvement in transactions of intermediaries and organizations whose activities have not yet been properly regulated. In their turn, these limitations may negatively affect consumers' awareness of new financial opportunities and risks, which is particularly relevant for the most vulnerable social groups and those who have never used such services before.

Another "technical" risk associated with the implementation of this scenario is discrimination against borrowers. Despite the fact that fintech tools do ensure compliance with the impartiality principle for all parties to transactions and guarantee the absence of accounts payable in the amount of controlling interest, automatic algorithms themselves are fraught with errors caused by developers, accidentally or deliberately (e.g. intentional discrimination against minority borrowers when developing a smart contract algorithm). Therefore combining "manual" and automatic decision-making modes seems to be the best approach.

Less-than-perfect consumer protection mechanisms can lead to the disclosure of personal data, breaches of confidentiality, inadequate tools for restoring violated rights, a low level of cybersecurity, and digital illiteracy. The main consequence of all these risks is the theft of personal data, which is the more likely to happen the lower the level of

customers' financial and digital literacy, and the smaller the range of alternative digital products.

A separate group of risks associated with this scenario is related to regulating innovative financial companies, primarily the lack of relevant experience. Regulators represented by national legislative and law enforcement authorities insist on the need to develop international standards for managing and supervising fintech companies' and service providers' activities, since the relevant regulatory practices remain very limited even in "established" market segments such as mobile banking. In other fintech market segments, only a few countries have legally regulated use of crypto-assets and related services, P2P lending, and algorithmic trading. Essentially there are no similar regulatory solutions for areas such as digital insurance technologies (InsurTech), robo-advising, and artificial intelligence-based lending. This is partly due to the lack of resources for developing adequate regulatory measures. The above limitations become critically important when it comes to managing cybersecurity risks, operational risks (including those of third parties), and the theft of borrowers' information (especially legal entities) provided in accordance with information disclosure requirements. Low-income countries are particularly vulnerable in this regard, forced to balance between a threat to financial stability and the prospect of losing the opportunities provided by new fintech tools.

In the context of international economic law, cross-border regulatory arbitrage risk deserves special mention, which allows countries to use differences in specific jurisdictions' regulatory frameworks to their advantage. A key feature of new digital economy business models is that there is no need for the seller or buyer to be physically present in a certain jurisdiction to conduct a transaction, which significantly increases the scope for applying various tax avoidance and tax evasion schemes. Digital fintech tools expand access to hybrid mismatch arrangements applied by hybrid and reverse hybrid companies[5]. In particular, such schemes include double non-taxation, double tax deduction, the deduction of interest expenditures in one country, and the non-inclusion of the corresponding income in the tax base in another country.

Scenario 3. The risks associated with the implementation of this scenario are related to the need to upgrade capital flow management mechanisms and strengthen macro-prudential measures. P2P transactions are difficult to monitor and limit. The increased number of channels for cross-border capital flows can lead to increased demand for regulatory arbitrage, aggravated adverse consequences of contagious (infectious) risks, loss of liquidity risks, and spillover effects.

A particular problem is the issuing and circulation of digital currencies, which if widely adopted, can change the key factors supporting the reserve currency status: the structure and nature of foreign trade and the financial network effects. Depending upon the new cryptocurrencies' liquidity and the level of confidence in them, they can affect the need for reserves (buffered inventories and/or liquid assets) or promote the emergence of new reserve currencies. In turn, this will affect gold and foreign exchange reserves, the choice of the exchange rate regime, and the size and structure of the global financial safety net (GFSN).

The above challenges and risks lead to the need to strengthen countries' cooperation to achieve a balance between the efficiency and risks associated with the emergence and development of new formats of global financial flows and minimize undesirable conflicts in international transactions. Cooperation between individual countries on the fintech market can improve the interaction between private players and national regulators, for example, it facilitates fintech companies' access to regulatory sandboxes[6] in other jurisdictions.

Before moving on to a review of the main areas of cooperation between Russia and the Republic of Korea in the financial sphere, let us take a look at the current level of innovative fintech in these two economies.

Russia and the Republic of Korea: the Development of Digital Fintech Tools

Digital Development in Russia and the Republic of Korea

The Republic of Korea has the most efficient start-up promotion system in Asia, which allows the country to vigorously compete with China and India. For example, if in 1999 there were 2,000 start-ups in Korea, by 2018 this number reached 37,000 [*Kong*, 2016].

[5] Hybrid companies (also called double-classification companies) are not tax residents (they do not pay corporate income tax in the jurisdiction where they conduct business), but are tax residents and do pay corporate income tax in a foreign jurisdiction. Reverse hybrids (companies with reverse classification), on the contrary, do not pay income tax in foreign jurisdictions but do pay it in the jurisdiction of conducting business. See: https://www.fatca.hsbc.com, accessed on 10.05.2020.

[6] Regulatory sandboxes, or platforms, allow for exploring innovative financial services and technologies by practically testing them or evaluating them in the scope of limited regulatory experiments. Fintech companies, primarily startups, use such sandboxes to test innovative financial tools and services by providing them to consumers in a limited way and under the control of a regulator. The participants can be fully or partially exempted from existing regulatory requirements. Projects implemented in regulatory sandboxes are mainly related to the application of artificial intelligence, biometric technologies, blockchain, cryptocurrencies, and crowdfunding.

Figure 4 presents a comparison of digital financial services' coverage in the Russian Federation and the Republic of Korea, and the overall digital competitiveness of these economies. For benchmarking purposes, the figure also presents aggregated values of relevant indicators for East Asian and Pacific (EAP) countries, which according to the World Bank classification include Korea and for European and Central Asian (ECS) nations includes Russia.

The data presented in Figure 4 shows that digital development indicators in the Republic of Korea, for the public and for overall economy alike, significantly exceed the average values in the region. The gap in the number of fintech users is especially wide. In Russia, the situation is reversed: the Digital Competitiveness Index and the coverage of the population by digital financial services are below the average for the relevant region. However, going back to fintech coverage (see Figure 2 above), as of 2018 its value in Russia was 82% (third place in the world, after India and China), while in Korea it was 64%, with a global average of 65% [Ernst & Young, 2019].

Such a significant gap is explained by the specific features of the calculation methodology: Ernst & Young experts, unlike those at the World Bank, used only observational data for Moscow and St. Petersburg to compile the FinTech Adoption Index. Concentration in large cities is one of the main features of the fintech sector's development in Russia (unlike in the US and the EU), along with insufficient regulation of many of its segments (e.g. P2P lending, collective investments, and cryptocurrency operations). At the same time, Russia remains one of the largest suppliers of IT professionals to the global fintech market: Russian programmers emigrate in search of higher salaries [Deloitte, 2018].

The regulation issue is relevant for the Republic of Korea too, but in a different way: strict regulatory requirements for the banking sector are hindering its digitalization and the growth of the domestic fintech market is primarily due to services provided by the non-banking sector. Another important feature of South Korean fintech is the key role of the government which was the main proponent of this sector's development in the country [*Ihn*, 2018]. The proximity to North Korea negatively affects cybersecurity for cryptocurrency operations: a significant proportion of transactions suffer from theft. According to FireEye, a US cybersecurity company, peaks of hacker attacks originating in North Korea have been noted since April 2017. Experts believe that the US economic sanctions against this country were the reason for the increased number of cryptocurrency crimes [The Economist, 2017].

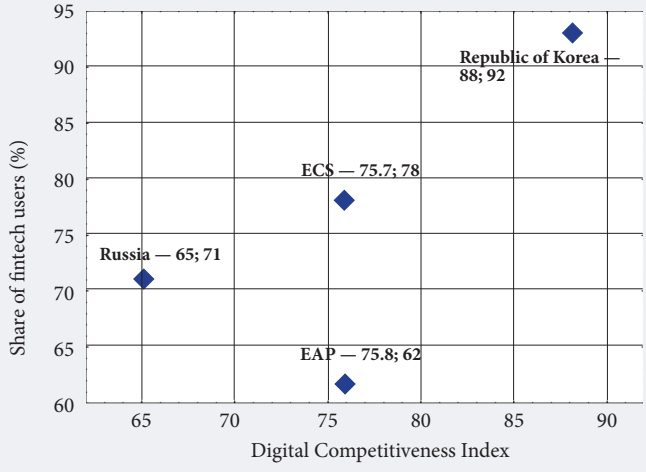
The Fintech Ecosystems in Russia and the Republic of Korea: Investment and Regulatory Aspects

The development of fintech and the rate of creation of relevant innovative products and services depend upon the formation and efficient functioning of an appropriate ecosystem comprising a set of interrelated factors such as access to funding, regulation, technology, demand, and human capital, which are developing in parallel (see, e.g., [*Nicoletti*, 2018]). Let us consider two elements of the fintech ecosystem which are of critical importance for both Russia and the Republic of Korea: investments and regulation.

I. Access to Funding

According to CB Insights, about $75 million were invested in the Russian fintech market in 2011-2016. Approximately 90% of that sum came from

Figure 4. **Digital Development in the Russian Federation and the Republic of Korea Compared with Relevant Regional Indicator Values**



Notes:

a) The share of fintech users: the share of people aged 15+ who made or received digital payments using mobile banking, debit or credit cards, or mobile phones, or paid for purchases and bills online over the previous 12 months.

b) The Digital Competitiveness Index reflects the country's position in the digital environment; it is calculated by the International Institute for Management Development (IMD) based on 50 ranked criteria divided into three groups of factors: knowledge, technology, and readiness for digital transformation.

Source: compiled by the authors based on [IMD, 2018; *Demirguc-Kunt et al.*, 2018].

leading Russian banks actively applying innovations in their business processes, both those developed in-house and those obtained from promising start-ups they supported.[7]

In the Republic of Korea, fintech companies are mainly funded by large corporations. For example, investments in local start-ups by giants such as Samsung and Naver are estimated at $500-600 million a year.[8]

Table 2 presents the main fintech investment promotion areas in Russia and South Korea.

Table 2. **Promotion of Investments in the Fintech Sector in Russia and the Republic of Korea**

Russia	Republic of Korea
Various investment promotion mechanisms Initiatives to support Russian fintech start-ups and promote investments Increasing the public's financial literacy	Equity crowdfunding P2P loans A system of benefits, including: • Tax benefits for SMEs • Capital tax benefits • Tax deductions for investments in R&D

Source: composed by the authors based on [Financial Stability Board, 2019; *Lee, Yim*, 2019; *Lee, Kim*, 2015], and the National Programme "Digital Economy in the Russian Federation" (see: https://data-economy.ru/, accessed on 17.02.2020).

An alternative way of financing the fintech sector in the Republic of Korea is through equity crowdfunding. Apart from start-ups, so-called social enterprises also can get additional capital this way (companies licensed by the Ministry of Employment and Labor, whose activities are aimed at improving financial and social welfare and the environmental situation through commercial initiatives such as providing employment for disabled people, contributing to urban development, etc.).

Debt financing in the form of P2P loans remains one of the most popular funding sources, with a constantly improving regulatory system (P2P Loan Guidelines). A new version of P2P Loan Guidelines has been in force since January 2019, setting borrowing limits between 10 and 40 million Korean won a year depending on the borrower's income. Investments in mortgage loans through P2P loans (e.g. project funding) are limited to 20 million won. No such limits are set for corporate or accredited individual investors.

The Korean government provides special incentives, mainly in the form of tax preferences. Small and medium fintech companies located outside densely populated cities can get a 50% discount on corporate income tax for up to five years. Companies with venture capital firm status (which make up a significant proportion of fintech market players) can also claim this benefit; no location requirements apply to them. Plus, there are benefits for conducting R&D: tax deductions for certain types of costs including labor and material costs [Financial Stability Board, 2019; *Lee, Yim*, 2019; *Lee, Kim*, 2016; *Yi*, 2019]. Finally, since mid-2019, a 10% VAT rate applies to global corporations providing digital services in the country.

II. Regulation

In the current situation, the fintech market regulator's main objective is to create a legal environment that would promote innovation while at the same time effectively monitoring and minimizing the risks on the market.

Table 3 summarizes the main responsibilities of fintech market regulators in Russia and in the Republic of Korea.

Major efforts of Russian and South Korean regulators are focused on creating regulatory sandboxes. In Russia such a platform was launched in April 2018, and in August, Sberbank already started using it for a pilot project: a service for credit organizations that allows them to integrate a platform for managing corporate clients' accounts remotely with the authority to conduct transactions on their behalf in bank branches. The objective was to reduce the costs to banking services users. To date, more than 30 applications to take part in the regulatory platform have been submitted, mainly by credit organizations and technology companies. More important subject areas include distributed ledger technology (DLT), big data and machine learning, and digital profiles (user identification and collecting data on individuals and legal entities from government databases). Projects related to the use and development of cryptocurrencies are not supported by the Bank of Russia due to the lack of regulatory requirements and principles for regulating these operations.

In the Republic of Korea, a regulatory sandbox was created in April 2019 and already in May the Financial Services Commission[9] approved 18 projects proposed by South Korean fintech companies. Since January 2019, a total of 105 applications have been submitted, 19 of which were given priority. Content-wise, the accepted projects are aimed at providing financial services using advanced technology platforms and mechanisms including

[7] See https://investinrussia.com/data/files/sectors/0_EY-focus-on-fintech-russian-market.pdf, accessed on 14.03.2020.

[8] See https://seoulz.com/korean-startup-ecosystem-and-blockchain-in-korea/, accessed on 14.03.2020.

[9] The Republic of Korea's central government body responsible for financial policy, supervision and control in this area.

[10] See https://www.fsc.go.kr/eng/new_policy/fintechpolicy.jsp for more, accessed on 15.08.2019.

Table 3. **Fintech Market Regulators in Russia and the Republic of Korea and their Main Responsibilities**

Country (regulatory authority)	Responsibility
Russia (Central Bank)	• Designing a mechanism for cross-regulating and coordinating activities aimed at developing fintech in Russia • Developing an electronic information exchange and document management system for financial market participants • Creating a "regulatory sandbox" • Extending international cooperation in the framework of various integration associations to promote the development of the fintech market
Republic of Korea (Financial Services Commission)	• Creating a "regulatory sandbox" • Reforming the financial regulation system by reviewing its formal and informal mechanisms hindering the development of fintech • Eliminating regulatory restrictions for financial companies› investments in fintech • Identifying and structuring business activities in which financial companies are allowed to invest • Taking part in the development and implementation of national technology initiatives

Source: composed by the authors based on [Deloitte, 2018; *Mittal,* 2019; *Choi M., Choi H.-L.,* 2016], and data published by the Financial Services Commission of the Republic of Korea (see https://www.fsc.go.kr/eng/new_policy/fintechpolicy.jsp, accessed on 15.08.2019).

blockchain technology.[10] According to experts, the main challenges the South Korean fintech sector faces have to do with regulation. In the scope of the Innovation Platforms Program, the government is implementing a reform aimed at deregulating technological development [*Kim, Choi*, 2019].

Conclusion

The current situation can be described as the emergence of Fintech 4.0 (similar to Industry 4.0), with start-ups and technology companies providing services to economic agents (individuals and companies alike) directly, bypassing the conventional financial intermediaries. Of course, digital technology *per se* does not facilitate access to financial services. This requires having in place an advanced payment system and physical infrastructure, an efficient regulatory framework, and an effective consumer protection system. The reduced costs of providing financial services should lead to their increased availability.

Our analysis shows that the most likely of the main fintech development scenarios involves the fragmentation of the existing market into numerous narrow segments and niches, which potentially can evolve into a market for multinational digital financial corporations capable of pushing back small firms and established conventional giants alike. At the same time, the scenario where major players conquer the financial market, despite being less likely, might make a more significant impact upon the global markets.

The increased coverage of the public by digital fintech instruments will be a key result of certain scenarios' implementation, identified on the basis of analyzing the current trends of the sector's development. Adequately meeting the challenges and risks associated with various fintech evolution paths on global markets requires new models of countries' interactions in regulating digital financial companies. Over the course of the analysis, the example of Russian-Korean relations was used to assess the areas of international cooperation in the field of finance at the current stage of market segmentation and the global digital transformation.

The first such area concerns sharing experience and best practices in setting up a regulatory sandbox mechanism. Relevant efforts will reduce regulatory risks by accumulating experience in creating and maintaining favorable conditions for innovative financial companies as well as the provision of financial products and services. The Russian experience of promoting the development of fintech instruments in the banking sector (which is going through a stage of profound deregulation in present-day Korea) seems to be relevant here.

Another area of bilateral cooperation, which will contribute to the accumulation of regulatory experience and promote the development of infrastructure that meets the new digital finance requirements, is international investment projects. Innovative fintech tools are one of the most popular investment areas. Of particular importance for Russia and the Republic of Korea in this regard is the successful completion of 2018 projects: the Agreement on Investment Protection and Trade in Services (regarding mutual investments in fintech and innovative insurance products) and cooperation in the framework of the Global Infrastructure Fund which includes plans for approximately $100 million of Korean investments in Russia to develop digital infrastructure in the Far Eastern regions.

The digital transformation of international financial markets makes countries' cooperation regarding the taxation of fintech companies extremely important, since it allows them to significantly reduce the risks of regulatory arbitration. Partnership

in the taxation sphere first of all concerns the implementation of the so-called "BEPS plan"[11] which defines a set of major changes in bilateral agreements to avoid double taxation and adapt tax regimes to new business models for the digital economy. The accumulated experience of Russian and Korean cooperation indicates the need to amend the current Convention "On Avoiding Double Taxation of Income" regarding the definition of the permanent representation concept. This would allow one to officially recognize the significant scale of businesses' presence in two jurisdictions in the context of the digital economy (where most fintech companies belong) and identify double and reverse classification companies. This, in turn, would allow for clearly identifying payments received by Russian and South Korean non-resident investors and counter hybrid cross-border schemes.

Generally, there are obvious gaps in the international regulation of the financial sphere, which provide incentives for using the legal asymmetries and loopholes to the advantage of one of the parties. This situation in itself presents a serious challenge that can undermine international economic cooperation and the sustainable development of global financial markets. Harmonizing individual countries' legislation on digital development will help them adopt uniform rules of the game for all and promote the rapid dissemination of innovative fintech tools on a global scale.

This study was carried out with the financial support of the Russian Foundation for Basic Research in the framework of the research project No. 20-010-00785 "Digital financial technologies as a factor in the development of the insurance market in the Russian Federation".

References

Alcamo J. (2001) *Scenarios as tools for international environmental assessments. Experts' corner report*, Copenhagen: European Environment Agency.

Ascencio L. (ed.) (2017) *Trade and Competition in the Era of the Digital Economy. Economic and Technical Cooperation. Report for the VII Annual Meeting of the Working Group on Trade and Competition of Latin American and the Caribbean (WGTC), San Salvador, El Salvador, 12–13 October 2017* (SP/VIIRAGTCCALC/DT 2-17), San Salvador: Sistema Económico Latinoamericano y del Caribe. Available at: http://www.sela.org/media/3205125/vii-ragtccalc-if-n-1-17-ingles.pdf, accessed 27.02.2020.

Banga R., Kozul-Wright R. (2018) *South-South Digital Cooperation for Industrialization: A Regional Integration Agenda* (UNCTAD/GDS/ECIDC/2018/1), Geneva: UNCTAD.

Banga R., Singh P.J. (2019) *BRICS Digital Cooperation for Industrialization* (Working Paper 4/2019), Geneva: UNCTAD, University of Johannesburg.

Börjeson L., Höjera M., Dreborg K.-H., Ekvall T., Finnveden G. (2006) Scenario types and techniques: Towards a user's guide. *Futures*, vol. 38, no 7, pp. 723–739.

Burton N., Bach N., Calvin P., Meissner D., Sarpong D. (2019) Understanding cross border innovation activities: The linkages between innovation modes, product architecture and firm boundaries. *Journal of Business Research* (online, in press). Available at: https://doi.org/10.1016/j.jbusres.2019.05.025, accessed on 27.03.2020.

Cambridge Center for Alternative Finance (2018) *Future of Finance is Emerging: New Hubs, New Landscapes. Global Fintech Hub Report*, Cambridge (UK): University of Cambridge.

Choi M., Choi H.-L. (2016) Building a National System of Technology Foresight in Korea. *Deploying Foresight for Policy and Strategy Makers: Creating Opportunities Through Public Policies and Corporate Strategies in Science, Technology and Innovation* (eds. L. Gokhberg, D. Meissner, A. Sokolov), Heidelberg, New York, Dordrecht, London: Springer, pp. 227–244.

Deloitte (2018) *Private FinTech as a Tool for Sustainable Business Development in Russia and Kazakhstan. FinTech Market Trends*, Moscow: Deloitte CIS Research Center.

Demirguc-Kunt A., Klapper L., Singer D., Ansar S., Hess J.R. (2018) *The Global Findex Database 2017: Measuring Financial Inclusion and the Fintech Revolution*, Washington, D.C.: World Bank Group.

Ernst & Young (2019) *Global FinTech Adoption Index 2019* (ed. G. Hwa), London: Ernst & Young.

Eurofound (2003) *Handbook of Knowledge Society Foresight*, Dublin (Ireland): European Foundation for the Improvement of Living and Working Conditions. Available at: http://www.eurofound.eu.int, accessed 25.01.2020.

Financial Stability Board (2019) *FinTech and market structure in financial services: Market developments and potential financial stability implications*, Basel (Switzerland): Financial Stability Board. Available at: https://www.fsb.org/wp-content/uploads/P140219.pdf, accessed 27.03.2020.

[11] The full name is Multilateral Convention to Implement Tax Treaty Related Measures to Prevent Base Erosion and Profit Shifting. The signatories are the OECD and the G20 countries.

Greeuw S., van Asselt M., Grosskurth J., Storms C., Rijkens-Klomp N., Rothman D., Rotmans J. (2000) *Cloudy Crystal Balls: An Assessment of Recent European and Global Scenario Studies and Models*, Copenhagen: European Environment Agency.

Grimm S., Hörig M., Wolf T. (2018) *Digital Transformation: Higher Education and Research for Sustainable Development*, Bonn: DAAD, DIE.

Heikura M. (2018) Digital transformation challenges and possible solutions through international cooperation. *Impact of Digitalisation on the Transformation of Tax Administrations* (eds. M.S. Pinta, A. Kővágó, M. Crawford), Budapest: Intra-European Organisation of Tax Administrations (IOTA), pp. 10–13.

Heimerl V., Raza W. (2018) *Digitalization and development cooperation: An assessment of the debate and its implications for policy*, Vienna: Austrian Foundation for Development Research (ÖFSE).

Ihn J. (2018) *The Future of Fintech in South Korea*. Available at: https://medium.com/qara/the-future-of-fintech-in-south-korea-37a0a1315742, accessed 15.08.2019.

IMD (2018) *IMD World Digital Competitiveness Ranking 2018* (eds. A. Bris, C. Cabolis), Lausanne: IMD World Competitiveness Center.

IMF, World Bank (2018) *The Bali FinTech Agenda*, Washington, D.C.: International Monetary Fund (IMF), World Bank Group.

IMF (2019) *Fintech: The Experience So Far* (IMF Policy Paper, June 2019), Washington, D.C.: International Monetary Fund. Available at: https://www.imf.org/~/media/Files/Publications/PP/2019/PPEA2019024.ashx, accessed on 15.04.2020.

Jäger J., Rothman D., Anastasi C., Kartha S., van Notten P. (2007) *Scenario development and analysis. Module 6. A training manual on integrated environmental assessment and reporting*, Nairobi (Kenya): UNEP.

Kim S.S., Choi Y.S. (2019) The Innovative Platform Programme in South Korea: Economic Policies in Innovation-Driven Growth. *Foresight and STI Governance*, vol. 13, no 3, pp. 13–22. DOI: 10.17323/2500-2597.2019.3.13.22

Kong A. (2016) *The State of FinTech in South Korea*. Available at: https://yostartups.com/the-state-of-fintech-in-south-korea/, accessed 15.08.2019.

Kosow H., Gaßner R. (2008) *Methods of Future and Scenario Analysis. Overview, Assessment, and Selection Criteria*, Bonn: Deutsches Institut für Entwicklungspolitik.

Lavrinenko A., Shmatko N. (2019) Twenty-First Century Skills in Finance: Prospects for a Profound Job Transformation. *Foresight and STI Governance*, vol. 13, no 2, pp. 42–51. DOI: 10.17323/2500- 2597.2019.2.42.51.

Lee J.M., Yim S. (2019) *Korea: FinTech 2019. FinTech Laws and Regulation. The International Comparative Legal Guides (ICLG)*. Available at: https://iclg.com/practice-areas/fintech-laws-and-regulations/korea, accessed 15.08.2019.

Lee T.-H., Kim H.-W. (2015) An Exploratory Study on Fintech Industry in Korea: Crowdfunding Case. *Open Journal of Applied Sciences*, vol. 6, no 11, pp. 771–782.

Lundquist K., Trippl M. (2011) Distance, Proximity and Types of Cross-Border Innovation Systems: A Conceptual Analysis. *Regional Studies*, vol. 47, no 3, pp. 450–460. DOI: 10.1080/00343404.2011.560933

Makkonen T., Widenfeld A., Williams A. (2017) Cross-Border Regional Innovation System Integration: An Analytical Framework. *Tijdschrift voor Economische en Sociale Geografie*, vol. 108, pp. 805–820. DOI: 10.1111/tesg.12223.

Meissner D., Roud V., Cervantes M. (2013) Innovation Policy or Policy for Innovation? *Search of the Optimal Solution for Policy Approach and Organization* (eds. D. Meissner, L. Gokhberg, A. Sokolov), Heidelberg, New York, Dordrecht, London: Springer, pp. 247–255.

Mention A.-L. (2019) The Future of Fintech. *Research-Technology Management*, vol. 62, no 4, pp. 59–63. DOI: 10.1080/08956308.2019.1613123.

Mietzner D., Reger G. (2005) Advantages and disadvantages of scenario approaches for strategic foresight. *International Journal Technology Intelligence and Planning*, vol. 1, no 2, pp. 220–239.

Miles I. (2016) The Future of Services. *Deploying Foresight for Policy and Strategy Makers: Creating Opportunities Through Public Policies and Corporate Strategies in Science, Technology and Innovation* (eds. L. Gokhberg, D. Meissner, A. Sokolov), Heidelberg, New York, Dordrecht, London: Springer, pp. 227–244.

Mittal V. (2019) *South Korea FinTech Landscape*. Available at: https://www.researchgate.net/publication/330701592_South_Korea_FinTech_Landscape, accessed 15.08.2019.

Netscribes (2019) *Global Fintech Market (2018–2023)*, Mumbai (India): Netscribes Pvt Ltd. Available at: https://www.marketresearchhub.com/report/global-fintech-market-2018-2023-report.html, accessed 14.03.2020.

Nicoletti B. (2017) *The Future of FinTech. Integrating Finance and Technology in Financial Services*, London: Palgrave Macmillan.

OECD (2013) *Regions and Innovation: Collaborating across Borders*, Paris: OECD. Available at: http://dx.doi.org/10.1787/9789264205307-en, accessed 15.08.2019.

Patiño J.A., Roja E.F., Agudelo M. (2018) *Regional digital market. Strategic aspects*, Santiago (Chile): Economic Commission for Latin America and the Caribbean.

Sokolov A., Veselitskaya N., Carabias V., Yildirim O. (2019) Scenario-based identification of key factors for smart cities development policies. *Technological Forecasting and Social Change*, vol. 148, art. 119729. Available at: https://doi.org/10.1016/j.techfore.2019.119729, accessed 14.03.2020.

Sparrow O. (2000) Making use of scenarios — From the vague to the concrete. *Scenario & Strategy Planning*, vol. 2, no 5, pp. 18–21.

The Economist (2017) *Fintech strategies diverge over crypto-currency regulation*. Available at: http://country.eiu.com/article.aspx?articleid=1545990738&Country=South%20Korea&topic=Economy&oid=1306119914&aid=1, accessed on 15.08.2019.

van Notten Ph. (2006) Scenario development: A typology of approaches. *Think Scenarios, Rethink Education*, Paris: OECD, pp. 69–84.

van Notten Ph., Rotmans J., van Asselt M., Rothman D. (2003) An updated scenario typology: An attempt at synthesis. *Futures*, vol. 35, pp. 423–443.

Wodak J., Neale T. (2015) A critical review of the application of environmental scenario exercises. *Futures*, vol. 73, pp. 176–186.

Xiang W.-N., Clarke K.C. (2003) The Use of Scenarios in Land-Use. *Environment and Planning B: Urban Analytics and City Science*, vol. 30, no 6, pp. 885–909. Available at: https://doi.org/10.1068%2Fb2945, accessed 15.08.2019.

Yi H. (2017) *SME Financing & Fintech in Korea,* Busan, Korea: Korea Technology Finance Corporation.

Yoon D. (2019) R&D Innovation Strategy for International Cooperation of Science and Technology in Asia. *Dynamic Perspectives on Globalization and Sustainable Business in Asia* (ed. P. Ordoñez de Pablos), Hershey, PA: IGI Global, pp. 1–11. DOI: 10.4018/978-1-5225-7095-0.

Zhang M. (2018) *China's Digitalization and its Implications for China-South Korea Economic Cooperation* (KIEP Research Paper 18–31), Korea Institute for International Economic Policy (KIEP). Available at: http://dx.doi.org/10.2139/ssrn.3299410, accessed 15.08.2019.

Competitiveness of Small and Medium Businesses and Competitive Pressure in the Manufacturing Industry

Alexander Kalita
Doctoral student, Doctoral School of Management, akalita.hse@gmail.com

Alexander Chepurenko
Professor and Head, Department of Sociology, achepurenko@hse.ru

National Research University Higher School of Economics, 11, Myasnitskaya St., 101000, Moscow, Russian Federation

Abstract

In this paper, the relationship between internal competitiveness factors and the perception of Russian SMEs' level of competitiveness are examined, based on a secondary analysis of the RuFIGE (Russian enterprises in the global economy) survey data obtained in 2014 about 1,677 Russian industrial small and medium-sized enterprises (SMEs).

It comes out that neither the high technological level, the introduction of the CRM system, nor the availability of external financing are sufficient for Russian manufacturing SMEs to feel competitive on the global market. From the other side, those manufacturing SMEs whose main competitors are domestic enterprises, count neither the technological level nor the presence of a CRM system to be necessary factors for competitiveness.

Further, there are different "weight categories" among Russian manufacturing SMEs. SME owners, who work only on local markets, are immune to competition from large foreign companies and consider Russian firms similar to their own as their main competitors. Those who work on the whole Russian market feel a great amount of competitive pressure from foreign manufacturers.

The conclusion provides theoretical and practical recommendations on the results of this study.

Keywords:
Firm competitiveness; competitive pressure; small and medium-sized enterprises; manufacturing; RuFIGE.

Citation: Kalita A., Chepurenko A. (2020) Competitiveness of Small and Medium Businesses and Competitive Pressure in the Manufacturing Industry. *Foresight and STI Governance*, vol. 14, no 2, pp. 36–50. DOI: 10.17323/2500-2597.2020.2.36.50

For a long time, studying companies' competitiveness mainly amounted to analyzing various internal factors [*Hoskisson et al.*, 1999; *Furrer et al.*, 2008] and the external market environment [*Hitt et al.*, 2016]. The analysis was mostly based on data from developed countries, with only a much smaller number of studies devoted to transitional (transformation) economies [*Hitt et al.*, 2004; *Aidis et al.*, 2008; *Meyer, Peng*, 2016]. Also, international researchers tended to focus on key factors affecting competitive advantages of large corporations, so their findings cannot be fully applied to better understand the specifics of small and medium enterprises (SMEs) [*Man et al.*, 2002; *Caloghirou et al.*, 2004; *Hurley*, 2018; *Lafuente et al.*, 2019].

Competitiveness is usually seen as a central element when corporate strategies are developed [*Barney*, 1991; *Porter*, 1980; *Hitt et al.*, 2016]. Furthermore, it is assumed that strategic decision-makers are well aware of the state of the competitive environment in the industry and can assess its effect upon the company's activities [*Porac et al.*, 1989; *Porac, Thomas*, 1990]. However, most SMEs do not have any formalized strategies at all and their assessment of the competitive environment essentially amounts to a subjective assessment of its pressure upon a firm.

The need to analyze competitiveness factors arises from the need to achieve adequate product quality, productivity, and operational efficiency as well as meet customers' and business partners' requirements [*Raymond et al.*, 2015, 2016]. Not only is the ability to network with strategic partners of critical importance here, but also being able to systematically adapt the organization's activities to match the changing market environment [*Díaz-Chao et al.*, 2016; *Lafuente et al.*, 2019].

How important is it for Russian SMEs to take their competitiveness into account? There are a number of empirical Russian studies of internal and external competitiveness factors. Their authors used various techniques to assess the competitive positions of Russian manufacturing enterprises [*Gurkov et al.*, 2005; HSE, 2008, 2014; *Shakina et al.*, 2017; *Alimova*, 2017; *Golikova, Kuznetsov*, 2017]. However, the impact the objective factors affecting SMEs' competitiveness make on SME managers' subjective assessment of the competitive pressure their companies experience remains poorly understood.

This paper analyzes the above relationship using the Russian manufacturing industry as an example, taking into account competitive pressure from domestic and foreign manufacturers.

Literature Review

No universally accepted definition of SMEs' competitiveness has yet been suggested in the academic literature [*Man et al.*, 2002; *Díaz-Chao et al.,* 2016; *Lafuente et al.*, 2019]. We define it as the ability to consciously manage the potential (technological level of products, application of information and communication technologies (ICT) and strategic partnerships, access to external funding and product markets) to support and strengthen key financial and economic indicators.

As an integrated and relative concept, SMEs' competitiveness in our understanding includes three interrelated aspects [*Man et al.*, 2002]:

- internal and external development factors;
- success in accomplishing specific results;
- achievement of performance indicators.

An indicator of companies' competitiveness is their market stability, i.e., the ability to maintain or expand the scale of their operations over a relatively long period.

Two fundamental approaches can be distinguished in the strategic management literature, which link competitiveness primarily with analyzing its potential. The "resource" approach is focused on internal factors. It is assumed that competitive advantages are based on the efficient use of unique available resources, capabilities, and key competencies which allow the company to surpass its rivals [*Wernerfelt*, 1984; *Prahalad, Hamel*, 1990; *Barney*, 1991]. The level of competition between companies depends upon "market commonality", which occurs if companies operate on the same market, consider it vital to their business, and have comparable resources ("resource similarity") [*Chen*, 1996; *Peteraf, Bergen*, 2003].

Other researchers point to the importance of market or industry characteristics. Companies can gain significant competitive advantages if they operate in attractive business sectors [*Porter*, 1980, 1985]. These approaches complement each other and thus allow one to assess the potential for becoming competitive in a narrow market segment or across the entire industry [*Hitt et al.*, 2016]. Competition cannot be homogeneous since there are always players who apply strong pressure on others, while other companies are not perceived as important rivals [*Barnett*, 1997]. Managers' perception of the competition plays a major role: it determines their reaction to, among other things, competitors' actions [*Hambrick, Mason*, 1984; *Porac et al.*, 1989; *Porac, Thomas*, 1990; *Cattani et al.*, 2017]. There is an established link between enterprises' performance and the entrepreneur's competencies, including their ability to assess the competitive environment and create organizational opportunities for realizing the company's potential [*Man et al.*, 2008]. It is the manager's competencies that ensure the company's long-term competitiveness and sustainable performance.

Another important factor is formal and informal network connections. Small enterprises more often use informal channels to obtain the information they need, including that about product development, competition, work organization, and communication with suppliers and customers [*Kingsley, Malecki*, 2004]. However, all of the above approaches are limited to identifying the link between no more than two aspects of competitiveness: the role of available resources and managers' competencies. Meanwhile actually becoming competitive involves the complex interactions between at least two groups of internal factors, objective and subjective ones, including a set of specific variables. Based on this, [*Lafuente et al.,* 2019] assessed companies' performance, depending on their size, using a competitiveness index based on 10 different factors: human capital, technology, strategic decision-making, product characteristics, marketing, use of ICT, networking, specific features of the domestic market, and internationalization. Making use of one's strengths and leveling weaknesses is of particular importance for improving small enterprises' productivity. Since companies have to become competitive in different socioeconomic and legal environments, the overall context also should be considered. In transition countries, strategic decisions that affect companies' competitiveness are largely determined by the institutional environment [*Puffer, McCarthy*, 2011; *Welter*, 2011; *Welter, Smallbone*, 2011].

The international analysis presented in [*Abel-Koch, Gerstenberger*, 2014][1] showed that in Brazil, Russia, and China, SMEs' competitiveness is limited by institutional factors such as bureaucracy, corruption, political and social instability, and the lack of appropriate business development infrastructure. Under these circumstances, companies' competitive positions tend to vary greatly. The reasons for this variability can be traced using Russia as an example, where companies' operations very much depend upon informal institutions [*May et al*., 2000; *Hitt et al*., 2004; *Puffer, McCarthy*, 2011; *Sauka, Chepurenko*, 2017]. This also applies to other "transitional" countries where companies frequently rely on the support provided by external stakeholders as opposed to formal institutions, which, because of their poor development, do not appear to be sufficiently legitimate [*Aidis et al*., 2008; *Chadee, Roxas*, 2013; *Volchek et al*., 2013; *Puffer et al*., 2018].

A number of studies are devoted to Russian manufacturing enterprises' competitive strategies and the reasons for their adoption (see Table 1 for more). However, several gaps remain:

- the concept of "competitiveness" does not have a uniform, generally accepted definition;
- the relationship between competitive strategies and specific competitive factors has not been sufficiently explained;
- the impact of internal competitiveness factors upon managers' perception of competitive pressure (as reflected in corporate strategies) does not seem to be clear;
- unique external factors affecting the availability of resources and the competitive strategy are not taken into account;
- the choice of particular strategies to match specific features of the market, in terms of major competitors' characteristics, has not been analyzed.

Russian SMEs' perception of their competitiveness may differ depending on the types of competitors they face, which affects their strategies. Russian players and their foreign and international competitors have incomparable resources [*Chen*, 1996; *Peteraf, Bergen*, 2003]. If a company competes exclusively with compatriots, the competition amounts to such aspects as the price-quality ratio, favorable terms of paying for services, and Russian brand recognition. To successfully compete with foreign manufacturers, innovations, focused customer relations, and the ability to identify and meet their preferences come to the fore [HSE, 2014]. However, these assumptions have not yet been empirically verified.

This paper proposes an original approach to defining the concept of "competitiveness". We study the mutual impact of resource availability and perceived level of competitive pressure as expressed in performance indicators (the company's sustainable development). In the case of SMEs, stakeholder groups other than managers play a very limited role in making key decisions. There are reasons to believe that it is the perception of the small firm's competitiveness by its managers that leads to optimizing the availability and use of resources, which is seen as a key factor in maintaining a strong competitive position. We examine how SMEs' internal competitiveness factors affect their managers' perception of competitive pressure in the Russian manufacturing industry. The analysis is carried out for two competitor types: compatriots and foreign manufacturers.

The Conceptual Model and Study Hypotheses

The conceptual structure of the study is presented in Figure 1, the hypotheses in Table 2. The paper considers five key factors which we believe define the competitive pressure on Russian manufacturing SMEs from domestic and foreign players:

[1] This study covered the US, Germany, the UK, France, Japan, Brazil, Russia, China, Spain, and Italy.

Table 1. **Russian Manufacturing Companies' Competitive Strategies**

Strategy type	Content
Clingfish	Establishing strong relationships with large partner companies allows small specialized firms which primarily serve just a single (or a few) big client located in the same region to avoid fierce competition.
Copy-paste	The enterprises' technological level is generally not high enough to develop their own technologies, so they are forced to borrow them.
No outsiders	Many companies that do not use resources efficiently enough choose one of the following two strategies: • rely on domestic market niches inaccessible to third-party players to avoid a strong pressure from market leaders; • enjoy state regulation protection, which limits the competition from stronger foreign players.

Note: the above strategy types are suggested by the authors.
Source: compiled by the authors based on [HSE, 2008, 2014; *Gonchar,* 2009; *Alimova,* 2017].

- technological level of products;
- use of ICT;
- strategic partnerships;
- external funding sources;
- product markets.

Enterprise size, age, and industry affiliation according to the taxonomy suggested by Keith Pavitt (*Pavitt*, 1984) were used as control variables. Note that competitiveness factors may vary for competitive pressure from Russian and foreign players.

Technological Level of Products

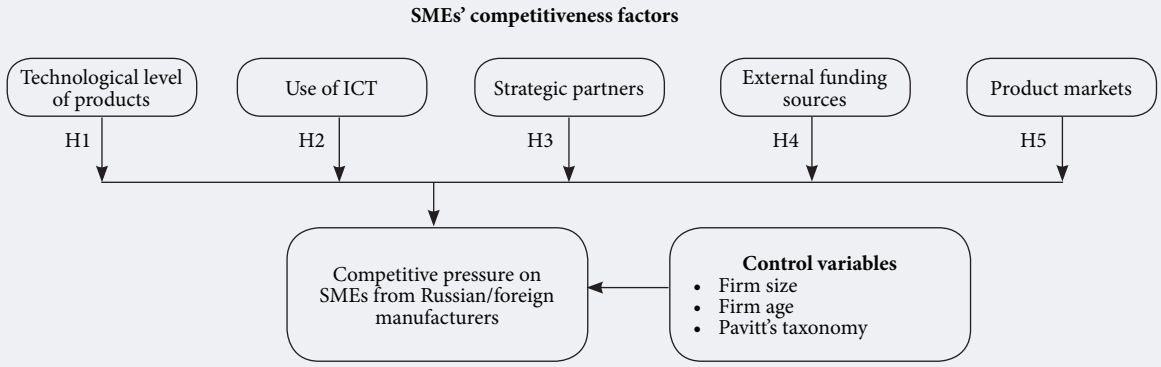
In this study, the technological level of the company's product is assessed in relation to products offered by its Russian and foreign competitors. Technological aspects of the company's strategy are crucial for its success in the competitive environment. They serve as a basis for drafting an action plan: a set of guidelines to efficiently use technological resources [*Zahra*, 1996]. The successful implementation of this plan depends upon the adequate identification and management of human and social resources (such as knowledge, access to technology, work experience in large companies, etc.) [*Garcia-Cabrera et al.*, 2019]. However, technological resources alone are not enough to ensure competitiveness. Strategic flexibility on external markets is also required, which will allow one to reach an acceptable technological level to be able to create an innovative product in the future [*Kapasuwan et al.*, 2007]. A competitive advantage can be secured by acquiring technologies externally, if they can be applied to improve distribution and logistics in the supply chain [*Knight*, 2000]. Various strategies to improve the technological level, such as innovation and marketing differentiation, price reduction, and so on can significantly reduce competitive pressure on SMEs [*Spanos, Lioukas*, 2001].

The Russian manufacturing industry lags far behind the leading countries because most enterprises lack the resources required for technological development [*Gonchar*, 2009; *Kuznetsov et al.*, 2011; HSE, 2014]. Therefore, it is assumed that companies offering products whose technological level is on a par with or exceeds the best Russian models do not experience significant competitive pressure (hypothesis H1).

Use of Information and Communication Technology

ICT, such as a websites, e-commerce, and customer relationship management (CRM) systems are considered important for maintaining competitive positions. The application of ICT can change the rules of competition in the industry, transform the company's operations, and create additional advantages [*Porter, Millar*, 1985]. ICT development strategies are applied if confrontation with other players threatens the firm's survival [*Rivard et al.*, 2006]. Previously, SME managers' attention was mainly focused on production; however, due to changes in the market environment driven by the internet technologies, the priority shifted to identifying and meeting customers' needs by applying digital resources [*Harrigan et al.*, 2011; *Nguyen et al.*, 2015]. A systemic analysis of SMEs' marketing practices revealed that adapting ICTs for marketing purposes became a major driver of change and development [*Bocconcelli et al.*, 2018]. Competition forces managers to use strategic resources to better understand customers and competitors through the effective use of marketing tools [*O`Cass, Weerawardena*, 2010]. Digital technology facilitates interactions with customers and partners on the international market [*Pergelova et al.*, 2019]. Having a foreign language website and using an e-commerce system is an important condition for Russian companies' entering foreign markets [*Fedyunina, Averyanova*, 2018]. Studies confirm there is a positive correlation between SMEs' export activities and their use of digital technology [*Kuzyk et al.,* 2020]. We assume that the use of ICT provides a competitive advantage by reducing pressure from other manufacturers (hypothesis H2).

Figure 1. **Conceptual Model of the Study**



Source: compiled by the authors.

Strategic Partners

Strategic partnerships are understood as a set of network connections that can be used by managers and entrepreneurs to strengthen their companies' competitive positions [*Jarillo*, 1988]. Being a member of such networks provides numerous competitive advantages such as access to information, resources, markets, technologies, and so on. [*Gulati et al.*, 2000]. Since SMEs tend to face serious resource constraints, problems with implementing innovations, and with internationalization, maintaining such partnerships is an important part of their development strategy in a competitive environment [*Street, Cameron*, 2007; *Agostini, Nosella*, 2019]. They acquire additional strategic resources including new formal and informal communication channels, access to R&D results and new markets, which can help optimize the creation of added value [*Partanen et al.*, 2018], [*Kingsley, Malecki*, 2004; *Hernandez-Carrion et al.*, 2017; *Martin et al.*, 2019].

On less developed markets, strategic partnerships can help deal with problems such as inadequate infrastructure and institutional constraints which hinder development [*Mesquita, Lazzarini*, 2008]. Chinese small and medium enterprises that are members of technological alliances tend to perceive the competition they face as low [*Wu, Pangarkar*, 2010]. Surveys conducted in 2008 and 2010 revealed companies' increased involvement in innovative cooperation, presumably due to the latter's increased role in overcoming the effects of the economic crisis [*Rebiazina et al.*, 2013].

Thus, cooperation expands SMEs' market opportunities, which would be harder to achieve on their own. It is assumed that when entering into partnerships enterprises experience lower competitive pressure from other manufacturers (hypothesis H3).

External Funding Sources

By external funding, we understand this to mean any sources other than the company's own funds. This is crucial for SMEs, especially after the financial crisis of 2008-2009 [OECD, 2017]. Small and medium companies need additional investments, primarily to accomplish the following objectives:

- focus on growth [*McMahon*, 2001];
- diversify by developing products with unique characteristics [*Camisón, Villar-López*, 2010];

Table 2. **Study Hypotheses**

Hypothesis	Description
H1	If the technological level of the company's main product is on a par with, or exceeds the best Russian models, the company managers perceive the competitive pressure from other manufacturers, including foreign ones, as low
H2	Russian manufacturing SMEs that use ICT (websites, e-commerce, CRM systems) to promote their products experience low competitive pressure from domestic and foreign manufacturers alike
H3	Having strategic partners contributes to SME managers' perceiving the competitive pressure from Russian and foreign manufacturers as low
H4	If SME managers have access to external funding sources, they perceive competitive pressure from Russian and foreign players as insignificant
H5	SME managers are inclined to assess the competitive pressure from Russian manufacturers as low if their company operates on the regional market, and the competitive pressure from foreigners as high if the company operates on the Russian national, CIS, and global markets

Source: compiled by the authors.

- improve their export performance [*St-Pierre et al.*, 2018].

In the Russian context, SMEs' access to investments is limited to partners and bank loans [*Sokolov, Rudnik*, 2014]. Studies show that manufacturing companies typically are not ready to put their business at risk and apply for bank loans, even if they are experiencing financial constraints. This is due to the high interest rates and the generally insufficiently developed banking services market [*Golikova, Kuznetsov*, 2017; *Alimova*, 2017]. Therefore, it can be assumed that companies with access to reliable external funding sources have better development opportunities and experience lower competitive pressure (hypothesis H4).

Product Markets

We consider the full range of possible markets for SMEs, from local to global ones. Diversifying markets allows companies to gain a significant competitive advantage as well as change their configuration and the value chains [*Porter*, 1985]. It has been established that the wider the market coverage, the more likely the company is to innovate [*Radas, Božić*, 2009]. A natural consequence of SMEs' growth is expanding the sales geography. Entering new markets leads to an increased number of customers, which in turn makes it possible to expand production [*Lu, Beamish*, 2001]. Accessing information on foreign markets is much more difficult than at home, so to improve export performance, the competitive strategy of such enterprises should rely on exclusive information [*Julien, Ramangalahy*, 2003].

Manufacturing enterprises in Russia operate mainly at the local and regional levels. Low competition from other domestic manufacturers in this case is due to high entry barriers and/or the market's low appeal for stronger players [HSE, 2008; *Alimova*, 2017]. Only a few such companies operate on the CIS markets, where they face a larger number of rivals including foreign ones [HSE, 2014]. Thus, SMEs which sell mainly on specific Russian regional markets are likely to experience low competitive pressure from other Russian manufacturers. Meanwhile those doing business across Russia, in the CIS, and on global markets face fierce competition from foreign players. Hence hypothesis H5 (see Table 2).

Methodology of the Study

The Sample

Our analysis is based on a survey of 1,950 Russian manufacturing enterprises with more than 10 employees, conducted in the scope of the RuFIGE project (Russian Enterprises in the Global Economy).[2] The survey was conducted by the GFK-Rus International Institute for Marketing and Social Research in 60 Russian regions during 2014 in the format of personal interviews with company managers. The questionnaire included questions that allowed the researcher to assess companies' competitiveness in the following aspects: organizational structure, personnel, innovation, investments, foreign trade, and business climate. The sample of the study is random, stratified, representative in terms of sectors and enterprise size, but its regional coverage is limited. To bring the sample into line with the structure of the general population of enterprises and stratify it by size groups and specific sectors, two additional variables were introduced into the RuFIGE database: relative and absolute weight. Each cell representing sectors and size groups has the same weight values, which eliminates distortions caused by the large number of firms in these categories.

For the purposes of our study, 1,677 Russian manufacturing SMEs with between 10 and 499 employees on the payroll were included in the sample.[3] Out of them, 70% were small and the rest were medium-sized. In terms of economic activity, the companies were broken down into nine groups. The largest one (over 20% of the surveyed enterprises) was food industry (22.7%), the smallest (4%) included the manufacturers of transport equipment. Three sectors (wood processing and pulp and paper industry; production of machinery and equipment; and metallurgy and production of metal products) were represented more or less equally at 12-13%. The sample structure is presented in detail in Table 3.

The Model and Variables Applied in the Study

The binary logistic regression model [*Hair et al.*, 2014] was used as the main tool for assessing the impact of competitiveness factors on Russian manufacturers' perception of competitive pressure (subsequently referred to as just "competitive pressure", for brevity):

$$\text{Y (competitive pressure)} = \beta_{0+} \beta_1 \text{Technology level of product}_i + \beta_2 \text{Use of ICT}_i + \beta_3 \text{Strategic partners}_i + \beta_4 \text{External funding}_i + \beta_5 \text{Product markets}_i + \beta_6 \text{Control variables}_i + \varepsilon_i \quad (1)$$

Two models are considered. In the first one, competitive pressure from domestic manufacturers is the *dependent variable*, in the second one – competition from foreign players. Both these variables are binary. The competition indicator takes the value 0 (low competitive pressure) if the respondent indi-

[2] For more about this project see: https://iims.hse.ru/rusfirms (accessed on 03.03.2020). It was funded in the framework of the HSE Basic Research Programme and carried out by the HSE Institute for Industrial and Market Studies (supervised by B. Kuznetsov and A. Yakovlev).

[3] Certain authors also include companies with up to 500 workers in the small and medium enterprises category [*Shirokova et al.*, 2013; *Volchek et al.*, 2013].

Table 3. **Sample Structure**

Criterion	Group	Number	Total (%)
Year of establishment*	1988 or earlier	267	16.3
	1989–2013	1403	83.7
Enterprise size (number of employees)	10–19	344	20.5
	20–49	503	30
	50–100	334	19.9
	101–249	325	19.4
	250–499	171	10.2
Sector	Food production	380	22.7
	Textile, sewing, leather and shoe production	161	9.6
	Wood processing, production of wood products, pulp and paper	215	12.8
	Chemical industry, production of coke and petroleum products, rubber and plastic products	180	10.7
	Production of other non-metallic products	141	8.4
	Metallurgy, and production of metal products	202	12
	Production of machinery and equipment	212	12.6
	Production of electrical, electronic and optical equipment	119	7.1
	Vehicles and transport equipment	67	4

*Note:** including missing values.
Source: compiled by the authors.

cated that there was no competition from domestic or foreign manufacturers, or it was insignificant. If it was reported that competition significantly or strongly affected the company, the indicator takes the value 1 (high competitive pressure). The variable "competitive pressure from foreign manufacturers" comprises two indicators: "competition from foreign manufacturers producing in Russia" and "competition from foreign manufacturers exporting products to Russia". The preliminary statistical analysis revealed that 82% of the respondents experiencing strong competitive pressure from foreign companies producing in Russia also assessed competition from foreign manufacturers exporting their products to the country as high. Accordingly, it was assumed that all foreign players make a single competitor group [HSE, 2014, p. 49].

Factors such as technological level of products, use of ICT (websites, e-commerce and CRM systems), strategic partnerships, external funding sources, and product markets (regional, national, the CIS, and international ones) were applied as *independent variables*. All independent variables are binary: they take the values 0 if the respondent answered the question about the presence of one of the above factors negatively, and the value 1 if the answer was positive.

The regression model also comprises a number of *control variables*: company age (the natural logarithm of the year it was established), company size (dummy variables of the number of employees), and industry affiliation according to Pavitt's taxonomy [*Pavitt*, 1984]. The following industry groups were used: "scale-efficient", conventional, specialized, and high-tech. The operationalization of the analyzed variables is presented in Table 4, the correlation matrix – in Table 5. All independent variables have low and moderate (mainly at the level of $p < 0.05$) correlation with each other. The highest correlation coefficients were noted for the variables "scale-efficient industries" and "conventional industries" (–0.568) at 5%. Thus, it can be sufficiently and confidently assumed there is no multicollinearity among the independent/control variables.

Analysis and Results

Table 6 presents descriptive statistics of the variables applied in the study. On average, slightly more than half of the enterprises (58%) sell products whose technological level is on a par with or exceeds the best domestic models. As for the use of ICT, 80% of the firms have a website, 28% take part in e-commerce via the internet, while only 16% use CRM systems. A total of 49% of Russian SMEs are involved in strategic partnerships and 40% have access to external funding sources. Russian SMEs mainly sell on domestic markets, regional (79%), and national (64%) ones. A relatively small number of SMEs operate on foreign markets, including the CIS (20%) and worldwide (6%). For most variables, differences in the perception of competitive pressure from domestic and foreign manufacturers was discovered, so these groups were considered separately. A negligible proportion of companies in the sample reported they had no competition from either domestic (0.5%) or foreign (1.7%) manufacturers. The coefficient values presented in Table 7 indicate that both models are reliable and suitable for further analysis.

The presented results allow one to identify two groups of SMEs based on the factors affecting managers' perception of competition from domestic producers. The respondents who do have strategic partners and access to external funding, and also operate on regional markets are highly likely to describe competitive pressure from compatriots as tangible. On the contrary, competition is considered low if the company sells products of a high

Table 4. **Operationalization of Variables**

Variables' codes	Description and values of variables
	Dependent variables
B7_SME	Impact of competition from domestic manufacturers on enterprises' activities (0 = low; 1 = high)
B89_SME	Impact of competition from foreign manufacturers (producing in Russia, and/or exporting their products) on enterprises' activities (0 = low; 1 = high)
	Independent variables
B54_SME	Enterprises' assessment of their main product's technological level (0 = does not match best domestic, average foreign, and best foreign models, 1 = does match)
B13_SME_23	Company has a website (0 = no, 1 = yes)
B13_SME_4	Company participates in e-commerce (sells/buys via the internet) (0 = no, 1 = yes)
B13_SME_5	Company uses a customer relationship management system (CRM) (0 = no, 1 = yes)
B36_SME	Company has strategic partners in Russia and abroad (0 = no, 1 = yes)
B89_SME	Company had access to external funding sources in 2011-2013 (i.e. all sources other than own funds) (0 = no, 1 = yes)
B6_SME_1	Company sells products on the regional market (0 = no, 1 = yes)
B6_SME_2	Company sells products on the Russian national market (0 = no, 1 = yes)
B6_SME_3	Company sells products on the CIS markets (0 = no, 1 = yes)
B6_SME_4	Company sells products on the global market (0 = no, 1 = yes)
	Control variables
F14_SME_1	Company has 10-19 employees (0 = no, 1 = yes)
F14_SME_2	Company has 20-49 employees (0 = no, 1 = yes)
F14_SME_3	Company has 50-100 employees (0 = no, 1 = yes)
F14_SME_4	Company has 101-249 employees (0 = no, 1 = yes)
F14_SME_5	Company has 250-499 employees (0 = no, 1 = yes)
B1_SME	Logarithm of the year company was established
S1_SME_1	Company operates in a "scale-efficient" industry (0 = no, 1 = yes)
S1_SME_2	Company operates in a conventional industry (0 = no, 1 = yes)
S1_SME_3	Company operates in a specialized industry (0 = no, 1 = yes)
S1_SME_4	Company operates in a high-technology industry (0 = no, 1 = yes)

Source: compiled by the authors.

technological level, uses a CRM system, and sells products on the global market.

As to competition from foreign players, if Russian SMEs offer products of a high technological level, use CRM systems, sell on regional and national markets, are involved in strategic partnerships, and have a medium size, the respondents tend to assess such competitive pressure as high. The exception is "scale-efficient" industries where it is perceived as low.

Discussion of Results

The empirical analysis confirmed some of the hypotheses fully and others partially. Hypothesis H1 turned out to be valid only for Model 1. Managers of enterprises which offer products of a high technological level assess the competitive pressure from domestic manufacturers as low and pressure from foreign ones as high. Thus, being able to manufacture high-tech products makes only the SMEs that compete mainly with compatriots competitive, but not with foreign players. This is probably due to the fact that most of Russian manufacturing companies lag behind foreign competitors in terms of technological development [HSE, 2014].

Hypothesis H2 turned out to be valid only for the "CRM system" variable in Model 1. Companies which used such a system assessed competitive pressure from Russian manufacturers as low, and that from foreign ones as high. In other words, owning a CRM system allows a firm to maintain a position only on the domestic market and then only in the absence of pressure from foreign players. This is consistent with certain studies' findings about a positive correlation between SMEs' export activities and the application of digital technologies [*Kuzyk et al.*, 2020].

The hypothesis testing the strategic partnership factor (H3) was not confirmed in both models. Managers of companies involved in strategic partnerships reported high competitive pressure from both domestic and foreign manufacturers. Despite the various advantages cooperation in the innovation sphere provides [*Gurkov*, 2013; *Rebiazina et al.*, 2013], our results indicate it does not affect Russian SMEs' competitiveness, regardless of the type of competition they encounter.

Table 5. **Correlation Matrix**

No.	Variables	1	2	3	4	5	6	7	8	9	10
1	B54_SME	1									
2	B13_SME_23	0.056*	1								
3	B13_SME_4	0.075**	0.009	1							
4	B13_SME_5	0.111**	0.069**	0.269**	1						
5	B36_SME	0.137**	0.123**	0.078**	0.108**	1					
6	B89_SME	0.072**	0.062*	0.034	0.072**	0.094**	1				
7	B6_SME_1	-0.061*	-0.011	-0.022	0.023	-0.020	0.051*	1			
8	B6_SME_2	0.197**	0.139**	0.093**	0.060*	0.160**	0.068**	-0.299**	1		
9	B6_SME_3	0.196**	0.129**	0.105**	0.155**	0.130**	0.036	-0.094**	0.316**	1	
10	B6_SME_4	0.119**	0.067**	0.095**	0.098**	0.117**	0.014	-0.059*	0.110**	0.342**	1
11	F14_SME_1	-0.090**	-0.052*	-0.087**	-0.129**	-0.136**	-0.052*	0.097**	-0.135**	-0.140**	-0.083**
12	F14_SME_2	-0.047	-0.071**	-0.017	-0.077**	-0.066**	-0.068**	0.030	-0.053*	-0.085**	-0.072**
13	F14_SME_3	0.012	-0.034	0.028	-0.009	-0.016	-0.036	-0.028	0.008	-0.055*	-0.009
14	F14_SME_4	0.089**	0.122**	0.043	0.138**	0.129**	0.118**	-0.106**	0.117**	0.182**	0.081**
15	F14_SME_5	0.057*	0.063**	0.049*	0.121**	0.137**	0.066**	0.000	0.097**	0.150**	0.127**
16	B1_SME	-0.029	0.125**	0.011	0.016	0.101**	0.035	-0.025	0.069**	0.123**	0.101**
17	S1_SME_1	-0.044	-0.008	0.007	0.020	0.020	0.030	0.069**	-0.122**	-0.047	-0.013
18	S1_SME_2	-0.064**	-0.062*	-0.042	-0.071**	-0.123**	-0.031	-0.002	0.017	-0.095**	-0.040
19	S1_SME_3	0.083**	0.032	0.044	0.044	0.064**	0.001	-0.062*	0.070**	0.072**	0.024
20	S1_SME_4	0.066**	0.065**	-0.007	0.012	0.063**	-0.008	-0.038	0.100**	0.131**	0.051*

No.	Variables	11	12	13	14	15	16	17	18	19	20
11	F14_SME_1	1									
12	F14_SME_2	-0.333**	1								
13	F14_SME_3	-0.253**	-0.326**	1							
14	F14_SME_4	-0.249**	-0.321**	-0.245**	1						
15	F14_SME_5	-0.171**	-0.221**	-0.168**	-0.165**	1					
16	B1_SME	-0.176**	-0.133**	-0.022	0.140**	0.283**	1				
17	S1_SME_1	-0.057*	-0.027	-0.001	0.036	0.072**	0.015	1			
18	S1_SME_2	0.066**	0.071**	0.019	-0.118**	-0.066**	-0.057*	-0.568**	1		
19	S1_SME_3	-0.021	-0.028	0.026	0.050*	-0.030	0.044	-0.466**	-0.238**	1	
20	S1_SME_4	0.030	-0.021	-0.061*	0.046	0.012	0.000	-0.322**	-0.164**	-0.135**	1

Note: **p<0.05, *p<0.1
Source: compiled by the authors.

The study did not confirm the H4 hypothesis either. It was established that even with access to external funding, managers considered competition from compatriots as tangible, while regarding competition with foreign players this factor did not play a role. Foreign investments are traditionally seen as an essential condition for SMEs' success (see, e.g., [*Golikova, Kuznetsov*, 2017]). Our results show, however, that their effect is actually limited: other factors are important for successfully competing with compatriots, and in the case of foreigners, this aspect alone is not sufficient.

Hypothesis H5 was partially confirmed. Managers of enterprises operating on regional markets only assess competitive pressure from domestic manufacturers as high and from foreign ones as low. These results do not support the thesis that Russian firms face low competition from compatriots on local or regional markets [HSE, 2008, 2014]. However, upon entering the Russian national market the perception changes: competitive pressure from foreign manufacturers is assessed as high. In addition, companies which operate on the global market describe competition from Russian firms as low. This confirms the well-known fact about the low representation of Russian manufacturers in international marketplaces.

Finally, SME managers perceive competitive pressure from foreign players as high if their enterprises are medium in size (employ between 101-249 people). Apparently, the larger the company, the less often it competes with small, local actors and the more often with large and international ones.

The second significant control variable shows that SME managers in "scale-efficient" industries face low competitive pressure from foreign manufac-

Table 6. **Descriptive Statistics**

Variable	Source of competitive pressure					
	Russian manufacturers			Foreign manufacturers		
	Low	High	Total	Low	High	Total
Technological level of products (%)	62.7	55.3	58.0	54.5	64.8	58.3
Website (%)	79.0	81.0	80.2	79.0	83.1	80.5
e-Commerce (%)	29.0	27.5	28.0	28.5	28.1	28.3
CRM systems (%)	17.1	14.8	15.6	14.1	18.7	15.8
Strategic partners (%)	44.2	52.4	49.4	45.3	56.6	49.5
External funding (%)	34.3	43.1	39.9	38.2	42.8	39.9
Product markets (regional) (%)	75.9	81.8	79.6	79.4	80.1	79.7
Product markets (national) (%)	66.4	62.4	63.9	59.0	72.1	63.9
Product markets (CIS) (%)	19.1	19.9	19.6	16.9	24.5	19.7
Product markets (global) (%)	7.3	4.4	5.5	4.8	6.7	5.5
Number of employees 10-19 (%)	19.4	21.1	20.5	21.5	18.6	20.4
Number of employees 20-49 (%)	31.7	29.1	30.0	31.1	28.4	30.1
Number of employees 50-100 (%)	22.4	18.4	19.8	20.7	18.6	19.9
Number of employees 101-249 (%)	17.5	20.7	19.5	16.7	23.8	19.4
Number of employees 250-499 (%)	9.1	10.8	10.2	10.0	10.7	10.3
Company age	21.1(26.0)	19.5(21.5)	19.6(21.9)	20.1(21.8)	19.3(20.5)	19.6(21.7)
"Scale-efficient" industry (%)	51.5	53.3	52.6	56.7	46.2	52.8
Conventional industry (%)	24.6	21.3	22.5	21.9	23.6	22.6
Specialized industry (%)	15.1	17.1	16.4	14.5	18.8	16.1
High-tech industry (%)	8.9	8.3	8.5	6.9	11.4	8.5
Number of observations	**613**	**1056**	**1669**	**1040**	**609**	**1649**

Note: standard error in brackets.

Source: compiled by the authors.

turers. These are mostly companies which make durable goods: machines, metallurgical and metal products, vehicles, and electronic and optical equipment (see Table 3). In these sectors (which are largely oriented towards public orders), there are high barriers in place, limiting the competition from more competitive foreign manufacturers.

Conclusions and Recommendations

This study makes a contribution to the existing literature [HSE, 2008, 2014; *Alimova*, 2017]. The perception of competition by manufacturing SME managers was analyzed taking into account a number of factors: technological level of products, the use of ICT, strategic partnerships, access to external funding, and product markets. It was found that a high technological level, the application of CRM systems, and external investments alone are not enough for Russian manufacturing SMEs to maintain sustainable positions on the global market. Apart from improving technologies and implementing innovations, additional support is required to succeed on international markets in particular enhancing Russian SMEs' competencies in such areas as branding, customization, international product certification, and so on. Companies' strategies and prospects can be improved by public policies, including the provision of expert services to promising SMEs by specialized business promotion agencies. The state should ensure the appropriate quality of such services [OECD, 2015]. Examples include assisting in export and exhibition activities, covering some of the costs of obtaining international product and technology quality certificates, and other mechanisms described in detail in international literature [*Lu, Beamish*, 2001; *Julien, Ramangalahy*, 2003]. In the case of Russian SMEs, which mainly compete with their compatriots, neither technological level, availability of CRM systems, nor external funding sources have an impact upon their success rate. Other aspects and factors work here (possibly interpersonal ones, etc.). This means that the naturally prevailing level of competition from domestic producers does not provide a strong incentive for Russian SMEs to step up product and process innovation. A vicious circle has emerged, the breaking of which will help expand the range of opportunities for third-party players to enter the market.

The importance of providing public organizational support to manufacturing SMEs to help them build partnerships and integrate into technological chains (a set of measures collectively referred to as

Table 7. **Logistic Regression Models for Analyzing SMEs' Competitiveness Factors and Competitive Pressure from Manufacturers**

Variable	**Dependent variable:** competitive pressure on SMEs from manufacturers	
	Domestic manufacturers (Model 1)	Foreign manufacturers (Model 2)
Constant	0.444 (0.401)	-1.391*** (0.406)
Technological level of products	-0.323*** (0.117)	0.274** (0.118)
Website	0.196 (0.141)	0.087 (0.149)
e-Commerce	0.010 (0.126)	-0.173 (0.127)
CRM systems	-0.280* (0.157)	0.301* (0.157)
Strategic partners	0.305*** (0.115)	0.294** (0.115)
External funding	0.344*** (0.114)	0.074 (0.114)
Product markets (regional)	0.326** (0.142)	0.272* (0.145)
Product markets (national)	-0.124 (0.130)	0.464*** (0.132)
Product markets (CIS)	0.160 (0.161)	0.114 (0.157)
Product markets (global)	-0.646** (0.251)	0.115 (0.253)
Control variables		
Company size (10-19 employees)	-0.146 (0.237)	0.170 (0.236)
Company size (20-49 employees)	-0.276 (0.219)	0.114 (0.218)
Company size (50-100 employees)	-0.331 (0.225)	0.016 (0.226)
Company size (101-249 employees)	0.066 (0.222)	0.403* (0.216)
Company age	-0.049 (0.066)	0.032 (0.066)
"Scale-efficient" industry	-0.003 (0.202)	-0.532*** (0.198)
Conventional industry	-0.004 (0.221)	-0.145 (0.217)
Specialized industry	0.223 (0.231)	-0.162 (0.224)
Model coefficients		
Log likelihood	1929.753	1896.051
Likelihood ratio test χ^2 (p-value)	54.434 (0.000)	81.188 (0.000)
Pseudo R^2	0.048	0.072
Number of observations	1514	1497

Note: standard error in brackets; ***p<0.01,**p<0.05, *p<0.1

Source: authors.

"bridging") [*Amezcua et al.*, 2013] has been noted in international literature. Enterprises can achieve a sustainable competitive advantage in the industry if the state actively promotes their integration into global value chains [*Lazzarini*, 2015]. Having strategic partners does not lead to Russian SME managers' perceiving the competition they face as low, regardless of whether they compete with Russian or foreign manufacturers. Therefore, stepping up industrial contracting and establishing strategic collaborations with larger partners alone will not increase manufacturing SMEs' sustainability.

Different "weight classes" have emerged among Russian small and medium-sized companies. The ones that operate only on local markets are not as susceptible to competition from large foreign companies and consider other Russian companies to be their main rivals. However, those that entered the Russian national market do feel high competitive pressure from foreigners. Stepping up their operations and entering the all-Russian market takes SMEs outside their "comfort zone", prompting them to adopt more advanced production, management, and logistics technologies. The data on medium-sized companies is noteworthy in this respect, which are interregional players by definition. By eliminating the barriers hindering business scaling (many of which are well-described in the literature) [*Simachev et al.*, 2016; *Simachev, Kuzyk*, 2017], the state could help strengthen the competitiveness and sustainability of Russian manufacturing SMEs. Finally, a very small group of players operating on the global market stands out, who do not feel any pressure from compatriots at all. Promoting exports of their products and services fully relies on participating in relevant alliances and business associations, with public support.

This study has certain limitations. First of all, the data available for analysis did not allow for reliably identifying leaders and outsiders among the surveyed SMEs in terms of objective financial and economic performance indicators (turnover growth, revenues, etc.). This would help one find out exactly how specific internal factors affect small and medium companies at different levels of development [*Kuzyk et al.,* 2020]. The paper examined SMEs' competitiveness factors which determine high and low competitive pressure from domestic and foreign players. It should be noted that a different approach is possible: to examine how competitive pressure promotes or hinders companies' activities, since the impact of potential competitive factors on competitive pressure is bilateral [*Wu, Pangarkar,* 2010]. Therefore, other factors affecting competitive pressure from manufacturers can also be studied. Plus, only Russian small and medium-sized manufacturing enterprises were analyzed, which suggests the possibility of checking and comparing the results by examining other sectors of the Russian economy. Finally, for research purposes, competitive pressure can be also seen as a mediator, that is, when studying, for example, the impact of the institutional environment upon various kinds of investments made to obtain a competitive advantage in export activities, in situations of different pressures from domestic and foreign manufacturers [*Ngo, Janssen,* 2016].

References

Abel-Koch J., Gerstenberger J. (2014) *KfW Competitiveness Indicator 2014*, Frankfurt am Main: KfW. Available at: https://www.kfw.de/PDF/Download-Center/Konzernthemen/Research/PDF-Dokumente-Wettbewerbsindikator/Wettbewerbsinsikator-2014_EN.pdf, accessed 19.05.2020.

Agostini L., Nosella A. (2019) Inter-organizational relationships involving SMEs: A bibliographic investigation into the state of the art. *Long Range Planning*, vol. 52, pp. 1–31.

Aidis R., Estrin S., Mickiewicz T. (2008) Institutions and entrepreneurship development in Russia: A comparative perspective. *Journal of Business Venturing*, vol. 23, no 6, pp. 656–672.

Alimova T. (2017) The Impact of Competition on the Economic Behavior and Performance of Manufacturing SMEs in Russia. *Entrepreneurship in Transition Economies: Diversity, Trends, and Perspectives* (eds. A. Sauka, A. Chepurenko), Heidelberg; New York; Dordrecht; London: Springer, pp. 367–380.

Amezcua A.S., Grimes M.G., Bradley S.W., Wiklund J. (2013) Organizational sponsorship and founding environments: A contingency view on the survival of business-incubated firms, 1994–2007. *Academy of Management Journal*, vol. 56, no 6, pp. 1628–1654.

Barnett W.P. (1997) The dynamics of competitive intensity. *Administrative Science Quarterly*, vol. 42, no 1, pp. 128–160.

Barney J. (1991) Firm Resources and Sustained Competitive Advantage. *Journal of Management*, vol. 17, no 1, pp. 99–120.

Bocconcelli R., Cioppi M., Fortezza F., Francioni B., Pagano A., Savelli E., Splendiani S. (2018) SMEs and marketing: A systematic literature review. *International Journal of Management Reviews*, vol. 20, no 2, pp. 227–254.

Caloghirou Y., Protogerou A., Spanos Y., Papagiannakis L. (2004) Industry- versus Firm specific effects on performance: Contrasting SMEs and Large-sized firms. *European Management Journal*, vol. 22, no 2, pp. 231–243.

Camisón C., Villar-López A. (2010) Effect of SMEs` international experience on foreign intensity and economic performance: The mediating role of internationally exploitable assets and competitive strategy. *Journal of Small Business Management*, vol. 48, no 2, pp. 116–151.

Cattani G., Porac J.F., Thomas H. (2017) Categories and competition. *Strategic Management Journal*, vol. 38, no 1, pp. 64–92.

Chadee D., Roxas B. (2013) Institutional environment, innovation capacity and firm performance in Russia. *Critical Perspectives on International Business*, vol. 9, no 1/2, pp. 19–39.

Chen M-J. (1996) Competitor analysis and interfirm rivalry: Toward a theoretical integration. *The Academy of Management Review*, vol. 21, no 1, pp. 100–134.

Díaz-Chao Á., Sainz-González J., Torrent-Sellens J. (2016) The competitiveness of small network firm: A practical tool. *Journal of Business Research*, vol. 69, no 5, pp. 1769–1774.

Fedyunina A., Averyanova Yu. (2018) Empiricheskij analiz faktorov konkurentosposobnosti rossijskikh eksporterov v obrabatyvayushchikh otraslyakh [Empirical Analysis of Competitiveness Factors of Russian Exporters in Manufacturing Industries]. *Ekonomicheskaya politika* [Economic Policy], vol. 13, no 6, pp. 102–121 (in Russian).

Furrer O., Thomas H., Goussevskaia A. (2008) The structure and evolution of the strategic management field: a content analysis of 26 years of strategic management research. *International Journal of Management Reviews*, vol. 10, no 1, pp. 1–23.

Garcia-Cabrera A.M., Garcia-Soto M.G., Olivares-Mesa A. (2019) Entrepreneurs` resources, technology strategy, and new technology-based firms` performance. *Journal of Small Business Management*, vol. 57, no 4, pp. 1506–1530.

Golikova V., Kuznetsov B. (2017) Suboptimal Size: Factors Preventing the Growth of Russian Small and Medium-Sized Enterprises. *Foresight and STI Governance*, vol. 11, no 3, pp. 83–93.

Gonchar K. (2009) Innovatsionnoe povedenie promyshlennosti: razrabatyvat' nel'zya zaimstvovat' [Industry Innovations: Development versus Adaptation]. *Voprosy Ekonomiki*, no 12, pp.1–17 (in Russian).

Gulati R., Nohria N., Zaheer A. (2000) Strategic networks. *Strategic Management Journal*, vol. 21, no 3, pp. 203–215.

Gurkov I. (2013) Why some Russian industrial companies innovate regularly: Determinants of firms` decisions to innovate and associated routines. *Journal for East European Management Studies*, vol. 18, no 1, pp. 66–96.

Gurkov I., Avraamova E., Tubalov V. (2005) Konkurentosposobnost' i innovatsionnost' rossiiskikh promyshlennykh predpriyatii (po rezul'tatam massovogo oprosa ikh rukovoditelei) [Competitiveness and Innovativeness of Russian Industrial Enterprises (on the Results of a Large-scale Survey of Enterprises)]. *Voprosy Ekonomiki*, no 2, pp. 75–90.

Hair J.F., Black W.C., Babin B.J., Anderson R.E. (2014) *Multivariate Data Analysis* (7th ed.). Harlow (UK): Pearson Education Limited.

Hambrick D.C., Mason P.A. (1984) Upper Echelons: The Organization as a Reflection of Its Top Managers. *Academy of Management Review*, vol. 9, no 2, pp. 193–206.

Harrigan P., Ramsey E., Ibbotson P. (2011) Critical factors underpinning the e-CRM activities of SMEs. *Journal of Marketing Management*, vol. 27, no 5–6, pp. 503–529.

Hernandez-Carrion C., Camarero-Izquierdo C., Gutierrez-Cillian J. (2017) Entrepreneurs` social capital and the economic performance of small businesses: The moderating role of competitive intensity and entrepreneurs` experience. *Strategic Entrepreneurship Journal*, vol. 11, no 1, pp. 61–89.

Hitt M.A., Ahlstrom D., Dacin M.T., Levitas E., Svobodina L. (2004) The institutional effects on strategic alliance partner selection in transition economies: China vs. Russia. *Organization Science*, vol. 15, no 2, pp. 173–185.

Hitt M.A., Ireland R.D., Hoskisson R.E. (2016) *Strategic Management, Competitiveness and Globalization: Concepts and Cases* (12th ed.), Boston, MA: Cengage Learning.

Hoskisson R.E., Hitt M.A., Wan W.P., Yiu D. (1999) Theory and research in strategic management: Swings of a pendulum. *Journal of Management*, vol. 25, no 3, pp. 417–456.

HSE (2008) *Rossiiskaya promyshlennost' na etape rosta: faktory konkurentosposobnosti firm* [Russian industry at the stage of growth: Factors of firms' competitiveness] (eds. K. Gonchar, B. Kuznetsov), Moscow: Vershina (in Russian).

HSE (2014) *Ocherki modernizatsii rossijskoj promyshlennosti: povedenie firm* [Essays on the Modernization of Russian Industry: Behavior of Firms] (ed. B. Kuznetsov), Moscow: HSE (in Russian).

Hurley C.O. (2018) MSME competitiveness in small island economies: A comparative systematic review of the literature from the past 24 years. *Entrepreneurship and Regional Development*, vol. 30, no 9–10, pp. 1027–1068.

Jarillo J.C. (1988) On strategic networks. *Strategic Management Journal*, vol. 9, no 1, pp. 31–41.

Julien P.A., Ramangalahy C. (2003) Competitive strategy and performance of exporting SMEs: An empirical investigation of the impact of their export information search and competencies. *Entrepreneurship Theory and Practice*, vol. 27, no 3, pp. 227–245.

Kapasuwan S., Rose J., Tseng C-H. (2007) The synergistic effects of strategic flexibility and technological resources on performance of SMEs. *Journal of Small Business and Entrepreneurship*, vol. 20, no 3, pp. 257–272.

Kingsley G., Malecki E.J. (2004) Networking for Competitiveness. *Small Business Economics*, vol. 23, no 1, pp. 71–84.

Knight G. (2000) Entrepreneurship and marketing strategy: The SME under globalization. *Journal of International Marketing*, vol. 8, no 2, pp. 12–32.

Kuznetsov B., Dolgopyatova T., Gimpelson V., Golikova V., Gonchar K., Yakovlev A., Yasin Y. (2011) Russian manufacturing revisited: Industrial enterprises at the start of the crisis. *Post-Soviet Affairs*, vol. 27, no 4, pp. 366–386.

Kuzyk M.G., Simachev Yu.V., Fedyunina A.A. (2020) Spetsifika uchastiya v mezhdunarodnoi torgovle malykh i srednikh bystrorastushchikh firm, vozmozhnye sledstviya dlya gosudarstvennoi politiki [Participation of fast-growing SMEs in international trade and implications for public policy]. *Zhurnal Novoj ekonomicheskoj assotsiatsii* [Journal of the New Economic Association], no 1, pp. 208–218 (in Russian).

Lafuente E., Leiva J.C., Moreno-Gómez J., Szerb L. (2019) A non-parametric analysis of competitiveness efficiency: The relevance of firm size and the configuration of competitive pillars. *Business Research Quarterly* (in press). First published online 07.02.2019. Available at: https://doi.org/10.1016/j.brq.2019.02.002, accessed 19.05.2020.

Lagutaeva D., Tretyak O., Grigoriev A. (2016) Vliyanie marketingovykh praktik na pribyl'nost' kompanii: issledovanie metodom mashinnogo obucheniya [Marketing Practices and Profitability of a Company: A Study by Machine Learning Method]. *Rossiiskii zhurnal menedzhmenta* [Russian Management Journal], vol. 14, no 4, pp. 3–20 (in Russian).

Lazzarini S.G. (2015) Strategizing by the government: Can industrial policy create firm-level competitive advantage? *Strategic Management Journal*, vol. 36, no 1, pp. 97–112.

Lu J.W., Beamish P.W. (2001) The internationalization and performance of SMEs. *Strategic Management Journal*, vol. 22, no 6–7, pp. 565–586.

Man T.W.Y, Lau T., Snape E. (2008) Entrepreneurial competencies and the performance of small and medium enterprises: An investigation through a framework of competitiveness. *Journal of Small Business and Entrepreneurship*, vol. 21, no 3, pp. 257–276.

Man T.W.Y., Lau T., Chan K.F. (2002) The competitiveness of small and medium enterprises: A conceptualization with focus on entrepreneurial competencies. *Journal of Business Venturing*, vol. 17, no 2, pp. 123–142.

Martin D., Romero I., Wegner D. (2019) Individual, Organizational, and Institutional Determinants of Formal and Informal Inter-firm Cooperation in SMEs. *Journal of Small Business Management*, vol. 57, no 4, pp. 1698–1711.

May R.C., Stewart W.H. (Jr.), Sweo R. (2000) Environmental scanning behavior in a transitional economy: Evidence from Russia. *Academy of Management Journal*, vol. 43, no 3, pp. 403–427.

McMahon R.G.P. (2001) Business growth and performance and the financial reporting practices of Australian Manufacturing SMEs. *Journal of Small Business Management*, vol. 39, no 2, pp. 152–164.

Mesquita L.F., Lazzarini S.G. (2008) Horizontal and vertical relationships in developing economies: Implications for SMEs` access to global markets. *Academy of Management Journal*, vol. 51, no 2, pp. 359–380.

Meyer K.E., Peng M.W. (2016) Probing theoretically into Central and Eastern Europe: Transactions, resources, and institutions. *Journal of International Business Studies*, vol. 36, no 6, pp. 600–621.

Ngo V.D., Janssen F. (2016) Resources investment and export competitive advantage of firms in a transition economy: the moderating role of domestic institutional environment and competitive pressures. *International Journal of Export Marketing*, vol. 1, no 2, pp. 166–192.

Nguyen T.H., Newby M., Macaulay M.J. (2015) Information technology adoption in small business: Confirmation of a proposed framework. *Journal of Small Business Management*, vol. 53, no 1, pp. 207–227.

O'Cass A., Weerawardena J. (2010) The effects of perceived industry competitive intensity and marketing-related capabilities: Drivers of superior brand performance. *Industrial Marketing Management*, vol. 39, no 4, pp. 571–581.

OECD (2015) *Russian Federation: Key Issues and Policies* (Series: OECD Studies on SMEs and Entrepreneurship), Paris: OECD.

OECD (2017) *Small, Medium, Strong. Trends in SME Performance and Business Conditions*, Paris: OECD.

Partanen J., Kauppila O.-P., Sepulveda F., Gabrielsson M. (2018) Turning strategic network resources into performance: The mediating role of network identity of small- and medium-sized enterprises. *Strategic Entrepreneurship Journal* (in press). First published online 04.06.2018. Available at: https://doi.org/10.1002/sej.1296, accessed 19.05.2020.

Pavitt K. (1984) Sectoral patterns of technical change: Towards a taxonomy and a theory. *Research Policy*, vol. 13, no 6, pp. 343–373.

Pergelova A., Manolova T., Simeonova-Ganeva R., Yordanova D. (2019). Democratizing Entrepreneurship? Digital technologies and the internationalization of female-led SMEs. *Journal of Small Business Management*, vol. 57, no 1, pp. 14–39.

Peteraf M.A., Bergen M.E. (2003) Scanning dynamic competitive landscapes: A market-based and resource-based framework. *Strategic Management Journal*, vol. 24, no 10, pp. 1027–1041.

Porac J.F., Thomas H. (1990) Taxonomic mental models in competitor definition. *Academy of Management Review*, vol. 15, no 2, pp. 224–240.

Porac J.F., Thomas H., Baden-Fuller C. (1989) Competitive groups as cognitive communities: The case of Scottish knitwear manufacturers. *Journal of Management Studies*, vol. 26, no 4, pp. 397–416.

Porter M. (1980) *Competitive strategy: Techniques for analyzing industries and competitors*, New York: Free Press.

Porter M., Millar V. (1985) How information gives you competitive advantage. *Harvard Business Review*, vol. 63, no 4, pp. 149–160.

Porter M.E. (1985) *Competitive Advantage: Creating and Sustaining Superior Performance*, New York: Free Press.

Prahalad C.K., Hamel G. (1990) The core competence of the corporation. *Harvard Business Review*, vol. 68, no 3, pp. 79–91.

Puffer S.M., McCarthy D.J. (2011) Two decades of Russian business and management research: An institutional theory perspective. *Academy of Management Perspectives*, vol. 25, no 2, pp. 21–36.

Puffer S.M., McCarthy D.J., May R.C., Shirokova G.V., Panibratov A. (2018) Managing Emerging Markets in Russia. *The Oxford Handbook of Management in Emerging Markets* (eds. R. Grosse, K.E. Meyer), New York: Oxford University Press, pp. 703–725.

Radas S., Božić L. (2009) The antecedents of SME innovativeness in an emerging transition economy. *Technovation*, vol. 29, no 6–7, pp. 438–450.

Raymond L., Bergeron F., Croteau A.-M., St-Pierre J. (2015) Developing absorptive capacity through e-business: The case of international SMEs. *Journal of Small Business Management*, vol. 53, no S1, pp. 75–94.

Raymond L., Bergeron F., Croteau A.-M., St-Pierre J. (2016) IT-enabled Knowledge Management for the Competitive Performance of Manufacturing SMEs: An Absorptive Capacity-based View. *Knowledge and Process Management*, vol. 23, no 2, pp. 110–123.

Rebiazina V., Smirnova M., Kouchtch S. (2013) Portfel'nyi i evolyutsionnyi podkhody k postroeniyu vzaimootnoshenii rossiiskikh kompanii s partnerami [Portfolio and Evolutionary Approaches to Building Relationships with Partners: The Case of Russian Companies]. *Rossiiskii zhurnal menedzhmenta* [Russian Management Journal], vol. 11, no 3, pp. 31–52 (in Russian).

Rivard S., Raymond L., Verreault D. (2006) Resource-based view and competitive strategy: An integrated model of the contribution of information technology to firm performance. *Journal of Strategic Information Systems*, vol. 15, no 1, pp. 29–50.

Sauka A., Chepurenko A. (2017) *Entrepreneurship in Transition Economies: Diversity, Trends, and Perspectives*, Heidelberg; New York; Dordrecht; London: Springer.

Shakina E., Barajas A., Molodchik M. (2017) Bridging the gap in competitiveness of Russia companies with intangible bricks. *Measuring Business Excellence*, vol. 21, no 1, pp. 86–100.

Shirokova G., Vega G., Sokolova L. (2013) Performance of Russian SMEs: Exploration, exploitation and strategic entrepreneurship. *Critical Perspectives on International Business*, vol. 9, no 1–2, pp. 173–203.

Simachev Y., Kuzyk M. (2017) Vliyanie gosudarstvennykh institutov razvitiya na innovatsionnoe povedenie firm: kachestvennye effekty [The impact of state development institutions on the innovative behavior of firms: qualitative effects]. *Voprosy Ekonomiki,* no 2, pp. 109–135 (in Russian).

Simachev Y., Kuzyk M., Zudin N. (2016) Import Dependence and Its Substitution in the Russian Manufacturing: Business Viewpoint. *Foresight and STI Governance*, vol. 10, no 4, pp. 25–45. DOI: 10.17323/1995-459X.2016.4.25.45.

Sokolov A., Rudnik P. (2014) Innovation in Russian SMEs: Growth under Transition. *The Promise of Small and Medium Enterprises* (eds. A. Arroio, M. Scerri), New Delhi: Routledge, pp. 76–118.

Spanos Y.E., Lioukas S. (2001) An examination into the causal logic of rent generation: Contrasting Porter`s competitive strategy framework and the resource-based perspective. *Strategic Management Journal*, vol. 22, no 10, pp. 907–934.

St-Pierre J., Sakka O., Bahri M. (2018) External financing, export intensity and inter-organizational collaborations: Evidence from Canadian SMEs. *Journal of Small Business Management*, vol. 56, no S1, pp. 68–87.

Street C.T., Cameron A-F. (2007) External relationships and the small business: A review of small business alliance and network research. *Journal of Small Business Management*, vol. 45, no 2, pp. 239–266.

Tretyak O., Rebiazina V., Vetrova T. (2015) Sovremennye marketingovye praktiki v Rossii: Rezul'taty empiricheskogo issledovaniya [Contemporary Marketing Practices in Russia: Results of Empirical Study]. *Rossiiskii zhurnal menedzhmenta* [Russian Management Journal], vol. 13, no 1, pp. 3–26 (in Russian).

Volchek D., Jantunen A., Saarenketo S. (2013) The institutional environment for international entrepreneurship in Russia: Reflections on growth decisions and performance in SMEs. *Journal of International Entrepreneurship,* vol. 11, no 4, pp. 320–350.

Welter F. (2011) Contextualizing entrepreneurship — conceptual challenges and ways forward. *Entrepreneurship Theory and Practice*, vol. 35, no 1, pp. 165–184.

Welter F., Smallbone D. (2011) Institutional perspectives on entrepreneurial behavior in challenging environments. *Journal of Small Business Management*, vol. 49, no 1, pp. 107–125.

Wernerfelt B. (1984) A resource-based view of the firm. *Strategic Management Journal*, vol. 5, no 2, pp. 171–180.

Wu J., Pangarkar N. (2010) The bidirectional relationship between competitive intensity and collaboration: Evidence from China. *Asia Pacific Journal of Management*, vol. 27, pp. 503–522.

Zahra S.A. (1996) Technology strategy and financial performance: Examining the moderating role of the firm`s competitive environment. *Journal of Business Venturing*, vol. 11, no 3, pp. 189–219.

Tax Incentives for Supporting Competitiveness of Telecommunication Manufacturers

Irina Dezhina

Head, Science and Technology Development[a]; Professor, Department of Innovation Management[b], i.dezhina@skoltech.ru

Tamam Nafikova

Analyst[a], t.nafikova@skoltech.ru

Timur Gareev

Deputy Head, Department of Science and Technology[a], t.gareev@skoltech.ru

Alexey Ponomarev

Vice-President for industrial development[a]; Professor, Department of Educational Programmes of the Institute for Statistical Studies and Economics of Knowledge (ISSEK)[b], ponomarev@skoltech.ru

[a] Skolkovo Institute of Science and Technology, 30, bld. 1, Bolshoy Bulvar, Innovation Center 'Skolkovo', Moscow 121205, Russian Federation

[b] National Research University Higher School of Economics (NRU HSE), 11 Myasnitskaya St., Moscow 101000, Russian Federation

Abstract

The article is dedicated to the analysis of cost factors, primarily the tax burden, that can explain the observable price differences on the Russian market between domestic telecommunication equipment and imports from China and USA. The relevance of the research is justified by the critical significance of this market for the economic, information, and technological security of the Russian Federation in a changing geopolitical environment. The present methods of tax burden calculation analyzed in this article revealed the sub-industry level measurement is the least studied. Based on data on 42 companies for 2015-2017, the cost structure of the telecommunication equipment manufacturing industry was studied, a model for computing the tax burden rate on domestic enterprises using imported components was built. The model was adjusted for a cross-country comparison to reflect the specifics of countries' tax systems. The calculations were based on the assumption of equal production costs in the three countries under examination. A comparative analysis showed that the tax burden in Russia is on average higher than in USA (almost 3 percentage points) and in China for enterprises operating in preferential economic zones (about 2 percentage points). However, this difference in tax burden rate does not explain the observed price discrepancy on the domestic market (up to 21 percent). The cost of components and cost of debt are additionally examined as factors that elucidate the divergence between economic conditions. An approximate assessment of their influence showed that the effect of reducing average costs with an increase in output of components, which is especially characteristic of China, has the largest impact. For American exporters, the tax burden level and high-end offers are the main competitive advantages. A number of tariff regulation measures that allow one to compensate for the price discrepancy on the domestic market are proposed for innovation policy in order to stimulate the technological development of national producers.

Keywords:
tax burden; competitiveness; economic sector; telecommunication equipment; Russia; China; United States; regulation

Citation: Dezhina I., Nafikova T., Gareev T., Ponomarev A. (2020) Tax Incentives for Supporting Competitiveness of Telecommunication Manufacturers. *Foresight and STI Governance*, vol. 14, no 2, pp. 51–62. DOI: 10.17323/2500-2597.2020.2.51.62

The objective of creating a tax regime that would be favorable for companies' operations, strengthen their market competitiveness, and contribute to implementing the state's fiscal policy is relevant for many of the world's economies. A major characteristic of such a regime is the tax burden, usually understood as the combined share of all tax payments in the income of the economic actor under consideration. However, there are many nuances associated with the relevant indicators and methods for their calculation. A wide variety of relevant research areas at the international and national levels are presented in Figure 1.

The tax burden calculation techniques applied by the Organisation for Economic Cooperation and Development (OECD) and the International Monetary Fund (IMF) are believed to be the most highly developed and widely accepted, including those for international comparison purposes [*Hanappi*, 2018; *Modica et al*., 2018; International Monetary Fund, 2014]. In Russia, the tax burden is calculated by the Russian Ministry of Finance [Ministry of Finance, 2016] and the Federal Tax Service (FTS)[1] using different methods. This paper analyzes the impact of the tax burden upon a particular industry segment and upon Russian manufacturers' competitiveness compared with foreign manufacturers or exporters of similar products into Russia. The area under consideration remains insufficiently researched since the bulk of relevant studies are devoted to macroeconomic analysis Further, when it comes to specific industries, comparisons are made only between exporters [*Xu*, 2017].

Our study examines the tax burden in the relatively narrow, but critically important segment of the radio-electronic and electronic industry: the production of telecommunications equipment (TCE). This choice is due to several reasons. Firstly, the promotion of the domestic production of TCE is a national-level priority reflected in, among other initiatives, the measures to promote the application of domestic TCE in the framework of the national project "Digital Economy"[2]. This segment stands out among the related economic activity types even by the level of regulation: the Russian TCE register is approved by the national government[3]. However, despite the various incentives introduced in public procurement,[4] the current development level and structure of the domestic TCE market do not meet strategic goals. In 2017, this market reached 465 billion rubles (less than 5% of global value [RSpectr, 2018]), while according to various estimates, the share of imported equipment in Russia remains between 92% and 95.5% [*Zhukova, Novy*, 2019; RSpectr, 2019; J'son & Partners Consulting, 2018].

The revision of initiatives to support domestic manufacturers in July 2019 resulted in the creation of a unified register of Russian radio-electronic products with increased contract price benefits over foreign public procurement participants' proposals between 15% and 30% for state-owned companies[5]. However, despite being extremely important for promoting the development of the TCE market, this measure still has not solved all of the problems since the companies with public participation make up a smaller share of consumers on this market.

The term "inverted duty structure" used by certain researchers[6] can be applied to describe the situation on the Russian market, with import duties for end-user equipment set at a lower level than those for the components with which this equipment is made (see, e.g., [*Pathania, Bhattacharjea*, 2020]). This policy distorts incentives, encouraging Russian consumers to import ready-made equipment rather than step up their innovative activities. Given the new round of telecommunications development associated with the introduction of 5G networks and the need to ensure the security of data transmission systems, the creation of domestic technological solutions by domestic TCE manufacturers is becoming particularly relevant.

Against the background of protectionist measures being taken to insulate the national TCE markets, especially from Chinese manufacturers, the issue

---

[1] Attachment No. 3 "Tax burden by economic activity type" to the Russian FTS Order of 30.05.2007 N MM-3-06/333@ (as amended on 10.05.2012) "On approving the On-site tax audit planning system concept". Available at: http://www.consultant.ru/document/cons_doc_LAW_55729/22fed7b20490780f0ca2ecae1005c2b8c36e2fbe/, accessed on: 05.03.2019.

[2] RF Government Instruction No. MA-P10-8bpr of 18 December 2018 "On the decisions following the meeting on applying domestic telecommunications equipment to implement the measures specified in the national programme and the national project "Digital Economy". Available at: http://government.ru/orders/selection/401/35355/, accessed on 11.03.2019.

[3] Available at: http://minpromtorg.gov.ru/opendata/?cat_38=15, accessed on 11.03.2019.

[4] RF Government Regulation No. 968 of 26 September 2016 "On restrictions on, and conditions for, allowing the application of certain types of radio-electronic products originating from foreign countries for the purpose of procurement to meet public state and municipal needs". (Available at: http://www.garant.ru/products/ipo/prime/doc/71400660/, accessed on 11.03.2019) and No. 925 of 16 September 2016 "On the priority application of products and services of Russian origin in relation to products originating from a foreign country, and services provided by foreign persons" (available at: https://rg.ru/2016/09/27/tovari-dok.html, accessed on 11.03.2019).

[5] RF Government Regulation No. 878 of 10 July 2019 "On measures to promote the production of radio-electronic products in the Russian Federation when procuring products and services to meet public and municipal needs; on amending the RF Government Regulation No. 925 of 16 September 2016, and invalidating certain RF Government acts" Available at: http://www.consultant.ru/document/cons_doc_LAW_329382/92d969e26a4326c5d02fa79b8f9cf4994ee5633b/, accessed on 20.07.2019.

[6] For the most precise and brief definition of the term, see: https://howtoexportimport.com/Meaning-of-Inverted-duty-structure-9244.aspx, accessed on 24.03.2020.

of the tax burden on this segment has acquired an international aspect. India began to pursue an active policy in this area, increasing import duties for several types of trunk TCE in 2018: up to 20% for optical networks, base stations, MIMO/4G LTE, and from 0% to 10% for printed circuit board electronic modules [FE Online, 2018]. Another example is the actions of the US government, which is preparing grounds to introduce a 25% duty for a number of TCE products to restrict Chinese imports [USTR, 2018].

Thus, a comparative analysis of the tax burden is important to better understand its impact upon the competitiveness of domestic TCE manufacturers.

Existing Approaches to Calculating the Tax Burden

A review of studies devoted to tax burden calculation techniques for various types of comparisons, regardless of the indicator aggregation degree, confirmed the lack of consensus among their authors. In particular, uncertainty remains about issues such as the classification of payments, classifying some of them as tax payments, and the choice of income indicators. For example, the OECD classifies compulsory social insurance contributions as taxes, while the IMF does not [*Gromov, Shatalova*, 2017]. According to the tax quota methodology applied by the IMF and the Russian Ministry of Finance to calculate the tax burden in the national economy, GDP is considered income, which in this context also seems to be debatable. [*Sokolov*, 2018] disputes the relevance of calculating tax revenue in relation to GDP in order to assess the tax burden in Russian economic realities and proposes the calculation of the burden on individuals and legal entities separately.

In a larger-scale industry breakdown, the Russian FTS's experience seems to be useful: it calculates tax burden as the ratio of the amount of paid taxes (reflected in official reports) and the organization's revenue according to the Federal State Statistics Service (Rosstat) data[7]. However, this approach does not allow one to take industry-specific aspects of taxation into account [*Nikolaev*, 2016]: for example, the TCE production segment is not present in the FTS industry classification because it is included in the "production of electrical equipment, computers, electronic and optical products" economic activity with a tax burden of 9.9%. Treating a specific segment as an entire industry seems to be a gross distortion.

When calculating the size of tax payments, the FTS does not take into account the specifics of customs and tariff regulations, plus this calculation, among other things, excludes insurance premiums when calculating personal income tax (PIT). This does not seem to be entirely legitimate since the actual burden of paying this tax is borne by workers, while enterprises, although acting as tax agents, include the amount of PIT they have paid in their production costs (as part of the labor costs). The situation with insurance premiums is the opposite: in this case, the transfers to the state budget is an additional net tax burden upon manufacturers. As a measure of profit, the FTS uses revenue, not value created (i.e., value added minus depreciation) because the Russian Ministry of Economic Development insists upon this approach [*Petlevoy et al.*, 2019]. Meanwhile, PwC correlates the amount of tax payments and social insurance contributions with the pre-tax profit [PwC, World Bank Group, 2018; PwC, 2016]. Obviously, several competing methodologies for calculating the tax burden exist and the advantages of some over others have not been convincingly proven yet.

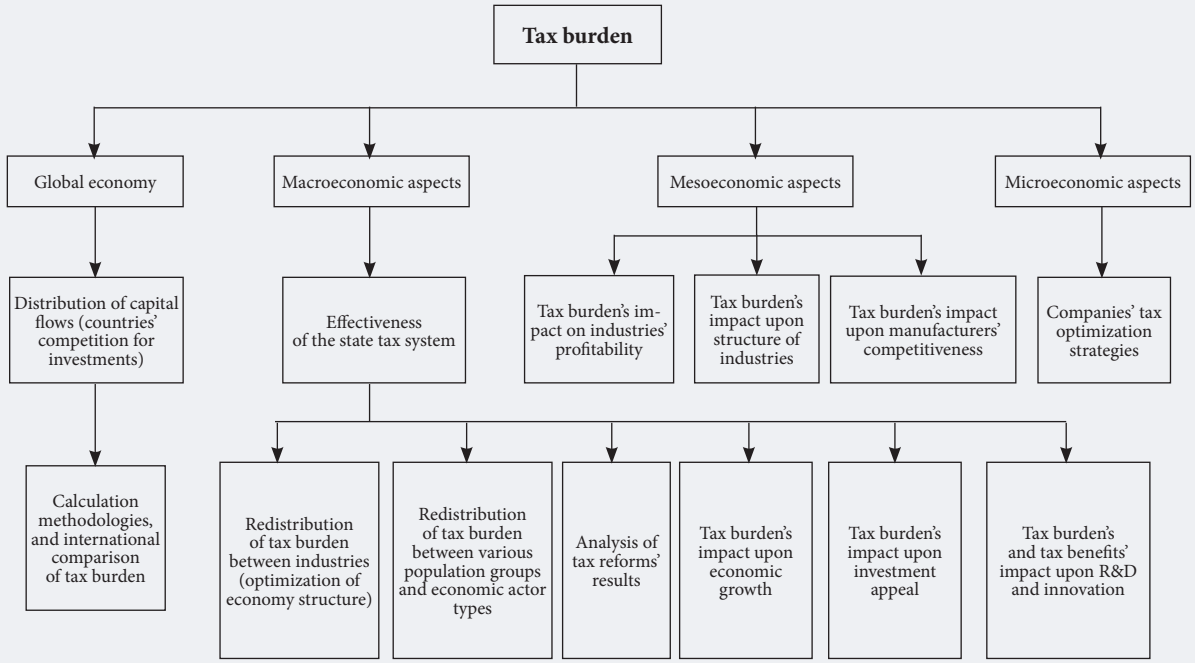
Among the indicators applied to measure tax burden in the context of international comparisons, the effective average and marginal tax rates the OECD uses[8] should be noted [*Sorensen*, 2004]. The effective average tax rate (EATR) is calculated as the ratio of tax payments to the value of the taxpayer's pre-tax surplus; it allows one to analyze the tax burden for various production factors and on specific entities in order to compare various tax jurisdictions or technological products [*Hanappi*, 2018]. The marginal effective tax rate (METR) indicator is the ratio of the difference between the expected return margin before and after tax to the pre-tax margin [*Fullerton*, 1999]. METR is applied to assess investment decisions by analyzing tax incentives' effects on the growth of investments in specific geographical areas. Both these techniques are more suitable either for highly aggregated data or for the evaluation of specific projects.

Another group of studies on approaches to tax burden calculation focus on assessing the consequences of introducing tax benefits, including those for research and innovation activities. These studies are of both qualitative (assessing the relevance of tax benefits and the extent of their application by companies) and quantitative nature, for example, when their authors consider the effect of such benefits upon the effective tax rate [*Bornemann et al.*, 2019; *Evers et al.*, 2015]. In particular, tax incen-

[7] Attachment 2 "Publicly available criteria for self-assessment of risks for taxpayers applied by tax authorities to select taxpayers for on-site tax audits" to the Russian FTS Order of 30.05.2007 N MM-3-06/333@ (as amended on 10.05.2012) "On approving the On-site tax audit planning system concept". Available at: http://www.consultant.ru/document/cons_doc_LAW_55729/f579efc1e846c86acedf1433b3fb8817a96a6916/, accessed on: 05.03.2019.

[8] OECD Statistics. Effective Tax Rates database. Available at: https://stats.oecd.org/Index.aspx?DataSetCode=CTS_ETR, accessed on 13.03.2019.

Figure 1. **Main Areas of Tax Burden-Related Research**



Source: compiled by the authors.

tives include increasing depreciation rate coefficients, the application of similar coefficients to the actual research and development (R&D) expenditures, the exemption of certain priority activities from VAT, and incentives made available in free and special economic zones. Studies based on Russian data indicate that demand for tax benefits is low, including for those related to R&D [*Kitova*, 2015; *Gokhberg et al.*, 2014; *Vlasova et al.*, 2018]. The main reasons include the insufficient transparency of the system, in particular, the significant costs of substantiating one's right to receive benefits, the high risks of disputes with tax authorities, and administrative prosecution. The situation with tax benefits abroad is much more favorable. In particular, in China many TCE manufacturers are located in areas where preferential regimes exist.

The Choice of Countries for Comparison

The countries with which to compare the tax burden were selected by analyzing the structure of TCE imports into Russia using the Federal Customs Service (FCS) database[9]. The geographic structure of imports (Figure 2) indicates that Chinese manufacturers are the main competitors to Russian ones on the domestic market. In its turn the US, despite being a traditional technology leader, lags more than ten times behind China in this segment. These two competing countries became the objects of our comparison.

In China, telecommunications products have been included in special registers since 2006, which allows companies to apply for preferential tax rates, cheap loans from state banks, and subsidies for export credit insurance. In 2009, the Radio Electronics Industry Restructuring and Revitalizing Plan was adopted in the country, which provides for tax incentives to promote export operations [*McCarthy*, 2012]. Meanwhile China remains the biggest TCE supplier in the world: the two leading companies, Huawei and ZTE, in 2018 accounted for 37% of the global market [*Pongratz*, 2019] which has reached $175 billion [*Burkitt-Gray*, 2019)].

On the contrary, the US does not apply any special measures to support domestic TCE manufacturers, so the country's international competitiveness is based upon the general economic conditions for doing business, a high level of technological competencies in the industry, and the historical dominance of the US company Cisco in the corporate segment. Together with

[9] The calculation was conducted using the foreign economic activity commodity nomenclature (FEACN) codes, specifically subheadings 8517 62 000 2, 8517 62 000 3, and 8517 62 000 9.

another American player, Ciena, they control about 13% of the global market[10].

Tax Burden Calculation Model

For international comparisons in the industry, a less sensitive approach to companies' national specifics was chosen, under which the tax burden is calculated as the ratio of tax payments to profit. Taking into account the availability of statistical data, company revenue was chosen as the profit measure.

Indicator types were selected on the basis of the following criteria:

- the number of indicators should not be excessively large or complicate calculations, since the main objective was to compare the tax burden upon manufacturers in different jurisdictions in a minimally reliable way, not to calculate its exact level;
- calculations should be based upon the available statistical data, therefore the initial sample of companies was built using the SPARK database (companies' financial statements section). To calculate the average weighted customs duty rates, the Eurasian Economic Union single customs tariff[11] was used to determine the rates for the selected FEACN codes, and the Russian FCS database was the source of data on imports of products with relevant codes.

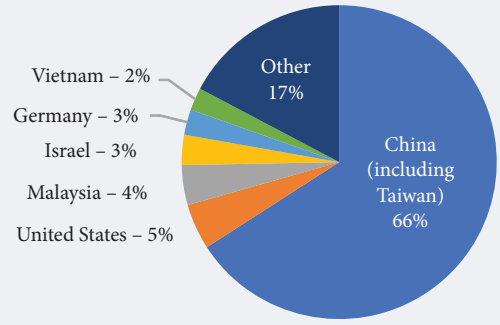
Payments taken into account to calculate the tax burden included profit tax, VAT, and social insurance contributions, but not personal income tax which defines the tax burden on workers rather than manufacturers. Although VAT is passed on to the buyer via the pricing mechanism, it still should be taken into account since prices higher than those of imported products reduce the competitiveness of domestic ones. Finally, the fact of paying customs duties is important for a comparative analysis, so they were also taken into account to calculate the tax burden.

In the absence of ready-made measurements for the TCE production segment (which was revealed by the analysis of tax burden sources), data on manufacturing companies was used. Data from 2015-2017 financial statements of TCE manufacturers engaged in the following OKVED activities was downloaded from the SPARK database:

- production of communication equipment;
- production of communication equipment, radio and television transmitting equipment, television cameras;
- production of radio and television transmitting equipment;
- production of communication equipment with switching systems functionality;
- production of spare parts and components for radio and television transmitting equipment and television cameras;
- production of other telephones, devices, and equipment for transmitting and receiving speech, images, or other data, including communication equipment for wired or wireless communication networks (e.g. local and global networks);
- production of computers and peripheral equipment;
- production of electronic components.

According to long-term observations of relevant industry associations such as the Association of Electronics Developers and Manufacturers (AEDM) and the Information and Advanced Electronics Analytical Centre [ARPE, 2019], there are between 60 and 80 developers and manufacturers of civilian TCE in Russia. In total, data on 62 companies for 2015-2017 was collected. Due to the gaps in the panel data, the final sample com-

Figure 2. **Major TCE Exporters to Russia (FEACN subgroups 8517 62)**



Source: calculated by the authors based on the Russian FCS customs statistics of foreign trade. Available at: http://stat.customs.ru/apex/f?p=201:2:4201345773515950::NO, accessed 08.03.2019.

[10] For more about the TCE market, see relevant industrial reports, e.g. [Market Research Future, 2019].

[11] Attachment to the decision of the Council of the Eurasian Economic Commission of 16.07.2012 No. 54 (as amended on 22.02.2019) "Common Customs Tariff of the Eurasian Economic Union". Available at: http://www.consultant.ru/document/cons_doc_LAW_133133/22ad39bb36d3b8a63d493b0be82dc7170c9f82f6/, accessed on 05.03.2019.

prised 42 companies. A total of 102 observations were analyzed, which ensures the robustness of the results. The presented sample is not only representative but sufficiently complete, since it includes observations on all major players in the highly concentrated Russian TCE production segment (Table 1).

The number of observations varied in terms of revenue, profit, and tax indicators, so to calculate the tax burden on Russian companies, the data was supplemented. Tax burden was defined as the ratio of the total amount of income tax, VAT, social insurance contributions, and customs duties paid to the total revenues.

Subsequent calculations were based on the following assumptions:

- Russian manufacturers import all components while they make modules and end-user equipment at their own facilities; development and marketing are carried out by third-party organizations within the country.
- Manufacturers in Russia and the US pay taxes at standard rates and do not use tax optimization techniques such as moving production to special economic zones or using other tax benefits; Chinese manufacturers can either pay standard taxes or use special preferential rates (both options will be considered).
- All tax systems under consideration are effective: if the tax system provides for VAT refunds for export-import operations, it is assumed that all participants on the relevant markets can freely and fully exercise this right.
- Logistical costs were not taken into account, but the cost of domestic equipment was, compared with the cost of foreign counterparts taking into account customs duties for products imported into Russia.
- Profit rates, components' and services' costs, and labor costs are the same in all countries and correspond to the model parameters for Russia. Each of these indicators is calculated as the ratio of total costs for all observations to total revenue for the entire sample.
- Customs duties were calculated using weighted average rates. For electronic components, they were calculated using the AEDM data on the cost structure of electronics production, compiled on the basis of a study of the Russian market and relevant equipment manufacturers [ARPE, 2017], plus customs statistics on the import of relevant FEACN subheadings[12]. The weighted average rate for imported equipment was calculated using customs statistics only. The weighted average customs duty for components amounted to 2.1%, and for end-user equipment 0%.
- Taking into account the AEDM data and the weighted average customs duty rate, it was assumed that in the structure of payments to suppliers and contractors, components (including customs duties) account for about 2/5 of the total costs, and services received within the country for 3/5.
- To calculate VAT, sales revenues and labor costs (including insurance premiums) were taken as value added (VA).

The above assumptions were necessary because studies such as ours imply specific estimates of random indicators (at the level of their mathematical expectations). In a more general case, we get a set of random value distributions whose ranges are limited by balanced proportions.

Also, the above assumptions balance the short-term random deviations of the applied indicators and the long-term effect of leveling the overall economic conditions the companies operate in. To eliminate the effect of the general taxation regime, the principle "all other conditions being equal" was applied, since otherwise any model would only reflect particular indicator fluctuations (as opposed to the integral effect). In reality, companies' profitability and other cost indicators are sufficiently varied. However, the likely inaccuracies in the assumptions made were not critically important to the results of the study. For example, the logic of economic balances does not allow even significant outliers to upset the balance of the system of indicators in the long term, due to the high competition on the TCE market. If a company buys components at a price much lower than the market average and thus obtains a competitive advantage, this factor will be leveled in the next accounting period. The specifics of the telecommunications market is such that it actively applies the rapid expansion strategy in the hope of receiving long-term payback due to network effects and "lock-in" mechanisms. Such measures include direct dumping, transfer pricing [*Gareyev*, 2008], and soft loans to consumers at the time of generational equipment replacement at customers' facilities. Plus, as was noted, the assumptions we made were of an averaging nature.

[12] The weighted average customs duty is calculated for the AEDM-identified component types (microcircuits, discrete semiconductors, passive elements, electromechanical components). Since each component type corresponded to several FEACN codes, before calculating the total weighted average rate it was necessary to determine it for each specific type. In the framework of each component type, a separate FEACN code was assigned a weight proportional to its share in total imports, in monetary terms. Then each component type was weighted by its share in the cost structure calculated on the basis of AEDM.

Table 1. **Production Concentration Coefficients* by Economic Activity Type in the TCE Production Segment, 2017 (%)**

Types of economic activities	For 25 companies	For 50 companies
Production of communication equipment	91.62	99.87
Production of communication equipment, radio and television transmitting equipment, television cameras	94.75	100
Production of communication equipment with switching systems functionality	100	100
Production of radio and television transmitting equipment	99.92	100

* Share of a certain fixed number of enterprises in the activity type, ranked by size, in descending order.

Source: Unified interdepartmental information and statistical system (UIISS) (2019). Production concentration coefficients by economic activity type since 2017. Available at: https://fedstat.ru/indicator/58999, accessed on 20.07.2019.

Thus, the formula for a simplified calculation of the tax burden on Russian manufacturers who use imported components is as follows:

$$\text{Tax burden}_{\text{nat}} = \frac{[t_\pi \Sigma \pi + t_{vat} \Sigma(\pi + \text{OT}) + \frac{t_S}{1+t_S} \Sigma \text{OT}] + d_\text{K} \Sigma \text{K}}{\Sigma R} \quad (1)$$

where π is sales revenue;

t_π is the profit tax rate;

t_{vat} is the VAT rate;

OT is the labor costs (including social insurance);

t_s is the social insurance premium rate;

is the value of components (without customs duties);

d_K is the weighted average customs duty for components;

R is revenue.

To calculate the tax burden on manufacturers of imported end-user equipment, the formula must be adjusted taking into account two main factors. First, the Chinese and US tax systems have their own specific features: in China, as in most countries of the world, the value of exported goods is cleared of VAT accrued within the country; in the US, not VAT but sales tax is applied to goods and services, but not to exported goods. When equipment from both China and the US is imported into Russia, VAT is charged for the cost of the goods and customs duties at the rate set by Russian law. Secondly, unlike domestic manufacturers for whom the duty is charged for components, for importers of foreign equipment, the calculation formula takes into account the value of equipment.

Accordingly, the formula for calculating the tax burden on manufacturers of imported equipment looks as follows:

$$\text{Tax burden}_{\text{im}} = \frac{\left[t_\pi \Sigma \pi + t_{vat}(1+d_{eq}) \Sigma(\pi + \text{OT}) + \frac{t_S}{1+t_S} \Sigma \text{OT}\right] + d_{eq} \Sigma R}{\Sigma R} \quad (2)$$

where d_{eq} is the weighted average customs duty for imported equipment.

In line with the assumptions made, the following indicator values were obtained, calculated as the ratio of the respective indicators' total values to the total revenue for the entire sample (Table 2).

Table 2. **TCE Manufacturing Industry Ratios**

Indicator	Value (%)
Sales revenues rate (π/R)	9.6
Labor costs rate (OT/R)	27.1
Component costs rate excluding customs duties (K/R)	24.2

Source: compiled by the authors.

By normalizing the revenue figures and using the above industry proportions, we obtain the following formula for calculating the tax burden on Russian TCE manufacturers:

$$\text{Normalized tax burden}_{\text{nat}} = [9.6\, t_\pi + 36.7\, t_{vat} + 27.1 \frac{t_S}{1+t_S}] + 24.2\, d_\text{K} \quad (3)$$

Comparing Tax Burdens

Based on the obtained simplified model, the tax burden was calculated for the Russian (component importers), Chinese, and American (end-user product manufacturers exporting to Russia) TCE segments. The tax rates for 2017 were applied. The profit tax and compulsory social insurance rates in the US and China were taken from the KPMG (audit and consulting company) database[13]. An additional scenario was calculated for China: apply-

[13] Employer social security tax rates (https://home.kpmg/xx/en/home/services/tax/tax-tools-and-resources/tax-rates-online/social-security-employer-tax-rates-table.html, accessed on 12.03.2019) and corporate tax rates table (https://home.kpmg/xx/en/home/services/tax/tax-tools-and-resources/tax-rates-online/corporate-tax-rates-table.html, accessed on 12.03.2019).

Table 3. **Tax Burden on the Russian TCE Manufacturing Segment, Chinese and US Exporters (%)**

Indicator	Russia	China	China (preferential regime)	US
VAT rate*	18.0	18.0	18.0	18.0
Profit tax rate	20.0	25.0	15.0	40.0
Social insurance premium rate	30.2	33.9	23.5	7.7
Weighted average tax duty on components	2.1	–	–	–
Weighted average tax duty on equipment	–	0.0	0.0	0.0
Tax burden	**15.31**	**15.87**	**13.20**	**12.39**
Difference with Russia	**–**	**+0.56%**	**–2.11%**	**–2.92%**

Note: * Russian VAT rate is shown for China and the US, since these countries do not apply VAT/sales tax to exports and Russia taxes imports at the domestic VAT rate.
Source: compiled by the authors.

ing benefits widely available in special economic zones and reduced (to 15%) income tax rates for high-tech companies. For province-level social insurance contributions [*Van't Klooster*, 2018], the Shenzhen rate was applied, where the key TCE manufacturers Huawei and ZTE are located.

Based on these assumptions, the following tax burden was calculated for each country (Table 3).

All other things being equal, the tax burden in Russia turns out to be higher than in the US but lower than in China provided that companies there do not use a preferential tax regime. Apparently, most Chinese companies supplying TCE to Russia use the benefits and special provisions for exporting products abroad (or the advantages provided by a different cost structure).

An analysis of specific taxation components (Table 4) shows that, based on the assumption all countries have the same added value rate, the difference in VAT for producers is leveled. This is explained by the zero weighted average customs duty (increasing it by 1% leads to the tax burden on imported equipment (VAT) growing by 0.1%). In terms of profit tax and social insurance contributions, Russia is second only to the preferential regime in China (higher by 0.5% and 0.8%, respectively). In the US, the burden of providing a social safety net falls on individuals, so the difference here is enormous, at 4.4%. Finally, because of the already mentioned "inverted duty structure" foreign manufacturers are relieved of this burden, while domestic enterprises do have to pay duties, albeit relatively modest ones in terms of the overall tax burden.

Discarding the "*Ceteris Paribus*" Condition for Production Costs

Our analysis of the tax burden based on the "all other things being equal" (*ceteris paribus*) condition assumed that the production costs in the three countries under consideration were the same. However, they are affected by several other factors which ultimately determine companies' competitiveness:

- cost saving due to economies of scale;
- cost of credit;
- the organization of production.

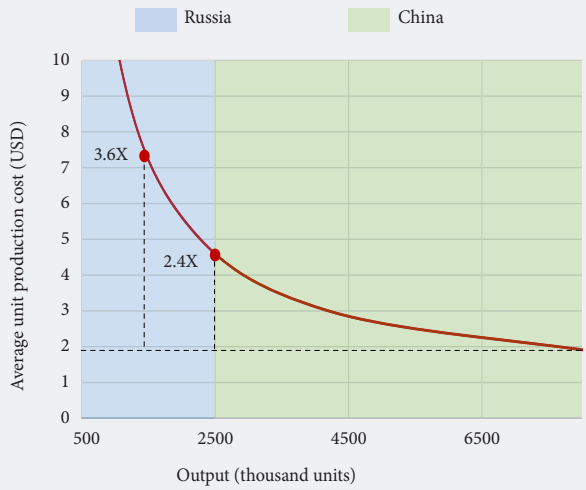
Since the organization of production depends upon many individual factors that are difficult to take into account even when comparing enterprises in one country, assessing its impact upon the competitiveness of industries in several countries is extremely difficult. The production of components does allow one to save costs through economies of scale [*Hsu, Li*, 2009]. Reduced average costs due to increased output allow one to sell products at a lower price. Figure 3 shows this effect for integrated circuits production in Russia and China. The graph clearly illustrates the significant difference in the production costs of this component type: the cost of production in Russia is 2.4-3.6 times higher than in China (depending on the amount of fixed costs).

Table 4. **Shares of Specific Taxes in the Overall Tax Burden on the Russian TCE Manufacturers, Chinese and US Exporters (%)**

Indicator	Russia	China	China (with benefits)	US
VAT	6.6	6.6	6.6	6.6
Profit tax	1.9	2.4	1.4	3.9
Social insurance premiums	6.3	6.9	5.1	1.9
Customs duties	0.5	0.0	0.0	0.0
Overall tax burden	**15.31**	**15.87**	**13.20**	**12.39**

Source: compiled by the authors.

Figure 3. **Integrated Circuit Production Costs in Russia and China**



Source: calculated by the authors based on the Unified interdepartmental information and statistical system (UIISS) "Production concentration coefficients by economic activity type (in line with the OKPD2)" (https://www.fedstat.ru/indicator/58998, accessed 13.03.2019) and "Production of main product types in physical terms since 2017 (in line with the OKPD2)" (https://www.fedstat.ru/indicator/58636?id=58636, accessed 13.03.2019); and [PRNewswire, 2019; *Kolomychenko,* 2017; *Hsu, Li,* 2009].

The observed gap in components' production costs can result in a significant difference in end-user equipment prices (Figure 4). Taking into account our earlier analysis of industry proportions and the AEDM data on the components' production costs structure, integrated circuits account for 12.1% of the end product price. Accordingly, just the integrated circuit production cost factor in Russia and China accounts for between 7% and 8.7% of the difference in TCE prices.

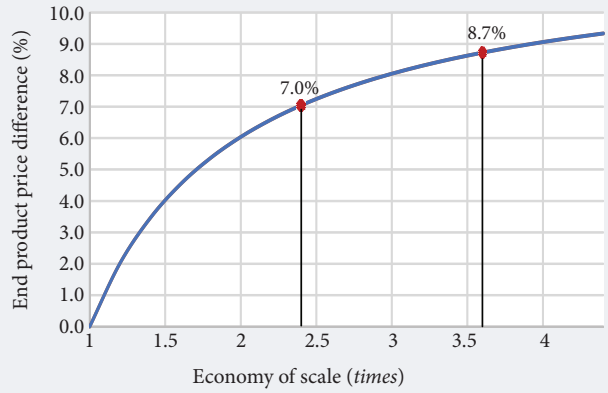
The second factor affecting production costs is the cost of credit, which depends upon interest rates. In Russia they are significantly higher than in the US and China: 10.56% versus 3.9% and 4.35%[14], respectively. With the lowest share of credit in revenues at 18% [NDIA, 2017] and the highest at 33%[15], this factor's contribution to the production costs of Chinese and American equipment ranges between 1.1%-1.2% and 2.0%-2.2%, respectively.

Conclusions and Areas for Further Research

Calculating the tax burden in a specific industry is critical for assessing the economic conditions for companies' development and its relevance is all the higher the more actively the government pursues a targeted policy to support domestic production in strategic industries. However, in the case of a specific industry segment, the analysis is complicated by the lack of a generally accepted methodology, including one for comparing the competitiveness of manufacturers in various jurisdictions.

The suggested approach allows one to calculate the tax burden on Russian TCE manufacturers taking into account the industry's specifics and compare it with similar indicators for manufacturers from China and the US who export their products to Russia. A comparative analysis of the tax burden and its components revealed that, all other things being equal, Chinese producers who enjoy preferential regimes operate in better economic conditions than Russian companies due to lower profit tax rates and social insurance contributions, as do

Figure 4. **Price Advantage of Imports from China over Russian Products due to Economies of Scale in Component Production**



Source: compiled by the authors .

[14] The World Bank Development Indicators database. Available at: https://databank.worldbank.org/data/reports.aspx?source=2&series=FR.INR.LEND&country=#, accessed on 03.04.2019

[15] An estimate based on data on Russian companies' accounts payable.

American firms due to transferring the burden of social insurance to individuals which reduces the profit tax burden. A consistent shift in the tax burden from legal entities to individuals in the US is also noted by other authors [*Sokolov*, 2018; *Grubert, Altshuler*, 2015]. Customs duties play a large role too: in addition to directly affecting the overall tax burden, they have an indirect effect through the VAT calculation mechanism applied to imported equipment. Increasing customs duties on end-user equipment imported into the country may strengthen the competitiveness of Russian manufacturers.

However, possible steps to create favorable economic conditions for domestic telecommunications companies are not limited to introducing higher customs duties for foreign manufacturers. As the Chinese experience shows, the broad application of benefits allows one to significantly reduce the tax burden, that is, the development of domestic production can be facilitated by transferring it to areas where special preferential regimes apply.

Our calculations are of a demonstrative nature because they are based on a number of assumptions. Nevertheless, the suggested assessment methodology has a number of advantages which give grounds to count on its further application. After the circle of observed companies (sectors) is determined, the variance in observations decreases with each reporting cycle. There is potential to apply Bayesian methods for modeling random variables used in the model, which will allow one to calculate substantiated, *informative* priors for related segments (electronics and radio electronics). In the medium term, this will allow one to assess the effects and contribution of taxation and other regulatory factors to the restructuring of the domestic TCE market.

A key assumption was considering the production ratios in all countries to be the same. However, manufacturers' cost structure in different countries is obviously different. When the variability of cost factors is included in the current model, the mathematical expectation of the highest percentage difference in production costs with Chinese equipment reaches 13%, with the reduction of the average costs due to increased output accounting for two-thirds of that. Thus, Chinese manufacturers can significantly reduce the cost of components.

The factors considered here, despite their indisputable importance, cover only a few competitiveness parameters. Technological advantages, sensible company strategies, and global macroeconomic conditions such as the quality and efficiency of the tax system and the availability of capital, play equally important roles in strengthening companies' competitiveness.

The authors are grateful to Alexei Chernikov, Director General of Eltex Enterprise LLC, and Ivan Pokrovsky, Director of the Association of Russian Electronics Developers and Manufacturers (AEDM), for the provided materials and valuable comments made during the discussion and preparation of this paper. Any possible remaining errors and interpretations are the responsibility of the authors.

References

ARPE (2017) *Otsenka reguliruyushchego vozdeistviya zagraditel'nykh tamozhennykh poshlin na rynok elektroniki* [Assessment of the regulatory impact of barrage customs duties on the electronics market]. Available at: http://arpe.ru/activities/lobbying-of-sectoral-interests/tamozhennoe-regulirovanie/, accessed 05.03.2019 (in Russian).

ARPE (2019) *Proizvoditeli telekommunikatsionnogo oborudovaniya* [Telecommunications equipment manufacturers]. Available at: http://www.sovel.org/spravochnik1/kompanii/#n1146, accessed 21.07.2019 (in Russian).

Bornemann T., Laplante S.K., Osswald B. (2019) The effect of intellectual property boxes on innovative activity & effective tax rates. *WU International Taxation Research Paper Series*, no 2018-03 (online). Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3115977, accessed 09.04.2019.

Burkitt-Gray A. (2019) *Nokia and Ericsson flat in infrastructure market as Huawei hits 29%, says Dell'Oro*. Available at: https://www.capacitymedia.com/articles/3823275/nokia-and-ericsson-flat-in-infrastructure-market-as-huawei-hits-29-says-delloro, accessed 20.07.2019.

Evers L., Miller H., Spengel C. (2015) Intellectual property box regimes: Effective tax rates and tax policy considerations. *International Tax and Public Finance*, vol. 22, no 3, pp. 502–530.

FE Online (2018*) India to US: Can't remove customs duty on telecom gear; it will put unbearable stress on economy*. Available at: https://www.financialexpress.com/economy/india-to-us-cant-remove-customs-duty-on-telecom-gear-it-will-put-unbearable-stress-on-economy/1388451/, accessed 12.03.2019.

Fullerton D. (1999) Marginal Effective Tax Rate. *The Encyclopedia of Taxation and Tax Policy*, pp. 270–272. Available at: https://www.urban.org/sites/default/files/alfresco/publication-pdfs/1000538-Marginal-Effective-Tax-Rate.pdf, accessed 05.04.2019.

Gareev T.R. (2008) *Osnovy mezhdunarodnogo marketinga* [Fundamentals of International Marketing], Kaliningrad: Immanuel Kant Baltic Federal University (in Russian).

Gokhberg L., Kitova G., Roud V. (2014) Tax incentives for R&D and innovation: Demand versus effects. *Foresight and STI Governance*, vol. 8, no 3, pp. 18–41.

Gromov V.V., Shatalova S.S. (2017) Otsenka nalogovoi nagruzki po metodike MVF [Assessment of Tax Burden by a Technique of the IMF]. *Upravlenčeskoe konsul'tirovanie / Administrative Consulting*, no 1, pp.74–83 (in Russian).

Grubert H., Altshuler R. (2015) Shifting the burden of taxation from the corporate to the personal level and getting the corporate tax rate down to 15 percent. *National Tax Journal,* vol. 69, no 3, pp. 643–676.

Hanappi T. (2018) *Corporate Effective Tax Rates: Model Description and Results from 36 OECD and Non-OECD Countries*, Paris: OECD.

Hsu C.I., Li H.C. (2009) An integrated plant capacity and production planning model for high-tech manufacturing firms with economies of scale. *International Journal of Production Economics*, vol. 118, no 2, pp. 486–500. Available at: https://ir.nctu.edu.tw/bitstream/11536/7435/1/000266478300012.pdf, accessed 25.03.2019.

International Monetary Fund (2014) *Government finance statistics manual 2014*, Washington, D.C.: International Monetary Fund. Available at: https://www.imf.org/external/np/sta/gfsm/index.htm, accessed 04.03.2019.

J'son & Partners Consulting (2018) *Atlas rynka telekommunikatsionnogo oborudovaniya rossiiskogo proiskhozdeniya (TORP)* [Market Atlas for Telecommunivation Equipment of Russian Origin]. Available at: http://json.tv/ict_telecom_analytics_view/atlas-rynka-telekommunikatsionnogo-oborudovaniya-rossiyskogo-proishojdeniya-20180227022931, accessed 11.03.2019 (in Russian)

Kitova G.A. (2015) Nalogovoe stimulirovanie nauki i innovatsii v Rossii: praktika i issledovaniya [Tax Incentives for Science and Innovation in Russia: Practice and Research], Moscow: HSE (in Russian).

Kolomychenko M. (2017) "Angstrem" prosyat osvobodit' nanometry ["Angstrem" is asked to free nanometers]. *Kommersant Newspaper,* no 79, p. 10. Available at: https://www.kommersant.ru/doc/3289550, accessed 14.03.2019 (in Russian).

Market Research Future (2019) *Telecom Equipment Market Research Report — Global Forecast up to 2023*. Available at: https://www.marketresearchfuture.com/reports/telecom-equipment-market-4441, accessed 20.07.2019.

McCarthy M.O. (2012) *Background Material for US-China Economic and Security Review Commission.* Available at: https://www.uscc.gov/sites/default/files/6.14.12McCarthy.pdf, accessed 22.03.2019.

Ministry of Finance (2016) *Osnovnye napravleniya nalogovoi politiki na 2017 god i planovyi period 2018 i 2019 godov* [The main directions of tax policy for 2017 and the planning period of 2018 and 2019], Moscow: Ministry of Finance of the Russian Federation. Available at: https://www.minfin.ru/ru/document/?id_4=116206, accessed 13.03.2019 (in Russian).

Modica E., Laudage S., Harding M. (2018) *Domestic revenue mobilisation: A new database on tax levels and structures in 80 countries*, Paris: OECD.

NDIA (2017) *Trustable Access to Leading Edge Technology*. Available at: http://www.ndia.org/-/media/sites/ndia/divisions/working-groups/tmjwg-documents/ndia-tm-jwg-team-2-white-paper-finalv3.ashx?la=en, accessed 27.03.2019.

Nikolaev I.A. (2016) *Analiticheskaya otsenka nalogovoi nagruzki v rossiiskoi ekonomike* [Analytical assessment of the tax burden in the Russian economy], Moscow: Committee of the RSPP on tax policy. Available at: https://www.fbk.ru/upload/docs/nalogovaya_nagruzka.pdf, accessed 19.03.2019 (in Russian).

Pathania K., Bhattacharjea A. (2020). Inverted Duty Structures and the Paradox of Negative Effective Protection in India, 2000–2014. *Foreign Trade Review*. Available at: https://doi.org/10.1177/0972266119894131, accessed 24.03.2020.

Petlevoi V., Kholyavko A., Bazanova E., Trifonova P. (2019) Pravitel'stvo ne ostavlyaet popytok sobrat' bol'she deneg s biznesa [The government does not abandon attempts to raise more money from business]. *Vedomosti,* 29.01.2019. Available at: https://www.vedomosti.ru/economics/articles/2019/01/29/792760-s, accessed 21.07.2019 (in Russian).

Pongratz S. (2019) *Key Takeaways – Worldwide Telecom Equipment Market 2018*. Available at: https://www.delloro.com/telecom-equipment-market-2018-2/, accessed 20.07.2019.

PRNewswire (2019) *China Wafer Production Capacity Growth Fastest in World.* Available at: https://www.prnewswire.com/news-releases/china-wafer-production-capacity-growth-fastest-in-world-300773756.html, accessed 17.03.2019.

PwC (2016) *The Total Tax Contribution Framework: Over a Decade of Development*, London: PricewaterhouseCoopers. Available at: https://www.pwc.com/gx/en/tax/pdf/the-total-tax-contribution-framework.pdf, accessed 19.03.2019.

PwC, World Bank Group (2018) *Paying Taxes 2019*. Washington, D.C.: PwC, World Bank, International Finance Corporation. Available at: https://www.pwc.com/gx/en/paying-taxes/pdf/pwc-paying-taxes-2019.pdf, accessed 12.03.2019.

RSpectr (2018) *Menyayu chuzhoe na svoe* [Changing Someone Else's for the Own]. Available at: https://www.rspectr.com/articles/392/menyayu-chuzhoe-na-svoe, accessed 20.07.2019 (in Russian).

RSpectr (2019) *Otechestvennye telekom-proizvoditeli poluchat l'goty* [Domestic Telecommunication Producers Will Get Incentives]. Available at: https://rspectr.com/articles/476/otechestvennye-telekom-proizvoditeli-poluchat-lgoty, accessed 11.03.2019 (in Russian).

Sokolov M.M. (2018) Ob urovne nalogovoi nagruzki v ekonomike Rossii i o vozmozhnostyakh po ee snizheniyu bez sokrashcheniya nalogovykh postuplenii [On the level of the tax burden in the Russian economy and the possibilities to reduce it without reducing tax revenues]. Èkonomika *v promyšlennosti / Russian Journal of Industrial Economics*, vol. 11, no 1, pp. 52–62 (in Russian).

Sorensen P.B. (2004) *Measuring the tax burden on capital and labor,* Cambridge, MA: Massachusetts Institute of Technology.

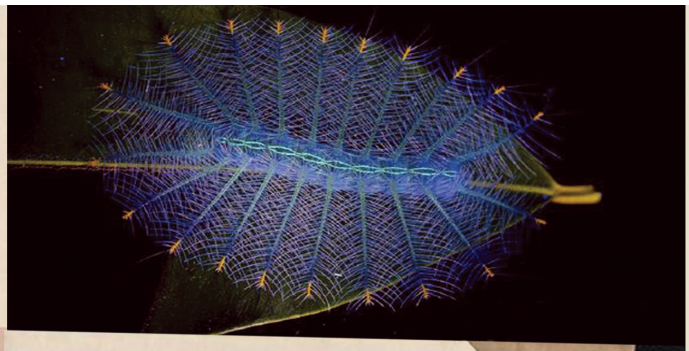
USTR (2018) Notice of Action and Request for Public Comment Concerning Proposed Determination of Action Pursuant to Section 301: China's Acts, Policies, and Practices Related to Technology Transfer, Intellectual Property, and Innovation. *Federal Register,* vol. 83, no 119, pp. 28710–28756. Available at: https://ustr.gov/sites/default/files/2018-13248.pdf, accessed 15.03.2019.

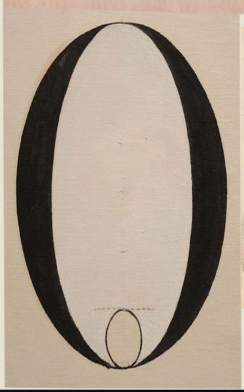
Van't Klooster M. (2018) *Hiring Local Employees in China: Chinese Taxes and Social Insurances*. Available at: https://www.1421.consulting/2018/06/chinese-taxes-and-social-insurances/, accessed 19.03.2019.

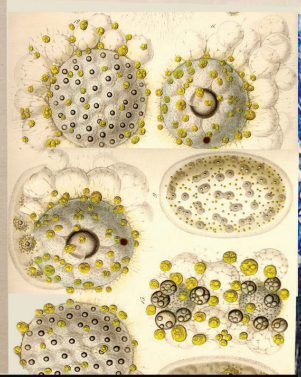
Vlasova V.V., Gershman M.A., Kuznetsova T.E., Roud V.A. (2018) *Delovoj klimat v nauke: effektivnost' mer nauchno-tekhnologicheskoi politiki. Informatsionnyi byulleten' (ekspress-informatsiya), seriya "Nauka, tekhnologii i innovatsii"* [The business climate in science: The effectiveness of measures of scientific and technological policy. Newsletter (express information), Series "Science, Technology and Innovation"], Moscow: HSE ISSEK. Available at: https://issek.hse.ru/data/2018/08/27/1154686176/NTI_N_99_29082018.pdf, accessed 18.03.2019 (in Russian).

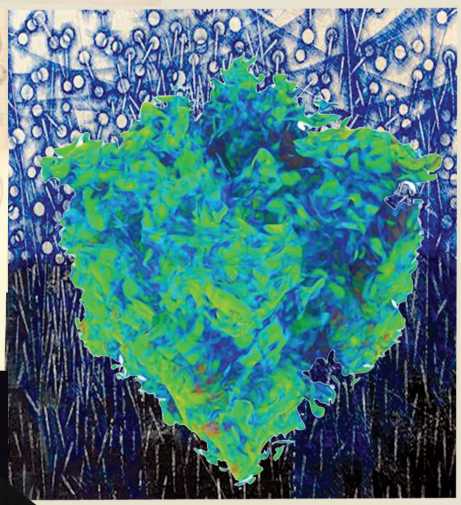
Xu J. (2017) The Role of China in the UK Relative Imports from Three Selected Trading Regions: The Case of Textile Raw Material Industry. *International Journal of Environmental Research and Public Health*, vol. 14, no 12, article 1481 (online). Available at: https://pdfs.semanticscholar.org/e381/0a61703eeaf35c85e7f1fdfd4021cfcc69c9.pdf, accessed 24.04.2019.

Zhukova K., Novyi V. (2019) Routery prokachayut poshlinami. Otechestvennykh proizvoditelej zashchityat ot inostrannykh [Routers pump over duties. Domestic manufacturers will get protection in the face of foreign counterparts]. *Kommersant Newspaper,* no 5, p. 7. Available at: https://www.kommersant.ru/doc/3854169, accessed 11.03.2019 (in Russian).









Interactive Applications with Artificial Intelligence: The Role of Trust among Digital Assistant Users

Pur Purwanto

Associate Professor, Faculty of Economics and Business, cakpo3r@gmail.com

Supratman University of Surabaya, Jl. Arief Rahman Hakim No. 14, Keputih, Kec. Sukolilo, Kota SBY, Jawa Timur 60111, Indonesia

Kuswandi Kuswandi

Lecturer, kuswandi56andi@gmail.com

Mahardhika School of Economics of Surabaya, Jl. Wisata Menanggal No. 42 A, Dukuh Menanggal, Kec. Gayungan, Kota SBY, Jawa Timur 60234, Indonesia

Fatmah Fatmah

Lecturer, Faculty of Economics and Business

Sunan Ampel University of Surabaya, Jl. Ahmad Yani No. 117, Jemur Wonosari, Kec. Wonocolo, Kota SBY, Jawa Timur 60237, Indonesia

Abstract

People are increasingly dependent upon technology. However, companies' large-scale investments to establish ongoing loyalty to technology platforms and ecosystems show negative results. This is due to lower levels of trust, concerns about risks, and increasing issues of privacy. Despite the continuous development of digital assistant applications to increase interactivity, however, there is no guarantee that the concept of interactivity is capable of gaining users' trust and addressing their concerns. The purpose of the present study is to analyze the effects of controllability, synchronicity, bidirectionality on perceived performance and user satisfaction with digital assistant applications as moderated by perceived trust. Amos 22.0 was used to analyze a sample of 150 digital assistant users of the brands Samsung Bixby, Google Assistant, Apple Siri, and others.

The results show that bidirectionality is the most worrying feature in terms of the perceived performance of digital assistants related to trust and privacy protection issues of personal data, whereas the other two features contribute to perceived performance and digital assistant users' satisfaction. Perceived trust plays a role in moderating the relationship between controllability, synchronicity, and the bidirectionality of perceived performance. Finally, perceived performance has an effect upon digital assistant users' satisfaction.

Keywords:
artificial intelligence; digital assistants; digital services; interactivity; technology innovation; perceived trust; perceived performance; satisfaction

Citation: Purwanto P., Kuswandi K., Fatmah F. (2020) Interactive Applications with Artificial Intelligence: The Role of Trust among Digital Assistant Users. *Foresight and STI Governance*, vol. 14, no 2, pp. 64–75. DOI: 10.17323/2500-2597.2020.2.64.75

Emotionally, people are currently highly dependent upon digital technology [*Peart,* 2018; *Karapanos,* 2013], despite the ethical and social issues of the privacy and security of personal data, such as the recent data leak of Facebook's database. However, it does not discourage people from continuing to use digital services for personal or business affairs [*Brill et al.,* 2019; *Pappas,* 2016; *Kumar et al.,* 2016; *Hauswald et al.,* 2015].

Today, there are several smart digital assistant applications that make work easier, such as Amazon Alexa, Samsung Bixby, Microsoft Cortana, Google Assistant, Apple Siri, and other digital assistants. Digital assistants are artificial intelligence technology (AI) capable of thinking as though they are humans and interacting with their users. According to Juniper Research, the number of digital assistant users is currently estimated at approximately 3.25 billion worldwide, and this figure is projected to reach 8 billion by 2023 [*Moar,* 2019]. Digital assistants offer a variety of benefits to consumers, as demanded by the customers. They are contextually and personally relevant, work in real-time, and offer high quality results and are further reliable and comfortable [*Baier et al.,* 2018; *Wise et al.,* 2016]. This technology can also dynamically help study consumer behavior in detail, making companies capable of creating more efficient business processes by completely automating customer service delivery [*Kumar et al.,* 2016; *Koehler*, 2016]. Therefore, businesspeople are currently innovating by integrating this technology into their operations in the hope of increasing productivity significantly [*Baier et al.,* 2018; *Bittner et al.,* 2019; *Brill et al.,* 2019].

Digital assistants work interactively and in real-time with their users. Interactivity is the two-way communication between the user and the computer [*Ha, James,* 1998; *Coyle, Thorson,* 2001; *Moar,* 2019]. Digital assistants' interactive features provide services such as the chatbot, social media, mobile applications, inventory management, automated banking, feedback form, bulletin boards, engine search, calendar and appointment management, text message sending, phone-call making, home automation, song search on YouTube, car navigation, trade conversations, and health monitoring [*Massey, Levy,* 1999; *McMillan,* 1998; *Brill et al.,* 2019; *Moar,* 2019].

Interactivity in the context of digital service consists of three dimensions: controllability, synchronicity, and bidirectionality [*Yoo et al.,* 2010; *McMillan,* 2005; *Fortin, Dholakia,* 2005; *Yadav, Varadarajan,* 2005]. Controllability is the feature that enables users can manipulate the content, timing, and sequence of communication with the digital assistant [*Fortin, Dholakia,* 2005; *Yadav, Varadarajan,* 2005; *Yoo et al.,* 2010; *Hauswald et al.,* 2015; *Brill et al.,* 2019]. Synchronicity is the speed of communication processes and facilities to respond quickly [*McMillan,* 2005; *Novak et al.,* 2000]. Bidirectionality is the two-way communication facilitated by digital assistants as a form of information exchange [*McMillan,* 2005; *Pavlik,* 1998; *Yoo et al.,* 2010; *Baier et al.,* 2018]. Liu [*Liu,* 2003] asserts that the three components of interactivity are interrelated [*Wu,* 2005; *Yoo et al.,* 2010; *Brill et al.,* 2019]. The performance of a digital assistant is determined by that of its three dimensions.

Among the indicators of the performance of a digital assistant is the customers' perceived trust in the goods and service providers [*Brill et al.,* 2019]. One key factor in the success of information exchange in technology is trust [*Ejdys et al.,* 2019] since, from the users' perspective, trust can distinguish the technological quality of a particular brand. Trust consists of security, credibility, reliability, loyalty, and accuracy of the performance of a technology [*Ejdys,* 2018]. A high level of perceived interactivity (controllability, synchronicity, and bidirectionality) can increase trust [*Merrilees, Fry,* 2003]. The quality of interactivity of digital assistants can build trust [*Stewart, Pavlou,* 2002; *Mithas, Rust,* 2016; *Pappas,* 2016]. Digital assistant features can improve decision quality, sensitivity to information, and result in value creation and user satisfaction [*Kim, LaRose,* 2004; *Brill et al.,* 2019].

Companies today focus on massive investments and redesigning their product lines by competitively making state-of-the-art digital assistants in order to serve their users well [*Mithas, Rust,* 2016; *Pappas,* 2016]. Despite the producers' endeavor to develop increasingly interactive digital assistant applications to improve technology performance and value creation capable of increasing user satisfaction, empirical literature shows scant attention to said efforts. In addition, there remain many uncertainties with regard to the concept of interactivity in the context of personal digital assistants [*Yoo et al.,* 2010; *Yadav, Varadarajan,* 2005]. The main purpose of the present study is to examine the relationship between interactivity dimensions and perceived performance, which ultimately results in consumer satisfaction with artificial intelligence applications.

Given that currently individuals work with their private data stored in their digital assistants, which requires that it be accessible to the providers of digital assistant application services [*Alpaydin,* 2014; *Pappas,* 2016], a number of users are worried that their data will be misused [*Bhat,* 2014; *Belanger, Xu,* 2015]. On the other hand, the application of technology with decision support systems is designed for complex tasks with the potential risks, making trust a success factor for the relationship between humans and digital application machines. As the trend of trust in and loyalty to technology

is increasingly declining, should service providers compromise or ignore the trade-off between technological innovations and the risk of security, credibility, and accuracy?

It is therefore important to examine the extent to which cognitive considerations related to perceived trust moderate the relationship among the interactivity dimensions of digital applications. Furthermore, the issue of privacy and trust also must be investigated in the realm of digital assistants in order to fill the empirical gap in the field of digital application consumer behavior. Finally, the authors review the literature, develop research hypotheses, and then present the research methodology, including a delineation of the measurement used to test the hypotheses. Following an examination of the results, we provide discussions, managerial implications, limitations, and further directions for research.

Literature Review

The Concept of Interactivity

Interactivity represents a real-time communication interaction between individual users or organizations with computers that is not limited by space and time [*Ha, James,* 1998; *Coyle, Thorson,* 2001; *Blattberg, Deighton,* 1991; *Kumar et al.,* 2016]. Interactivity is a form of user interaction via real-time content modification using artificial machine facilities [*Steuer,* 1992]. Interactivity is also defined as an interactive man–machine communication to search for information [*Zeithaml et al.,* 2002]. Stromer-Galley [*Stromer-Galley,* 2000] defines interactivity using cybernetics, rooted in media interaction. Furthermore, cybernetics is the use of information and feedback. Thus, interactivity is feedback on media in cybernetics [*Wiener,* 1948].

Interactivity consists of search engine interactions, user–user interactions, and user–message interactions [*Hauswald et al.,* 2015; *Kumar et al.,* 2016; *Cho, Leckenby,* 1997]. Interactivity emerges due to the rapid development of new communication technologies, such as the internet, making digital assistant users more interactive [*Baier et al.,* 2018; *Wise et al.,* 2016; *Ha, James,* 1998; *Liu, Shrum,* 2002]. These features contribute to the roles of the three dimensions of interactivity. For example, chatbot, social media, mobile apps, and feedback forms improve the perceived performance of digital assistants, which is affected by synchronicity since users can immediately find the necessary information [*Brill et al.,* 2019; *Moar,* 2019; *Ghose, Dou,* 1998]. Search engines affect perceived performance since users can control the information relevant to users [*Brill et al.,* 2019; *Moar,* 2019; *Hoffman, Novak,* 1996].

Many researchers paid special attention to the performance of digital assistants in terms of the level of interactivity as indicated by controllability, synchronicity, and bidirectionality. The importance of these three dimensions are noted due to the two-way communication [*van Dijk,* 1999; *Purwanto, Kuswandi*, 2017]; thus, a high level of synchronicity and controllability is needed to achieve the highest interactivity. Therefore, based on previous studies, interactivity can describe the extent to which controllability, synchronicity, and bidirectionality play a role in digital assistant applications.

Interactivity Dimensions and Perceived Performance of Digital Assistants

A number of previous researchers examined the effect of interactivity on website marketplaces. Their results showed that a high level of interactivity increases trust [*Merrilees, Fry,* 2003]. Furthermore, it was found that interactivity can create a value, thereby increasing trust in e-commerce [*Stewart, Pavlou,* 2002]. Interactivity and flexibility can increase customer value and satisfaction [*Purwanto, Kuswandi,* 2017]. Since digital assistants aim to help their users handle their jobs, the various recommendation systems, such as personalized facilities, are used to assist in the decision-making process. This feature can improve the quality of customer decisions and customer trust. In addition, many researchers suggest that digital assistants' interactivity has an effect upon the perceived quality, self-regulation, trust, privacy, and satisfaction [*Brill et al.,* 2019; *Kim, LaRose,* 2004].

The features of digital assistants positively impact perceived consumer values, such as a sense of security, trustworthiness, and maintenance of users' privacy [*Teo et al.,* 2003]. Given that state-of-the-art digital assistants are among the most important factors for business success [*Brill et al.,* 2019; *Zeithaml,* 1988], the benefits of the various features of digital assistants would be seen by users as an output of the performance of digital assistants [*Brill et al.,* 2019; *Sheth et al.,* 1991].

Performance is subdivided into objective performance and perceived performance [*Venkatesh et al.*, 2003]. Objective performance is the real performance of a product or service, while perceived performance is the result of a subjective assessment. Perceived performance is generally used as a guide to validate satisfaction models. Despite the very dependence upon the individual and the very-difficult-to-measure nature of perception [*Yi,* 1990], users of digital assistants objectively have equal access to their performance. Therefore, perceived performance can be measured objectively based on performance appraisals in general [*Brill et al.,* 2019]. Performance is an individual's cognitive evaluation of product performance attributes

[*Spreng, Olshavsky,* 1993]. Thus, the following hypotheses are proposed:

***H_1*:** Controllability of digital assistants has a significant effect upon perceived performance.

***H_2*:** Synchronicity of digital assistants has a significant effect upon perceived performance.

***H_3*:** Bidirectionality of digital assistants has a significant effect upon perceived performance.

Customer Satisfaction

Customer satisfaction is an indicator of a company's success in delivering services to consumers [*Akbari et al.,* 2015; *Minta,* 2018]. In the marketing literature, customer satisfaction reflects various dimensions that offer value, quality, and loyalty to customers. Therefore, the definition of customer satisfaction cannot be universally accepted since it is highly dependent upon individual consumers [*Giese, Cote,* 2000]. The differences in the definition is caused by the dynamic, complex, and specific nature of the services [*Zhao et al.,* 2012].

The present study adopted the definition proposed by Oliver [*Oliver*, 2014] that satisfaction is a consumer response to the fulfillment of consumer expectations. Consumer response is an assessment of products/services, which either fail to meet or exceed expectations. If individual consumers' assessments are pleasant, consumers would feel satisfied, and vice versa, due to the dissonance between the expected level and the perceived level of satisfaction [*Hasan, Nasreen*, 2014]. Perceived performance is an antecedent of customer satisfaction by confirming the comparison of expectations with the actual performance of the products or services [*Spreng, Page*, 2003]. Thus, perceived performance serves as a standard of expectations and perceived reality. When reality exceeds expectations, there would be satisfaction, and vice versa. Thus, the following hypothesis is proposed:

H_4 : Perceived performance has a significant effect upon the satisfaction of digital assistant users.

Moderating the Role of Perceived Trust

The concept of trust has been widely used in many ways, but it relates to one's attitude and the intentions of being vulnerable in anticipation of certain outcomes [*Brill et al.,* 2019]. Perceived trust involves an individual's assessing the certainty of the performance of products and services. Trust includes interpersonal trust (between at least two people), institutional/organizational trust, and technological trust [*Ejdys,* 2018]. Despite the distinction between the different types of trust above, users' perceived trust focuses more on the vendor and its technological capabilities, while with regard to the people behind the operation of a technology, the authors argue that an individual's performance integrity is implicitly the organization's responsibility. Thus, users let the organization or company be entirely responsible for the trusted people in question.

Thus, trust referred to in the present study is specific to certain vendors (organizations) and the attributes of digital assistant applications (technology) in terms of competence, virtue, and integrity [*Komiak, Benbasat,* 2006; *Ejdys,* 2018]. Trust in technology represents the expectation in the efficiency, reliability, and effectiveness of equipment and technical systems from the perspective of an individual who creates or a creator of a particular technology or material object [*Ejdys,* 2018]. Since perceived trust is very subjective, the trustworthiness of digital assistant applications can be determined by the quality of information, perceived privacy protection, perceived security of systems, third-party authentication systems, organizational reputation, and user experience [*Ejdys,* 2018].

The performance of the interactivity dimension depends upon how users' perceiving digital assistants in terms of content, timing, process speed, and data protected by technology as providing certainty [*Yoo et al.,* 2010; *Bhatt,* 2014]. Digital assistants' very promising potential in terms of technology adoption is not without problems. Given that this technology leaves digital footprints for its users, it means that personal data are vulnerable to being misused by others [*Bhatt,* 2014; *Belanger, Xu,* 2015; *Pappas,* 2016]. Smith et al. [*Smith et al.,* 1996] describes such violations of rights as the unauthorized use of data, access stealing, and the misuse of personal information for publication. Thus, digital assistant users are faced with difficult tradeoffs between technological innovation and the risk of information privacy problems [*Acquisti et al.,* 2015]. Digital assistants are not sensitive to these problems [*Belanger, Xu,* 2015]. Therefore, consumers see these risks as an issue that needs to be mitigated or avoided by not adopting technological innovation in the form of digital assistants. Thus, the performance of technology is inseparable from that of the people and organizations. Therefore, perceived trust can be either a synergistic interaction or a buffering interaction between interactivity dimensions and perceived performance [*Brill et al.,* 2019; *Cohen et al.,* 2003]. Thus, the following hypothesis is proposed:

***H_5*:** Perceived trust positively moderates the effect of controllability upon perceived performance.

***H_6*:** Perceived trust positively moderates the effect of synchronicity upon perceived performance.

***H_7*:** Perceived trust positively moderates the effect of bidirectionality upon perceived performance.

Research Methodology

Samples and Data Collection

Samples of digital assistant users with an average age of 41.5 years from the large city of Surabaya, East Java, Indonesia were used. Respondents tended to be younger and had a higher level of education than those of the study respondents who did not employ artificial intelligence technology [*McKnight et al.,* 2002]. Data were collected online by means of questionnaires with a computer-assisted web interviewing system connected to the internet. The items were accompanied by instructions during the interviewing process in order to ensure rapid responses from participants.

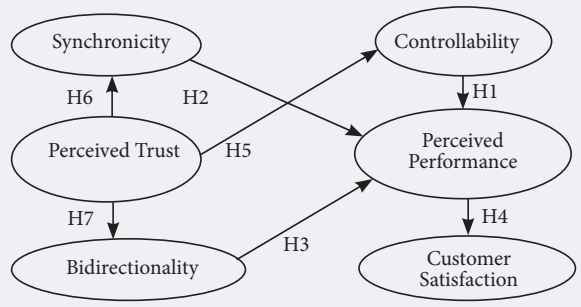
Respondents were asked to share their personal experiences with using digital assistants and, at the same time, to describe their demographic structure. Thus, the data describes the real respondents. Participants who completed the survey and provided a valid email address and contact person would be given an internet data package as a reward. Two hundred and sixty-five (N=265) respondents took part, but 115 respondents were eliminated because their responses did not meet the requirements or the total return rate of 56.6%. Thus, 150 respondents could be used, of which 85 (56.6%) were male and the remaining 65 (43.4%) were female. The average age of the digital assistant users was 41.5 years.

Respondents were mostly concentrated in the top three brands: Samsung Bixby (65%), Google Assistant (15%), Apple Siri (7%) and others (13%). Experience with using digital assistants was higher than 18 months on average. Sample characteristics are shown in Table 1.

Measures

The measures used in the present study were adopted from a number of previous studies. The questionnaire consisted of five parts: controllability, synchronicity, bidirectionality, perceived performance, and customer satisfaction. Perceived controllability, synchronicity, and bi-directionality were measured with a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree), consisting of nine constructs adopted from [*Liu,* 2003; *Yoo et al.,* 2010]. Perceived performance, consisting of six constructs, was adopted from [*Davis et al.,* 1989; *Xiao, Benbasat,* 2002; *Malhotra et al.,* 2004; *Kim et al.,* 2008]. Customer satisfaction, consisting of one construct, was adopted from [*Yoo et al.,* 2010]. Finally, perceived trust, consisting of six constructs, was adopted from [*Ejdys,* 2018; *Ejdys et al.,* 2019; *Brill et al.,* 2019]. Those items are shown in Table 2.

Figure 1. **Conceptual Framework**



Source: authors.

Results

Confirmatory Factor Analysis (CFA)

Anderson and Gerbing [*Anderson, Gerbing,* 1988] recommends the following for conducting a structural analysis: First, test the model fit which is hypothesized as a whole. The test results show $\chi^2/df = 2.155$, GFI = 0.908, AGFI = 0.904, TLI = 0.922, CFI = 0.929, RMSEA = 0.0 76). There is no standard residual of more than 2.0, and the *Chi-square* of 637.315 (100 *df*, p = 0.000) means that the overall model fit is acceptable [*Hair et al.,* 2010]. Second, test the adequacy of each scale consisting of the number of questions on each construct. Test results show a satisfactory residual and unidimensional scale. This means that each item shows a significant standard by *convergent validity*.

Table 1. **Sample Characteristics (N=150)**

Items	Frequency	Share (%)
Gender		
Male	85	56.60
Female	65	43.40
Geographic Background		
Megapolitan	30	20.00
Metropolitan	92	61.33
Small City	28	18.66
Merk Digital Assistants		
Bixby Samsung	97	65.00
Google Assistant	22	15.00
Apple Siri	11	7.00
Other	20	13.00
User Experience		
6–12 months	37	24.6
1–2 years	106	70.6
Over 2 years	7	4.6

Note: mean age of respondents is 41.5 years, standard deviation is 5.41.
Source: authors.

The reliability of the instrument was tested by calculating Cronbach's alpha. The test results shows that each construct has a reliability level above Cronbach's alpha of 0.78, meaning that each item has moderate to high internal consistency. In addition, the *average variance extracted* (AVE) ranges from 0.57 to 0.81, indicating that the variance accounted for by the construct is greater than that caused by measurement errors [*Fornell, Larcker,* 1981], as shown in Table 3.

Structural Model and Hypothesis Testing

Since the proposed measurement model was consistent with the data, hypotheses were tested with AMOS using the covariance matrix. As shown in Table 4, the three latent constructs account for 67% of the effect of perceived performance of digital assistants and bidirectionality accounts for 18% of the effect of perceived performance of digital assistants.

Thus, hypotheses 1–3 were supported. Perceived performance has a significant effect upon satisfaction since it can account for the satisfaction of users of digital assistants. The users were assured that digital assistants facilitated their work, despite concern for the security and privacy of personal data, but customers assume that all people also feel the same way [*Brill et al.,* 2019].

The moderation effects were tested using the moderated multiple regression (MMR) analysis as

Table 2. **Measurement Scale**

Items	Description	Mean	SD	Cronbach's Alpha
Controllability [*Liu,* 2003; *Yoo et al.,* 2010; *Brill et al.,* 2019]	- I feel a lot of control over this digital assistant application.	5.17	1.17	0.78
	- I feel free to do anything with this digital assistant application.	5.23	1.19	
	- I gain a lot of experience from this digital assistant application.	5.28	1.27	
Synchronicity [*Liu,* 2003; *Yoo et al.,* 2010; *Brill et al.,* 2019]	- My digital assistant processes my request quickly.	4.30	1.56	0.81
	- I get more information than what I expect from this application.	5.78	1.37	
	- I can obtain information immediately without delay.	5.21	1.28	
Bidirectionality [*Liu,* 2003; *Yoo et al.,* 2010; *Brill et al.,* 2019]	- Digital assistants provide feedback correctly.	5.86	1.31	0.79
	- This digital assistant provides the user with the opportunity to interact more freely.	5.85	1.28	
	- This digital assistant makes me feel like continuing to use it	5.72	1.32	
Perceived Performance [*Davis et al.,* 1989; *Xiao, Benbasat,* 2002; *Malhotra et al.,* 2004; *Kim et al.,* 2008]	- This digital assistant is capable of increasing my work productivity.	1.74	1.54	0.85
	- This digital assistant is capable of understanding my needs.	2.67	1.66	
	- I am convinced that other people are also concerned about the privacy of personal data.	2.89	1.58	
	- I am afraid that digital assistant application providers will use my personal data.	3.38	1.57	
	- Overall, interactivity dimensions of digital application assistants can be trusted.	2.55	1.57	
	- Overall, interactivity dimensions of digital assistant application providers can be trusted	2.51	1.84	
Customer satisfaction [*Yoo et al.,* 2010]	- Overall, I am satisfied with the performance of digital assistants	3.04	0.82	0.80
Perceived Trust [*Ejdys,* 2018; *Ejdys et al.,* 2019; *Brill et al.*, 2019]	- All digital application assistant brands can be trusted.	2.91	0.76	0.87
	- I believe that this digital assistant application brand gives me a sense of security.	2.50	1.82	
	- I believe that this digital assistant application brand protects users' personal data.	2.56	1.78	
	- I believe that service providers (companies) will not misuse users' personal data.	2.09	1.75	
	- All tasks are easier with this digital assistant application brand.	2.18	1.71	
	- I believe that this digital assistant application makes our lives better	1.67	1.52	

Note: all items were measured at 5-point Likert scale, from 1= strongly disagree to 5= strongly agree
Source: compiled by the authors.

Table 3. **Correlation Matrix CFA (Fornell-Larcker criterion)**

	Controllability	Synchronicity	Bi-directionality	Perceived performance	Satisfaction	Perceived trust
Controllability	**0.791**					
Synchronicity	0.241	**0.852**				
Bidirectionality	–0.021	0.111	**0.794**			
Perceived performance	0.222	0.111	0.004	**0.780**		
Satisfaction	0.251	0.080	–0. 140	0.311	**0.781**	
Perceived trust	0.311	0.651	0.231	0.541	0.376	**0.787**
Age	0.057	0.125	0.113	0.136	0.135	0.115
Gender	–0.072	–0.041	–0. 026	–0. 023	–0. 125	–0.165
Geographic background	–0.053	–0.210	0.012	–0.008	0.041	–0.091
Merk Digital Assistants	–0.076	–0.051	–0.041	–0.031	–0.022	–0.037
Experience	–0.067	–0.032	0.021	–0.015	–0.012	–0.017
Composite Reliability (CR)	0.927	0.945	0.928	0.729	0.797	0.728
Average Variance Extracted (AVE)	0.768	0.811	0.765	0.641	0.571	N/A
Mean	0.913	0.946	0.928	0.729	0.792	0.732
Standard Deviation (SD)	0.014	0.008	0.007	0.045	0.034	0.018

Model fit: Chi-square = 2.155, p < 0.01, df = 1.407; CFI = 0.929; TLI = 0.922; RMSEA = 0.076; SRMR = 0.06

Notes:

[a] The square roots of AVE for each construct are presented in bold on the diagonal of the correlation matrix.

[b] AVEs of formative indicators are not applicable

[c] N = 150

Source: compiled by the authors.

recommended by [*Cohen et al.,* 2003]. The test results show adjusted R^2 = 0.48, 0.37, and 0.028 for the relationship of controllability, synchronicity, and bidirectionality, respectively, with perceived performance as an interaction moderation. This means that 48%, 37%, and 2.8% of variations in satisfaction can be accounted for by the three dimensions of interactivity and perceived trust. Despite the small adjusted R^2, the results of ANOVA test or *F*-test show a F_{count} = 3.147 and a probability of 0.026, meaning that the model can be accepted. The *beta* values indicate significant values of 0.13, 0.19, and 0.21 and p = 0.001, p = 0.004, and p = 0.012, respectively, meaning that perceived trust strengthens the relationship of controllability, synchronicity, and bidirectionality with perceived performance. Thus, *H5, H6,* and *H7* are supported.

Discussion

The purpose of the present study was to examine the effect of controllability, synchronicity, and bidirectionality upon perceived performance and satisfaction. The model is generally capable of accounting for 77.2% of variance in interactivity in predicting the perceived performance of and satisfaction with digital assistants in a significant manner. The results of the present study confirm the first three hypotheses, namely that controllability, synchronicity, and bidirectionality have a significant effect upon perceived performance. The fourth hypothesis was confirmed, namely that perceived trust positively and significantly moderates the relationship of controllability, synchronicity, and bidirectionality with perceived performance. Finally, perceived performance has an effect upon the satisfaction of digital assistant users.

The results also show that users of artificial intelligence (AI) in the form of digital assistants need two-way interactions in which the user's wishes can be understood. In general, the present study is consistent with the previous literature. Interactivity, consisting of controllability, synchronicity, and bidirectionality, plays a significant role in improving the perceived performance of digital assistants [*Yoo et al.,* 2010; *Brill et al.,* 2019; *Teo et al.,* 2003; *Raney et al.,* 2003]. The present study found new empirical findings about how the performance of digital assistants is measured by the three dimensions of interactivity.

Table 4. **Hypothesis Test**

Hypothesis	Structural path	Standardized estimate	t-statistic	p-values
H1	Controllability → Perceived performance	0.676	15.685	0.007*
H2	Synchronicity → Perceived performance	0.681	23.114	0.001**
H3	Bidirectionality → Perceived performance	0.182	6.761	0.009*
H4	Perceived performance → Satisfaction	0.786	21.876	0.000**
H5	Moderating Controllability → Perceived performance	0.128	11.621	0.002**
H6	Moderating Synchronicity → Perceived performance	0.251	32.111	0.003**
H7	Moderating Bidirectionality → Perceived performance	–0.117	12.743	0.012**

Note: Significant at: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.
Source: compiled by the authors.

First, controllability helps users to manage the content, timing, and sequence of activities; thus, a digital assistant performs like a personal assistant capable of thinking like humans and meeting most of the user's demands with natural language [*Kumar et al.,* 2016; *Hauswald et al.,* 2015]. Second, synchronicity shows the speed with which digital assistants respond to users by meeting the user's requests in a real-time manner with high quality, reliability, and convenience [*Baier et al.,* 2018; *Wise et al.,* 2016; *Yoo et al.,* 2010]. Third, bidirectionality shows that digital assistants can exchange data reciprocally, serving as a conversation agent employing the principle of equality in communication [*Peart,* 2018; *Moar,* 2019; *Yoo et al.,* 2010].

This finding is also reinforced by the moderating role of perceived trust. Perceived trust has a positive and significant role in the relationship of interactivity dimensions with perceived performance. The use of technology raises concerns that data can be misused [*Bhatt,* 2014]. Due to the concerns about the misuse of private information by organizations without permission, the unauthorized use of data, errors in personal information and access, an individual's perceived trust can strengthen the dimensions of interactivity based upon the performance of digital assistant applications. Despite the release of digital assistant applications by strong brands, however, managers should continue to re-approve the principles of trust with customers in any interaction as a factor that should be maintained. Given that users indicate that they have a high level of trust, perceived risks related to information quality, integrity, and reliability will be reduced [*Kim et al.,* 2012]. The present study confirms that a higher level of trust strengthens the relationship between the interactivity dimensions and perceived performance. Thus, given the extent of potential risks, managers should invest in securing personal information physically and systematically.

Despite the significant effect of the three dimensions of interactivity, bidirectionality is the smallest factor affecting the performance of digital assistants. This finding is consistent with previous studies on trust in terms of the concerns about the privacy and security of personal data with digital assistants [*Brill et al.,* 2019; *Fitzgerald,* 2019]. According to data by Cohn&Wolfe[1], 75% of consumers were prepared to share their personal information with brands they trust. The involvement of digital assistants with its users allows data exchanges to be more vulnerable to abuse. This user concern is not absurd given that trust can be fragile and subjective [*Yannopoulou et al.,* 2011]. Users sincerely expect that their personal information in digital assistants must be made confidential, protected, and be used only with the owner's approval. Thus, they can integrate broader data into digital assistants for the benefit of their daily lifestyle. Therefore, the owners of digital assistant brands must realize that trust constitutes a performance item of paramount importance for them. Finally, perceived performance has a significant effect upon satisfaction. This effect proves that digital assistant users assess, evaluate, compare, and ensure that the settings, the processing speed, and data exchange meet and even exceed their expectations.

Managerial Implications

Consumers use digital assistants for their personal and organizational tasks, expecting that the capabilities and features of their applications are continuously improved in line with their needs [*Baier*

[1] Available at: http://www.authentic100.com, accessed 17.01.2019.

et al., 2018] despite the various features of each brand of digital assistants [*Kumar et al.,* 2016]. Thus, digital assistant service providers should be aware of important factors of perceived performance of digital assistants.

Digital assistants can be involved in marketing activities as a medium of conversation in transactions, such as amplification tools, interface devices, feedback tools, and creative tools in order to obtain valuable feedback from customers [*Harmeling et al.,* 2017]. Data collected by digital assistants can serve as a source of analysis for companies. Therefore, companies should monitor and evaluate it as a whole to ensure that this technology is in line with customer needs [*Ranjan, Read,* 2016]. The present study demonstrates that customer expectations are met through interaction with digital assistants. Thus, this technology can serve as a catalyst for the development of digital assistant technology in sustainable business activities. Additionally, the users would obtain a greater understanding of how digital assistants can provide more recent relevant information and efficiently perform important tasks for them [*Brill et al.,* 2019].

Limitations and Future Research

The present study only examines the performance of digital assistants in terms of interactivity dimensions (controllability, synchronicity, and bidirectionality) and user satisfaction in general. Thus, the performance of digital assistant brands cannot be partially inferred. However, user expectations and patterns of use of interactivity features can vary for each brand of digital assistants. For example, the two-way communication provided by each digital assistant cannot respond to individual users' desires due to the difference in language in each country. Therefore, future studies can examine various brands of personal assistants specifically to gain more in-depth knowledge of the role of interactivity in the perceived performance of digital assistants.

The samples of the present study were all current users of digital assistants, a number of which were new users, whereas former users who quit using it for some reason were not included in this study. Thus, this study is too exclusive and incapable of exploring in detail other predictors of perceived performance and user satisfaction. Future studies can explore commitment and loyalty and examine the factors causing users to quit using digital assistant applications and, at the same time, improve various features more fully. Finally, the unit of analysis of the present study was well-known brands (Samsung Bixby, Google Assistant, and Apple Siri) and is undoubtedly related to the performance delivered (image, high level of trust, protection of user privacy). Therefore, future studies can explore more closely other brands of digital assistants not dominating the market of artificial intelligence application technology.

References

Acquisti A., Brandimarte L., Loewenstein G. (2015) Privacy and human behavior in the age of information. *Science*, vol. 347, pp. 509–514.

Akbari M., Salehi K., Samadi M. (2015) Brand heritage and word of mouth: The mediating role of brand personality, product involvement and customer satisfaction. *Journal of Marketing Management,* vol. 3, no 1, pp. 83–90.

Alpaydin E. (2014) *Introduction to machine learning*, Cambridge, MA: MIT Press.

Anderson J.C., Gerbing D.W. (1988) Structural equation modeling in practice: A review and recommended two-step approach. *Psychology Bulletin*, vol. 103, pp. 411–423.

Baier D., Rese A., Röglinger M. (2018) *Conversational user interfaces for online shops? A categorization of use cases*. Paper presented at the 39th International Conference on Information Systems (ICIS), December 2018, San Francisco, USA.

Belanger F., Xu H. (2015) The role of information systems research in shaping the future of information privacy. *Information Systems Journal*, vol. 25, no 6, pp. 573–578.

Bhatt A. (2014) Consumer attitude towards online shopping in selected regions of Gujarat. *Journal of Marketing Management,* vol. 2, no 2, pp. 29–56.

Bittner E., Oeste-Reiß S., Leimeister J.M. (2019) *Where is the bot in our team? Toward a taxonomy of design option combinations for conversational agents in collaborative work*. Paper presented at the 52nd Hawaii International Conference on System Sciences, January 8-11, Maui, Hawaii, USA.

Blattberg R.C., Deighton J. (1991) Interactive marketing: Exploiting the age of addressability. *Sloan Management Review,* vol. 33, no 1, pp. 5–14.

Bretz R. (1983) *Media for Interactive Communication*, Beverly Hills, CA: Sage.

Brill T., Munoz L., Richard J. (2019) Siri, Alexa, and other digital assistants: A study of customer satisfaction with artificial intelligence applications. *Journal of Marketing Management,* vol. 35, no 15–16, pp. 1401–1436.

Cho C.-H., Leckenby J.D. (1997) Internet-related programming technology and advertising. *Proceedings of the Annual Conference of the American Academy of Advertising* (ed. M.C. Macklin), Cincinatti, OH: American Academy of Advertising, p. 69.

Cohen J., Cohen P., West S., Aiken L. (2003) *Applied multiple regression/correlation analysis for the behavioral sciences* (3rd ed.), Mahwah, NJ: Lawrence Erlbaum Associates.

Coyle J.R., Thorson E. (2001) The effects of progressive levels of interactivity and vividness in web marketing sites. *Journal of Advertising*, vol. 30, no 3, pp. 65–77.

Davis F.D., Bagozzi R.P., Warshaw P.R. (1989) User acceptance of computer technology: A comparison of two theoretical models. *Management Science*, vol. 35, no 8, pp. 982–1003.

Ejdys J. (2018) Building technology trust in ICT application at a University. *International Journal of Emerging Markets,* vol. 13, no 5, pp. 980–997.

Ejdys J., Ginevicius R., Rozsa Z., Janoskova K. (2019) The Role of Perceived Risk and Security Level in Building Trust in E-Government Solutions. *Ekonomie a Management*, vol. 22, pp. 220–235. DOI: 10.15240/tul/001/2019-3-014.

Fitzgerald K. (2019) In the 'Opt-In' data economy, consumer confidenceis key. Available at: https://www.forbes.com/sites/forbestechcouncil/2019/01/16/in-the-opt-in-data-economy-consumer-confidence-is-key/#7410e4736634, accessed 15.02.2020.

Fornell C., Larcker D.F. (1981) Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, vol. 18, no 1, pp. 39–50.

Fortin D.R., Dholakia R.R. (2005) Interactivity and vividness effects on social presence and involvement with a web-based advertisement. *Journal of Business Research*, vol. 58, no 3, pp. 387–396.

Ghose S., Dou W.Y. (1998) Interactive functions and their impacts on the appeal of internet presences sites. *Journal of Advertising Research,* vol. 38, no 2, pp. 29–43.

Giese J.L., Cote J.A. (2000) Defining consumer satisfaction. *Academy of Marketing Science Review*, vol. 1, pp. 1–24. Available at: https://www.proserv.nu/b/Docs/Defining%20Customer%20Satisfaction.pdf, accessed 18.11.2019.

Ha L., James E.L. (1998) Interactivity reexamined: A baseline analysis of early business web sites. *Journal of Broadcasting and Electronic Media,* vol. 42, no 4, pp. 457–469.

Hair J.F., Anderson R.E., Tatham R.L., Black W.C. (2010) *Multivariate Data Analysis*, Delhi: Pearson Education.

Hanssen L., Jankowski N.W., Reinier E. (1996) Interactivity from the perspective of communication studies. *The Contours of Multimedia: Recent Technological, Theoretical, and Empirical Developments* (eds. N.W. Jankowski, L. Hanssen), Luton (UK): University of Luton Press, pp. 61–73.

Harmeling C.M., Moffett J.W., Arnold M.J., Carlson B.D. (2017) Toward a theory of customer engagement marketing. *Journal of the Academy of Marketing Science,* vol. 45, no 3, pp. 312–335.

Hasan U., Nasreen R. (2014) The empirical study of relationship between post purchase dissonance and consumer behaviour. *Journal of Marketing Management*, vol. 2, no 2, pp. 65–77.

Hauswald J., Laurenzano M.A., Zhang Y., Li C., Rovinski A., Khurana A., Tang L. (2015) *Sirius: An open end-to-end voice and vision personal assistant and its implications for future warehouse scale computers.* Paper presented at the Twentieth International Conference on Architectural Support for Programming Languages and Operating Systems, March 14–18, *2015,* Istanbul, Turkey.

Hoffman D.L., Novak T.P. (1996) Marketing in hypermedia computer-mediated environments: Conceptual foundations. *Journal of Marketing,* vol. 60, no 3, pp. 50–68.

Karapanos E. (2013) *User experience over time*, Heidelberg, New York, Dordrecht, London: Springer: Springer.

Kim D.J., Ferrin D.L., Rao H.R. (2008) A trust-based consumer decision-making model in electronic commerce: The role of trust, perceived risk, and their antecedents. *Decision Support Systems,* vol. 44, no 2, pp. 544–564.

Kim H.W., Xu Y., Gupta S. (2012) Which is more important in internet shopping, perceived price or trust? *Electronic Commerce Research and Applications*, vol. 11, no 3, pp. 241–252.

Kim J., LaRose R. (2004) Interactive e-commerce: Promoting consumer efficiency or impulsivity? *Journal of Computer-Mediated Communication*, vol. 10, no 1, pp. 211–219.

Koehler J. (2016) Business process innovation with artificial intelligence — benefits and operational risks. *European Business & Management,* vol. 4, no 2, pp. 55–66.

Komiak S.X., Benbasat I. (2006) The effects of personalization and familiarity on trust and adoption of recommendation agents. *MIS Quarterly*, vol. 30, no 4, pp. 941–960.

Kumar V., Dixit A., Javalgi R.R.G., Dass M. (2016) Research framework, strategies, and applications of intelligent agent technologies (IATs) in marketing. *Journal of the Academy of Marketing Science*, vol. 44, no 1, pp. 24–45.

Liu Y. (2003) Developing a scale to measure the interactivity of websites. *Journal of Advertising Research,* vol. 43, no 2, pp. 207–216.

Liu Y., Shrum L.J. (2002) What is interactivity and is it always such a good thing? Implications of definition, person, and situation for the influence of interactivity on advertising effectiveness. *Journal of Advertising*, vol. 31, no 4, pp. 53–64.

Malhotra N.K., Kim S.S., Agarwal J. (2004) Internet users' information privacy concerns (IUIPC): The construct, the scale, and a causal model. *Information Systems Research*, vol. 15, no 4, pp. 336–355.

Massey B.L., Levy M.R. (1999) Interactivity, online journalism, and English language web newspapers in Asia. *Journalism & Mass Communication Quarterly,* vol. 76, no 1, pp. 138–151.

McKnight D.H., Choudhury V., Kacmar C. (2002) Developing and validating trust measures for e-commerce: An integrative typology. *Information Systems Research*, vol. 13, pp. 334–359.

McMillan S.J. (1998) Who pays for content? Funding in interactive media. *Journal of Computer Mediated Communication,* vol. 4, no 1, pp. 89–96.

McMillan S.J. (2005) The researchers and the concept: Moving beyond a blind examination of interactivity. *Journal of Interactive Advertising,* vol. 5, no 1 (online). Available at: https://doi.org/10.1080/15252019.2005.10722096, accessed 17.12.2019

Merrilees B., Fry M.-L. (2003) E-trust: The influence of perceived interactivity on e-retailing users. *Marketing Intelligence & Planning*, vol. 21, no 2, pp. 123–128.

Minta Y. (2018) Link between satisfaction and customer loyalty in the insurance industry: Moderating effect of trust and commitment. *Journal of Marketing Management*, vol. 6, no 2, pp. 25–33.

Mithas S., Rust R.T. (2016) How information technology strategy and investments influence firm performance: Conjecture and empirical evidence. *MIS Quarterly*, vol. 40, no 1, pp. 223–246.

Moar J. (2019) *The Digital Assistants of Tomorrow* (White Paper), Basingstoke (UK): Juniper Research Ltd.

Novak T.P., Hoffman D.L., Yung Y.F. (2000) Measuring the customer experience in online environments: a structural modeling approach. *Marketing Science,* vol. 19, no 1, pp. 22–43.

Oliver R.L. (2014) *Satisfaction: A behavioral perspective on the consumer* (2nd ed.), New York: Routledge.

Pappas N. (2016) Marketing strategies, perceived risks, and consumer trust in online buying behaviour. *Journal of Retailing and Consumer Services*, vol. 29, pp. 92–103.

Pavlik J.V. (1998) *New Media Technology: Cultural and Commercial Perspectives*, Boston, MA: Allyn and Bacon.

Peart A. (2018) Conversational AI platforms demand is growing. Available at: https://blog.worldsummit.ai/conversational-ai-platforms-demand-is-growing, accessed 04.02.2020.

Purwanto P., Kuswandi K. (2017) Effects of Flexibility and Interactivity on the Perceived Value of and Satisfaction with E-Commerce (Evidence from Indonesia). *Market-Tržište,* vol. 29, no 2, pp. 139–159. Available at: https://doi.org/10.22598/mt/2017.29.2.139, accessed 02.12.2019.

Raney A.A., Arpan L.M., Pashupati K., Brill D. (2003) At the movies, on the web: An investigation of the effects of entertaining and interactive web content on site and brand evaluations. *Journal of Interactive Marketing,* vol. 17, no 4, pp. 38–53.

Ranjan K.R., Read S. (2016) Value co-creation: Concept and measurement. *Journal of the Academy of Marketing Science,* vol. 44, no 3, pp. 290–315.

Sheth J.N., Newman B.I., Gross B.L. (1991) *Consumption values and market choice*, Cincinnati, OH: South Western Publishing.

Smith H.J., Milberg S.J., Burke S.J. (1996) Information privacy: Measuring individuals' concerns about organizational practices. *MIS Quarterly*, vol. 20, no 2, pp. 167–196.

Spreng R.A., Olshavsky R.W. (1993) A Desires Congruency Model of Consumer Satisfaction. *Journal of the Academy of Marketing Science*, vol. 21, no 3, pp. 169–177.

Spreng R.A., Page T.J. (2003) A test of alternative measures of disconfirmation. *Decision Sciences,* vol. 34, no 1, pp. 31–62.

Steuer J. (1992) Defining virtual reality: Dimensions determining telepresence. *Journal of Communication,* vol. 42, no 4, pp. 73–93.

Stewart D.W., Pavlou P.A. (2002) From consumer response to active consumer: Measuring the effectiveness of interactive media. *Journal of the Academy of Marketing Science,* vol. 30, no 4, pp. 376–396.

Stromer-Galley J. (2000) Online interaction and why candidates avoid it. *Journal of Communication*, vol. 50, no 4, pp. 111–132.

Teo H.H., Oh L.B., Liu C., Wei K.K. (2003) An empirical study of the effects of interactivity on web user attitude. *International Journal of Human Computer Studies,* vol. 58, no 3, pp. 281–305.

Van Dijk J. (1999) *The Network Society: Social Aspects of New Media*, London: Sage.

Venkatesh V., Morris M.G., Davis G.B., Davis F.D. (2003) User acceptance of information technology: Toward a unified view. *MIS Quarterly*, vol. 27, no 3, pp. 425–478.

Wiener N. (1948) *Cybernetics, or Control and Communication in the Animal and the Machine*, Cambridge, MA: Technology Press.

Wise J., VanBoskirk S., Liu S. (2016) *The rise of intelligent agents*, Cambridge, MA: Forrester Research. Available at: https://www.forrester.com/report/The+Rise+Of+Intelligent+Agents/-/E-RES128047#figure1, accessed 12.01.2016.

Wu G. (2005) The mediating role of perceived interactivity in the effect of actual interactivity on attitude toward the website. *Journal of Interactive Advertising*, vol. 5, no 2, pp. 29–39.

Xiao S., Benbasat I. (2002) *The impact of internalization and familiarity on trust and adoption of recommendation agents* (Working Paper 02-MIS-006), Vancouver: University of British Columbia.

Yadav M.S., Varadarajan P.R. (2005) Interactivity in the electronic marketplace: An exposition of the concept and implications for research. *Journal of the Academy of Marketing Science*, vol. 33, no 4, pp. 585–603.

Yannopoulou N., Koronis E., Elliott R. (2011) Media amplification of a brand crisis and its affect on brand trust. *Journal of Marketing Management,* vol. 27, no 5–6, pp. 530–546.

Yi Y. (1990) A critical review of consumer satisfaction. *Review of Marketing*, vol. 4, no 1, pp. 68–123.

Yoo W.S., Yunjung L., Jung K. P. (2010) The role of interactivity in e-tailing: Creating value and increasing satisfaction. *Journal of Retailing and Consumer Services,* vol. 17, pp. 89–96.

Zack M.H. (1993) Interactivity and communication mode choice in ongoing management groups. *Information Systems Research*, vol. 4, no 3, pp. 207–239.

Zeithaml V.A. (1988) Consumer perceptions of price, quality and value: A means-end model and synthesis of evidence. *Journal of Marketing,* vol. 52, no 3, pp. 2–22.

Zeithaml V.A., Parasuraman A., Malhotra A. (2002) *An Empirical Examination of the Service Quality Value-Loyalty Chain in an Electronic Channel* (Working Paper), Chapel Hill, NC: University of North Carolina.

Why are Some Recommendation Systems Preferred?

Gaofeng Yi

Dean, Business School, yigf@yctu.edu.cn

Yancheng Teachers University, 2, Nan Road, Xiwang Avenue, 224007 Yancheng City, Jiangsu Province, P.R. China

Abstract

There has been wide interest in exploring ways to provide more efficient personalized recommendation systems (RSs) in order to attract customers and increase product sales. The majority of the existing studies are concerned with improving the accuracy and effectiveness of the recommendation algorithms or focusing on how to limit perceived risks with the aim of increasing consumer satisfaction. Unlike these aforementioned studies, this research begins from the perspective of customer-RS interaction and ends with revealing the mechanisms involved in consumers' acceptance of the recommendations by using the technology acceptance model. The empirical results show that perceived interpersonal interaction is an important factor that directly impacts university students' intentions to use RS, while the perceived ease-of-use influences them in an indirect way through the mediation of perceived usefulness. On this basis, the study thus provides suggestions on how to provide improved interactions with an easy-to-use personalized RS.

Keywords: online personalized recommendation system (RS); technology innovation; customer choice; customer-RS interaction; adoption intention

Citation: Yi G. (2020) Why are Some Recommendation Systems Preferred? *Foresight and STI Governance*, vol. 14, no 2, pp. 76–86. DOI: 10.17323/2500-2597.2020.2.76.86

The development of e-commerce has transformed consumers' traditional purchasing habits and online purchases have gained much popularity in recent years. As of December 2018, Chinese online shoppers reached a staggering 610 million according to the 43rd China Statistics Report on Internet Development released by China Internet Network Information Center (CNNIC) in February 2019 [CNNIC, 2019]. With the rapid development of online purchasing sites, an increasing number and variety of goods are available on e-commerce websites. However, customers with complaints have to face a massive data jungle resulting in frustration and confusion to order and receive their selection on a specific date. Recommendation systems (RSs) arose in response to this situation, which proved to be a valuable tool in helping customers [*Jannach et al.,* 2010]. Such systems provide customers with information and suggestions to help them with their decision making and purchasing process [*Resnick, Varian,* 1997; *Qiang et al.*, 2016]. According to the user's preferences gleaned from the customer-RS interaction information, the RS actively recommends products or provides interesting information, which helps decrease confusion, tap into potential demand, and increase the sales of e-commerce goods.

According to the China University Students' Consumption Insight Report, released by IResearch in August 2018, annual consumption by students amounts to 381.6 billion RMB, of which over 95% are online purchases. It seems that, as a group, students prefer to choose personalized RSs with specific characteristics [IResearch, 2018]. The main goal of a RS is to aid users in their online decision-making process [*Jannach et al.,* 2010] and thereby simplify specific item searches. Confusing personalized RS not only do not help users improve decision-making efficiency, but make them sceptical of future help. During the decision-making process, the "true feeling" of the interaction between the user and the RS is a key factor in determining whether or not to adopt the RS and purchase the recommended commodity. In recent years, the influencing factors of RSs have been an important research topic in such fields as computer science and marketing. Nonetheless, they are now focusing on to how to improve the accuracy of the algorithm but still face the problem of lacking customer acceptance [*Herlocker*, 2004]. With virtualization, cloud computing, and big data technology being the important foundation for the development of RSs, the "physical" level of RSs has been better developed, but the degree of "personalization" has not been improved simultaneously. The recommendation system is focused on "computers", mainly on the "hard" problems of computer software and hardware systems such as databases, storage, recommendation algorithms, and so on. In turn, the personalized recommendation system is oriented toward "human" factors, mainly focusing on the main body of the system — the actual behavior of the user and their real subjective feelings, from which they start in order to explore the "soft" issues of the content and interaction with the system service supply. Therefore, the personalized recommendation system should pay more attention to the user's "interaction and experience." It is a pity that scant attention has been paid to the perception of customer-RS interactions. This is the research gap our study addresses.

The algorithm is not the main focus of personalized recommendation research, users' external behavior and their inherent psychological characteristics are at the core. Therefore, based on the perspective of "interaction" and focusing on the "human" factor, this study proposes an RS adoption intentions (RSAIs) model based on the technology acceptance model (TAM), which is used to fill the gap on factors that influence the development of RSAIs and considers the university students' perceived interpersonal interactions and perceived human-computer interactions (perceived ease of use along with perceived usefulness) (Figure 1). Compared with previous literature, the incorporation of "customer-RS" reaction theoretical framework can offer a more holistic representation of the interactions' relationship with various factors. This study provides a basis, gained from factual evidence, for the proper design of a recommendation system. With the rapid development of e-commerce and the universal use of a personalized RS in China, these findings are a generalization and can provide useful references. The findings will be vitally important to actors who are concerned with the improvement of RSs and increasing sales.

Theoretical Foundation and Literature Review

Recommendation System

The development of RSs began as early as the 1980s [*Salton, McGill,* 1986] and to this date, this has been an expanding research field. With the proliferation of big data, the RS is now a very crucial and useful tool utilized extensively in seeking customer satisfaction based on business-to-consumer relations through personalization [*Ricci et al.,* 2011]. Based on the interaction with consumers, the RS aims to select and suggest the most relevant items, information, services, and special promotions to their users by considering their profiles, purchase history, preferences, opinions, and communication with offered products and services [*Villegas et al.,* 2018]. Existing literature explored the partial influencing factors related to the characteristics of the user and recommendation system. For example,

they proposed that the usefulness of recommendations, user preferences, and privacy protection have a positive and significant impact upon the adoption intention of RS [*Carlson et al.,* 2015]. However, there are few studies on the interaction between consumers and the RS, especially from the perspective of the integration of "interpersonal interaction and human-computer interaction," despite the fact that the perception of interaction is the key factor influencing the customers' decisions on whether or not to continue using the system. Therefore, we need further research on "customer-RS" factors in order to explore how it operates among university students.

University students generally possess a higher intellect and have a strong ability to search for and process information but lack adequate finances. Their spending ability, while limited, does not deter them from using mobile devices for communication such as smart phones while attempting to become fashionable with the latest wardrobe, purchase train or airplane tickets, and hotel bookings. Before actually purchasing, they have a propensity to evaluate all aspects of a product or service to ensure their expectations are met. Therefore, the experience of the decision-making process from the interaction between university student consumers and RS is not only very critical for increasing sales, but also plays an important role in driving them to adopt RSs.

Perceived Interpersonal Interaction and RS Adoption Intention

Based on computer networks, Hoffman and Novak [*Hoffman, Novak,* 1996] proposed interactive forms of human-computer interaction and interpersonal interaction between users and systems. The user directly indicates his or her needs to the recommendation system by browsing, searching, and sending information. The system recommends products that may be of interest to the user and the user then provides feedback on the recommendation results, and the communication between the users and the system forms an interactive process. Interpersonal interaction refers to the interaction through the recommendation system, emphasizing the recommendation system as a medium for communication between humans through which users can share values, exchange information, and maintain interpersonal relationships. Narver and Slater [*Narver, Slater,* 1990] pointed out that customers' sense of value comes from the product characteristics and interpersonal interaction process with a particular emphasis upon the influence of interpersonal interaction.

The RS provides real-time feedback based not only on the user's past documented records, but also on the behavior data of the present. It is suggested that the higher the level of consumer participation in personalized recommendations, the greater their satisfaction with and trust in the recommendations [*Dabholkar, Sheng,* 2012]. Therefore, the system needs to be continuously interacting with the users and analyzing feedback information to correct and optimize the recommendation results. The "satisfaction" and interactivity of the interactive interface of the RS can affect user experience. Product descriptions, reviews, ratings, and so on in the interactive interface have a significant impact upon the user experience. The simpler and clearer the navigation and layout of the recommended product list is, the higher the consumer satisfaction [*Bo, Benbasat,* 2007]. When a consumer is dissatisfied with a recommendation, a RS allows that potential consumer to modify preferences at any time before the sale is completed and dynamically adjusts the recommendation results according to the diagnostics of consumer modification. Consumers obviously have higher ratings for referral systems with similar interactive features [*Bo, Benbasat,* 2007]. Increasing interactive modification will increase consumer trust and satisfaction with the RS [*Pereira,* 2001]. Studies have shown that establishing visualized interactions has a positive impact upon increasing user satisfaction and user interaction with the system [*Zhao et al.,* 2010]. For example, SFViz (Social Friends Visualization) visualizes the connection between users and user interests, helping them find suitable friends with similar interests [*Gou et al.,* 2011]. The RS allows users to set up discussions that interest them with the possibility of establishing contact by tracking one other. The interactive query should be able to inform the user of the reason for query failure should there be one and the strategy for modifying the query. Informing consumers of the search progress during the interactive process of product-searching can lead them to think that the system saves them from more and possibly unfruitful search attempts [*Bechwati, Xia,* 2003]. As a result, consumers' satisfaction and evaluation of the search process are increased. Thus, perceived interpersonal interaction is an important antecedent for the adoption intention of RS.

Perceived Human-Computer Interaction and RS Adoption Intention

Davis [*Davis,* 1989] applied the Theory of Planned Behavior (TPB) to the study of information technology acceptance and proposed the technology acceptance model (TAM). According to TAM, perceived human-computer interactions can be divided into two dimensions: perceived ease of use and perceived usefulness, which both affect the user's intention to use the new information technology, thereby affecting his/her usage behavior [*Davis,* 1989; *Smith,* 2013]. Perceived ease of use is defined

as the degree to which a user believes that using a certain system would be free from complications. The term perceived usefulness refers to the degree to which a person believes that using a certain system would help enhance work performance [*Davis,* 1989]. Existing literature has confirmed that perceived ease of use and usefulness did have an influence upon customers' RS adoption intention. Some studies even stated that perceived ease-of-use and perceived usefulness have been identified as important factors that impact users' continued intention to use RSs [*Roca, Gagné,* 2008; *Rodrigues et al.,* 2016; *Jeng, Tseng,* 2018]. For example, it was confirmed that perceived ease of use impacts individuals' intentions to adopt information technology [*Yuan, Jeyaraj,* 2013]. Moreover, according to the TAM, perceived usefulness is a determinant of RS adoption intention and perceived ease of use enhances the perceived usefulness effect for RS adoption [*Tsai et al.,* 2011; *Yi et al.,* 2018]. Therefore, this study examines the relationship of three candidates, these are perceived ease of use, perceived usefulness, and adoption intention.

Conceptual Models and Hypotheses

In order to answer the key question, we need further research on "customer-RS" factors and to explore their relationships and mechanisms among the university students. Therefore, we propose the RS adoption intentions (RSAIs) model to fill the gap (Figure 1) based on the TAM. Using quantitative research, this study aims to determine the key influencing factors and their effects upon RSAIs through empirical data to provide references for future RS producers and consumers. The following six hypotheses are formulated.

Firstly, the hypotheses in this study are to confirm the relationships among perceived interpersonal interaction, perceived ease of use, and university students' RS adoption intentions.

H1: Perceived interpersonal interaction has a significant positive effect upon RS adoption intention.

H2: Perceived interpersonal interaction has a significant positive impact upon perceived ease of use.

H3: Perceived ease of use has a significant positive impact upon the RS adoption intention.

Secondly, the hypotheses in this study are to evaluate the relationship among perceived ease of use and perceived usefulness. According to the TAM, perceived ease of use enhances the perceived usefulness effect upon RS adoption [*Tsai et al.*, 2011; *Yi et al.*, 2018]. Thus, the hypothesis is as follows:

H4: Perceived ease of use has a significant positive impact upon perceived usefulness.

Thirdly, the hypotheses deal with the relationships among perceived interpersonal interaction, perceived usefulness, and RS adoption intention. It is thus hypothesized that they follow an action path as "perceived interpersonal interaction → perceived usefulness → university students' RS adoption intention". These hypotheses are as follows:

H5: Perceived interpersonal interaction has a significant positive impact upon perceived usefulness.

H6: Perceived usefulness has a significant positive effect upon RS adoption intention.

Methods

Participants and Data Collection

This study selected at random 1,500 university students from the eastern, central, and western regions of China according to the research objectives laid down in April 2018. The primary data collection for variables was undertaken online through a structured questionnaire, which was distributed to the students by their supervisors, mainly via QQ or WeChat group, a convenient platform for the students to respond utilizing cell phones or computers. A total of 1,072 valid questionnaires were collected, broken down as follows: 590 (55.04%) eastern, 244 (22.76%) central, and 238 (22.2%) western regions of China, all undergraduates for which the male to female ratio was 354 (33.02%) and 718 (66.98%), respectively.

Measures

The theoretical model of RSAIs in this study principally includes one dependent variable, namely, RS adoption intention and three independent variables, that is, perceived interpersonal interaction, perceived ease of use, and perceived usefulness. The four constructs measured in this present study are mainly adopted from existing scales. All proposed questions were evaluated with a five-point Likert scale ranging from 'strongly disagree' (1) to 'strongly agree' (5). All items are shown in Table 2.

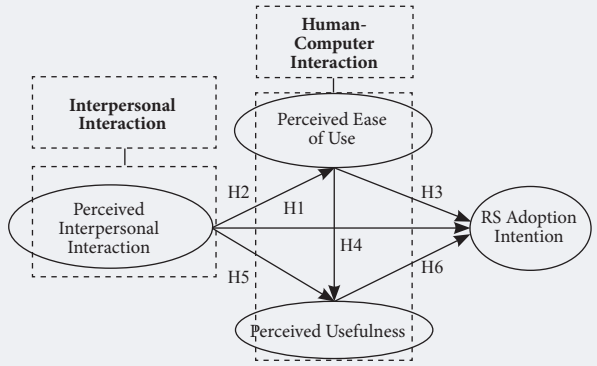
This study defines perceived interpersonal interaction as the extent to which users believe that using a RS would be flexible, offer convenient exchanges of relevant information, and efficiently deal with the purchase process with the service provider, thereby providing a satisfactory experience. For example, a consumer is able to modify any purchase preference thus giving flexibility to the whole interaction and allowing one to communicate with other consumers going as far as befriending others with similar interests. There are six items on the scale derived from [*Dong et al.,* 2014; *He et al.,* 2018].

In addition, by "perceived ease of use" we mean the extent to which consumers believe that using a

RS would be effortless [*Hsu et al.,* 2014]. There are four items on the scale derived from [*Davis,* 1989; *Tsai et al.,* 2011; *He et al.*, 2018]. Perceived usefulness pertains to the degree to which a consumer believes that adopting a RS would be beneficial. Four items used to measure perceived usefulness are adapted from the scale of [*Davis,* 1989; *Dong et al.,* 2014].

Finally, adoption intention refers to a consumer's subjective probability, intention, and prospects with regard to the adoption of a RS for purchasing a product or a service. Three items used to assess adoption intention are adapted from the scale of [*Dodds,* 1991; *Bhattacherjee, Premkumar,* 2004; *Tsai et al.,* 2011; *Jeng, Tseng,* 2018].

Figure 1. **Research Framework of RSAIs**



Source: compiled by the author.

Empirical Analysis

Confirmatory Factor Analysis (CFA)

Amos 24.0 software is used for CFA in order to assess the model fit criteria, reliability, convergent validity, and discriminant validity (Table 1). For the model's goodness-of-fit index, the test results are presented as follows: $\chi 2 = 301.609$, $\chi 2/df = 2.67<5$, CFI = 0.98, GFI = 0.97, AGFI = 0.96, NFI = 0.97, RFI = 0.96, IFI = 0.98, TLI = 0.98, and RMSEA = 0.039, SRMR = 0.028. The four constructs are proved to have satisfactory reliability because the overall values of Cronbach's α exceeds 0.8 and the composite reliability ranges from 0.80 to 0.87, exceeding the suggested benchmark of 0.60 [*Bagozzi, Yi,* 1989] (Table 2). For the validity test, all the measured items' factor loadings range from 0.67 to 0.78 (all $p < 0.001$), the average of variance extracted (AVE) estimates are ≥ 0.6, and most of the square multiple correction values are greater than 0.5, as is shown in Table 2 (above 0.36 is acceptable and above 0.5 is ideal) [*Fornell, Larcker,* 1981].

Discriminant validity is assessed with the following two strategies. Firstly, this study constructs six constrained models, in which a particular correlation coefficient is fixed to 1. For instance, in M2, the fixed parameter is the correlation between CRSI and PEoU. Subsequently, a series of $\chi 2$ change tests are conducted to determine whether the constraint conditions worsen model fits compared to the basic model (i.e., M1) in which all correlations are freely estimated [*Anderson, Gerbing,* 1988]. The resulting significant differences in $\chi 2$ value indicate that the discriminant validity is approved (Table 3). Secondly, this study examines the confidence intervals of correlations among latent variables using the bootstrapping method. As is shown in Table 3, the discriminant validity is provided because the value of 1 is not included in all of the computed confidence intervals [*Bagozzi, Phillips,* 1982], similar to the studies of [*Kolar, Zabkar,* 2010; *Zampetakis et al.,* 2015; *Fernández-Pérez et al.,* 2019]. Therefore, the discriminant validity of the measurement model proves to be adequate.

Hypothesis Testing

Before hypothesis testing, the adaptability analysis of the structural model must be tested. Again the Amos 24.0 software was used to obtain the goodness-of-fit indices for the model, and here are the results: $\chi 2 = 301.61$, $\chi 2/df = 2.67<5.0$, RMSEA = 0.039<0.80, SRMR=0.028, GFI = 0.97, AGFI = 0.96, CFI = 0.98, NFI = 0.97, RFI = 0.96, and TLI = 0.98, which indicates that the model has a satisfactory model for goodness-of-fit [*Hair et al.,* 2010].

Subsequently, the aforementioned hypotheses in this model were tested and the results are shown in Figure 2. It was found that perceived interpersonal interactions have direct and significant impacts upon university students' RSAIs and their standardized path coefficients are 0.243***. Therefore, we conclude that H1 is supported. Meanwhile, perceived interpersonal interactions have direct and significant impacts upon perceived ease of use and perceived usefulness, and their standardized path coefficients are 0.662***and 0.605***, respectively, showing that H2 and H5 are verified.

As for the relationships among perceived ease of use, perceived usefulness, and RSAI, it is clear that perceived ease of use has direct and significant impacts upon perceived usefulness and the same being true with perceived usefulness on RSAI, with the standardized path coefficients of the former being 0.379*** and that of the latter at 0.652***. In this evaluation, H4 and H6 are confirmed. All path coefficients, except for H3, are found to be significant ($p < 0.001$). H3 states that perceived ease of use has a significant positive impact upon the RS adoption intention. However, according to the test

Table 1. **Description of Variables**

Construct	Item	Measures
Interpersonal interaction		
Customer-RS interacttion (CRSI)	CRSI1	The RS is flexible for me to interact with
	CRSI2	The RS provides a dedicated module to collect my evaluation of the items
	CRSI3	I can modify my shopping preferences at any time
	CRSI4	The RS encourages interactions among users
	CRSI5	The RS provides a platform for two-way communication
	CRSI6	I can choose the objects and time of interactions and the degree of information disclosure
Human-computer interaction		
Perceived ease of use (PEoU)	PEoU1	Learning to operate the RS is easy for me
	PEoU2	Becoming skillful at using the RS is easy for me
	PEoU3	I find it easy to complete online shopping by using the RS
	PEoU4	I find the RS easy to use
Perceived usefulness (PU)	PU1	Using this RS would enable me to make purchase decision more quickly
	PU2	Using this RS would improve my purchase performance
	PU3	Using this RS would enable me to have extra benefits
	PU4	Using this RS would enhance my effectiveness in shopping
Adoption intention		
RS adoption intention (RSAI)	RSAI1	I will use the RS when I need to make a purchase
	RSAI2	I will continue online shopping with the help of RS
	RSAI3	I will use the RS in the future

Source: compiled by the author.

results, this hypothesis was not supported. In other words, perceived ease of use greatly affects perceived usefulness with its path coefficient standing at 0.379***.

The findings also reveal that perceived ease of use and perceived usefulness mediate the relationship between perceived interpersonal interaction and RS adoption intention for the reason that all the correlations between the variables are significant ($p<0.001$). Furthermore, the bootstrap test is performed at a 95% confidence interval with 5,000 samples [*Preacher, Hayes,* 2008; *Taylor et al.,* 2008] to investigate the indirect effects. As is shown in Table 4, the results of the bootstrap test confirm the existence of a positive and significant mediating influence upon perceived ease of use between perceived interpersonal interactions and RSAI (standardized indirect effect = 0.260, $P<0.001$), and also on perceived usefulness between perceived interpersonal interactions and RSAI (standardized indirect effect = 0.387, $P<0.001$). This is also valid for the case of perceived usefulness between perceived ease of use and RSAI (standardized indirect effect = 0.247, $P<0.001$).

Conclusions and Suggestions

Based on TAM, this study provides valuable research results regarding the possible relationships among perceived interpersonal interaction, perceived human-computer interaction, and RSAI.

From the analysis path of human-computer interaction, such results indicate that perceived ease of use has direct and significant impacts upon perceived usefulness, and the same being true with perceived usefulness upon RSAI. Perceived ease of use has an indirect influence on university students' intentions to use RS through the mediation of perceived usefulness. Therefore, it also indicates that perceived human-computer interaction is an important factor that affects university students' intentions to use RS.

From the analysis path of interpersonal interaction, such results indicate that perceived interpersonal interaction is an important factor that directly affects their intentions to use RS. Accordingly, the customer-RS interaction, ease of use, and usefulness of RS should all be improved in order to enhance students' RSAI, thereby playing the role of "human-computer interaction" and "interpersonal interaction", especially the role of the latter so as to attract more customers. For example, by improving the operation interface of the personalized recommendation system, the ease of use and usefulness of the RSs that customers use can be enhanced and human-computer interaction can also be strengthened to attract users. Through the recommendation system plug-in and corresponding module functions, users can comment, share, and discuss related products, earn points, form a commodity-social model, improve interpersonal interactions, and cultivate user loyalty.

Table 2. **Confirmatory Factor Analysis for the Measurement Model**

Item	Unstd.	S.E.	z-value	P	SFL	SMC	CR	AVE	Cronbach's Alpha
CRSI1	1.000	—	—	—	0.667	0.445	0.868	0.523	0.867
CRSI2	1.182	0.057	20.742	***	0.720	0.518			
CRSI3	1.158	0.054	21.497	***	0.751	0.564			
CRSI4	1.148	0.055	20.690	***	0.718	0.516			
CRSI5	1.215	0.057	21.341	***	0.744	0.554			
CRSI6	1.152	0.054	21.144	***	0.736	0.542			
PEoU1	1.000	—	—	—	0.769	0.591	0.849	0.585	0.849
PEoU2	1.027	0.041	24.923	***	0.771	0.594			
PEoU3	0.999	0.041	24.212	***	0.750	0.563			
PEoU4	1.004	0.040	24.871	***	0.769	0.591			
PU1	1.000	—	—	—	0.731	0.534	0.848	0.582	0.847
PU2	1.120	0.045	24.700	***	0.775	0.601			
PU3	1.069	0.043	24.622	***	0.772	0.596			
PU4	1.079	0.044	24.629	***	0.773	0.598			
RSAI1	1.000	—	—	—	0.731	0.534	0.793	0.561	0.792
RSAI2	1.063	0.045	23.369	***	0.756	0.572			
RSAI3	0.970	0.041	23.461	***	0.759	0.576			

Notes: N=1072; SFL= Standardized factor loading. CR = Composite reliability; AVE = Average variance extracted; *p <0.05; **p<0.01; ***p<0.001. For the description of item codes see Table 1.

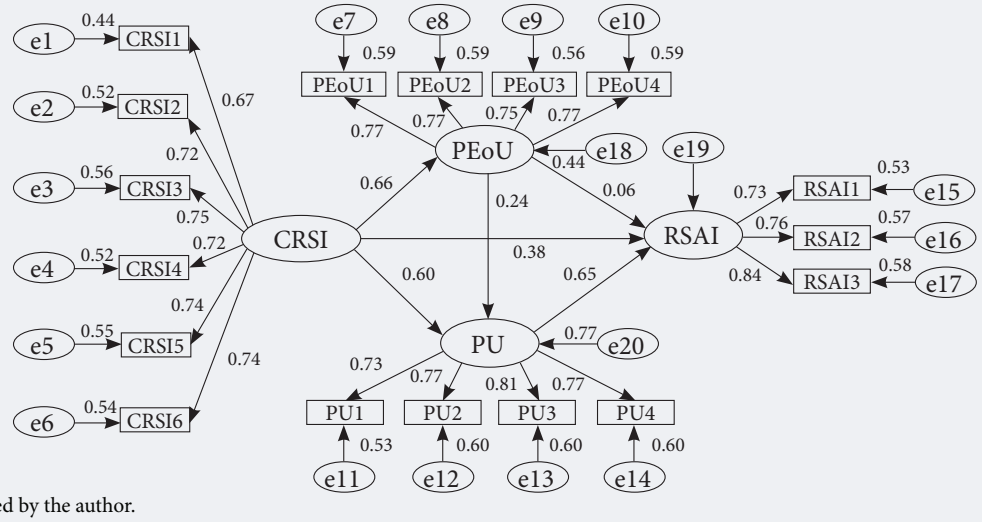
Source: compiled by the author.

Implications for Practice

This research contributes to the work of practitioners, especially that of e-commerce managers. The empirical study shows that the interactions between users and the RS can improve the usability of the RS and enhance user willingness to adopt the RS. As is expected, the results of this study provide strong support for our first hypothesis and confirms that the positive effect of perceived interpersonal interaction on RSAIs is indeed significant. Interactions between users and RS can make the assumptions of technology acceptance easier by improving online shopping experiences in the following ways.

First, the RS can improve the interaction between the users and the system by providing fully functioning settings showing their preferences, such as questioning, rating, commenting, favorites recording, and giving approval ratings. Second, more attention can be given to network-based recommendations to improve the social value of personalized recommendation services. In this way, individuals from various social circles can generate a common stance on a certain product or service,

Figure 2. **Standardized Path Coefficient of the Model of RSAIs**



Source: compiled by the author.

Table 3. **The Test of Discriminant Validity of Each Measurable Variable**

Model		M1	M2	M3	M4	M5	M6	M7
Pair variable		Basic model	CRSI<--> PEoU	PEoU<--> RSAI	PU<--> RSAI	CRSI<--> PU	PEoU<--> PU	CRSI<--> RSAI
χ^2		301.609	692.847	611.202	538.782	605.564	595.931	606.049
df		113	114	114	114	114	114	114
$\Delta\chi^2$		—	391.238***	309.593***	237.173***	303.955***	294.322***	304.440***
Δ *df*		—	1	1	1	1	1	1
RMSEA		0.039	0.069	0.064	0.059	0.063	0.063	0.063
GFI		0.967	0.940	0.946	0.950	0.945	0.946	0.945
AGFI		0.956	0.919	0.928	0.933	0.926	0.927	0.927
TLI		0.977	0.929	0.939	0.948	0.939	0.941	0.939
CFI		0.981	0.940	0.949	0.956	0.949	0.950	0.949
Point estimation		—	0.662	0.729	0.907	0.855	0.779	0.841
Bootstrapping 5000 times, 95% CIs	Bias-corrected percentile	Min	0.601	0.665	0.870	0.818	0.726	0.796
		Max	0.716	0.785	0.941	0.890	0.826	0.879
		P	***	***	***	***	***	***
	Percentile	Min	0.601	0.664	0.870	0.819	0.726	0.797
		Max	0.716	0.784	0.942	0.891	0.825	0.880
		P	***	***	***	***	***	***

Note: CRSI — Customer-RS interaction; PEoU — Perceived ease of use; PU — Perceive usefulness; RSAI — RS adoption intention; *p <0.05; **p<0.01; ***p<0.001. CIs denotes confidence intervals.

*Source:*compiled by the author.

helping to attract more customers to use the RS and maintain existing ones. The third is to establish an incentive system to strengthen interactions with consumers. Due to the lack of data from new users, the RS does not possess adequate information to know about their preferences and thus may frequently provide low-quality recommendations. In this case, a customer reward system can operate, such as the giving of "points" or vouchers when logging into a particular website. This enticement can be used to encourage them to actively enter personal preference information.

The empirical study also confirms that the development of customer-RS interaction would not only increase customers' RSAIs, but also be helpful in improving their perceived ease of use. This can be improved by:

1) Optimizing a search engine and navigation system of the online sites making it easier for the consumers to find the products they want.

2) Placing the recommendations in a more prominent position on the webpage and displaying them in an appealing color scheme. For example, using the keyword search "body clothing" a website might appear retailing high-end skin-tight sportswear. The designers of the site could predominantly use red and black to convey courage and maleness to attract users.

Table 4. **Summary of the Standardized Direct, Indirect, and Total Effects in this Model**

Path	Point estimation	Product of coefficients		Bootstrapping 5000 times 95% CI					
				Bias-corrected percentile			Percentile		
		SE	z-value	Lower	Upper	P	Lower	Upper	P
Standardized indirect effect									
CRSI → PEoU → PU	0.260	0.033	7.879	0.199	0.329	0.000	0.197	0.326	0.000
CRSI → PU → RSAI	0.387	0.065	5.954	0.269	0.525	0.000	0.270	0.527	0.000
PEoU → PU → RSAI	0.247	0.050	4.940	0.163	0.357	0.000	0.161	0.354	0.000
Total standardized indirect effect	0.894	0.110	8.127	0.696	1.126	0.000	0.696	1.124	0.000
Standardized direct effect	0.239	0.072	3.319	0.097	0.385	0.002	0.094	0.382	0.002
Total standardized effect	1.141	0.158	7.222	0.860	1.474	0.000	0.862	1.476	0.000

Notes: CRSI — Customer-RS interaction; PEoU — Perceived ease of use; PU — Perceived usefulness; RSAI — RS adoption intention; *p <0.05; **p <0.01; ***p <0.001.

Source: author.

3) Optimizing the interface design of the RS. For example, set the "sort" function button in the recommendation interface to facilitate consumers being able to categorize recommended products along with other helpful detailed searches to include user rating, price, and also highlight products that are on sale. However, caution should be used and one should not allow too many pop-up dialogs or dynamic ads on the website given that this can affect the loading speed of the webpage and complicate the consumer's ability to navigate due to an excess of information, thus slowing down the whole process.

Additionally, enhancing the usefulness of the system is also a possible option for improving the human-computer interaction when designing the recommendation system, thought needs to be given to improve the accuracy of the recommendation information in order to shorten the time for the customers to identify and select the products. Therefore, the acceleration of the recommendation responses is paramount while also trying to provide real-time recommendations which would allow customers to obtain the updated product information speedily. Another suggestion is to recommend personalized products for customers by conducting research and analyzing consumer behavior data, allowing users to feel that the recommendation system is not primarily aimed at advertising for the main purpose of increasing sales, but to meet their own personalized needs and thus improve their shopping experience in an efficient manner.

Limitations and Further Research

Although the findings of this study supply numerous meaningful references for practitioners, there are also certain limitations that can provide avenues for future studies. First, this study explores the influence of some key variables on the RSAI of university students. However, since the online RS cannot function independently without the embedded shopping websites and the design capability and service quality of the sites, they cannot be guaranteed, which results in the consumers' turning to the advice of the shopping website. As such, future studies should be devoted to delving into the factors affecting the RS of the shopping websites and the willingness to adopt a large personalized RS in a more comprehensive way on the basis of customer-RS interaction research. Second, the limited sample size of students might constrain the generalization of the results since the survey is restricted to the Chinese context. Therefore, it is suggested that future studies be conducted with broader data collection or less limiting constraints and consideration of such things as the specific geographical location or even cultural conditions.

References

Anderson J.C., Gerbing D.W. (1988) Structural equation modeling in practice: A review and recommended two-step approach. *Psychological Bulletin,* vol. 103, no 3, pp. 411–423.

Bagozzi R.P., Phillips L.W. (1982) Representing and testing organizational theories: A holistic construal. *Administrative Science Quarterly,* vol. 27, no 3, pp. 459–489.

Bagozzi R.P., Yi Y. (1989) On the use of structural equation models in experimental designs. *Journal of Marketing Research,* vol. 26, no 3, pp. 271–284.

Bechwati N.N., Xia L. (2003) Do computers sweat? The impact of perceived effort of online decision aids on consumers' satisfaction with the decision process. *Journal of Consumer Psychology,* vol. 13, no 1/2, pp. 139–148.

Bhattacherjee A., Premkumar G. (2004) Understanding changes in belief and attitude toward information technology usage: A theoretical model and longitudinal test. *MIS Quarterly,* vol. 28, no 2, pp. 229–254.

Bo X., Benbasat I. (2007) E-commerce product recommendation agents: Use, characteristics, and impact. *MIS Quarterly,* vol. 31, no 1, pp. 137–209.

Carlson J., O'Cass A., Ahrholdt D. (2015) Assessing customers' perceived value of the online channel of multichannel retailers: A two country examination. *Journal of Retailing & Consumer Services,* vol. 27, no 6, pp. 90–102.

CNNIC (2019) *The 43rd China Statistics Report on Internet Development*, Beijing: China Internet Network Information Center.

Dabholkar P.A., Sheng X. (2012) Consumer participation in using online recommendation agents: Effects on satisfaction, trust, and purchase intentions. *Service Industries Journal,* vol. 32, no 9, pp. 1433–1449.

Davis F.D. (1989) Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly,* vol. 13, no 3, pp. 319–340.

Dodds W.B. (1991) Effects of price, brand, and store information on buyers' product evaluations. *Journal of Marketing Research,* vol. 28, no 3, pp. 307–319.

Dong H.Z., Chang Y.P., Jian J.L., Xin L. (2014) Understanding the adoption of location-based recommendation agents among active users of social networking sites. *Information Processing & Management — An International Journal,* vol. 50, no 5, pp. 675–682.

Fernández-Pérez V., Montes-Merino A., Rodríguez-Ariza L., Galicia P.E.A. (2019) Emotional competencies and cognitive antecedents in shaping student's entrepreneurial intention: The moderating role of entrepreneurship education. *International Entrepreneurship and Management Journal,* vol. 15, no 1, pp. 281–305. DOI: 10.1007/s11365-017-0438-7.

Fornell C., Larcker D.F. (1981) Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, vol. 18, no 1, pp. 39–50.

Gou L., You F., Guo J., Wu L. (2011) *Sfviz: Interest-based friends exploration and recommendation in social networks.* ACM International Conference Proceeding Series, 2011. DOI: 10.1145/2016656.2016671. Available at: https://www.researchgate.net/publication/254003084_SFViz_Interest-based_friends_exploration_and_recommendation_in_social_networks, accessed 23.10.2019.

Hair J.F., Black B., Babin B., Anderson R.E., Tatham R.L. (2010) *Multivariate data analysis* (7th ed.), London: Pearson Prentice Hall.

He Y., Chen Q., Kitkuakul S., Wright L.T. (2018) Regulatory focus and technology acceptance: Perceived ease of use and usefulness as efficacy. *Cogent Business & Management, vol. 5*, no 1, pp. 1–22. DOI: 10.1080/23311975.2018.1459006. Available at: https://www.cogentoa.com/article/10.1080/23311975.2018.1459006.pdf, accessed 25.10.2019.

Herlocker J.L., Konstan J.A., Terveen L.G., Riedl J.T. (2004) Evaluating collaborative filtering recommender systems. *ACM Transactions on Information Systems,* vol. 22, no 1, pp. 5–53.

Hoffman D.L., Novak T.P. (1996) Marketing in hypermedia computer-mediated environments: Conceptual foundations. *Journal of Marketing,* vol. 60, no 3, pp. 50–68.

Hsu M.H., Chang C.M., Chu K.K., Lee Y.J. (2014) Determinants of repurchase intention in online group-buying. *Computers in Human Behavior,* vol. 36, issue C, pp. 234–245.

IResearch (2018) *China university students' consumption insight report in 2018*, Beijing: IResearch.

Jannach D., Zanker M., Felfernig A., Friedrich G. (2010) *Recommender systems: An introduction*, Cambridge: Cambridge University Press.

Jeng R., Tseng S.M. (2018) The relative importance of computer self-efficacy, perceived ease-of-use and reducing search cost in determining consumers' online group-buying intention. *International Journal of Human and Technology Interaction,* vol. 2, no 1, pp. 1–12.

Kolar T., Zabkar V. (2010) A consumer-based model of authenticity: An oxymoron or the foundation of cultural heritage marketing? *Tourism Management,* vol. 31, no 5, pp. 652–664. DOI: 10.1016/j.tourman.2009.07.010.

Narver J.C., Slater S.F. (1990) The effect of a market orientation on business profitability. *Journal of Marketing,* vol. 54, no 4, pp. 20–35.

Pereira R.E. (2001) Influence of query-based decision aids on consumer decision making in electronic commerce. *Information Resources Management Journal,* vol. 14, no 1, pp. 31–48.

Preacher K.J., Hayes A.F. (2008) Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods,* vol. 40, no 3, pp. 879–891.

Qiang Y., Lin Z., Li Y., Shuang W., Sun T., Wang L., Chen H. (2016) Effects of product portfolios and recommendation timing in the efficiency of personalized recommendation: Effects of recommendation portfolios & timing. *Journal of Consumer Behaviour,* vol. 15, no 6, pp. 516–526.

Resnick P., Varian H.R. (1997) Recommender systems. *Communications of the ACM,* vol. 40, no 3, pp. 56–58.

Ricci F., Rokach L., Shapira B., Kantor P.B. (2011) *Recommender Systems Handbook*, Heidelberg, New York, Dordrecht, London: Springer.

Roca J.C., Gagné M. (2008) Understanding e-learning continuance intention in the workplace: A self-determination theory perspective. *Computers in Human Behavior,* vol. 24, pp. 1585–1604.

Rodrigues L.F., Oliveira A., Costa C.J. (2016) Playing seriously – how gamification and social cues influence bank customers to use gamified e-business applications. *Computers in Human Behavior,* vol. 63, no 9, pp. 392–407.

Salton G., McGill M. (1986) *An introduction to modern information retrieval*, New York: McGraw-Hill.

Smith A.D. (2013) Information exchanges associated with internet travel marketplaces. *Online Information Review,* vol. 28, no 4, pp. 292–300.

Taylor A.B., Mackinnon D.P., Tein J.Y. (2008) Tests of the three-path mediated effect. *Organizational Research Methods,* vol. 11, no 2, pp. 241–269.

Tsai M.-T., Cheng N.-C., Chen K.-S. (2011) Understanding online group buying intention: The roles of sense of virtual community and technology acceptance factors. *Total Quality Management & Business Excellence,* vol. 22, no 10, pp. 1091–1104. DOI: 10.1080/14783363.2011.614870.

Villegas N.M., Sánchez C., Díaz-Cely J., Tamura G. (2018) Characterizing context-aware recommender systems: A systematic literature review. *Knowledge-Based Systems,* vol. 140, no 15, pp. 173–200.

Yi H., Chen Q., Kitkuakul S. (2018) Regulatory focus and technology acceptance: Perceived ease of use and usefulness as efficacy. *Cogent Business & Management,* vol. 5, pp. 1–22.

Yuan S., Jeyaraj A. (2013) Information technology adoption and continuance: A longitudinal study of individuals' behavioral intentions. *Information & Management,* vol. 50, no 7, pp. 457–465.

Zampetakis L.A., Lerakis M., Kafetsios K., Moustakis V.S. (2015) The moderating role of anticipated affective ambivalence in the formation of entrepreneurial intentions. *International Entrepreneurship and Management Journal,* vol. 12, no 3, pp. 815–838. DOI: 10.1007/s11365-015-0367-2.

Zhao S., Zhou M.X., Quan Y., Zhang X., Zheng W., Fu R. (2010) Who is talking about what: Social map-based recommendation for content-centric social websites. *Proceedings of the 2010 ACM Conference on Recommender Systems, RecSys 2010, Barcelona, Spain, September 26-30, 2010* (eds. X. Amatriain, M. Torrens, P.J. Resnick, M. Zanker), New York: Association for Computing Machinery, pp. 143–150. DOI: 10.1145/1864708.1864737.

Foresight for Career Development

Anna Kononiuk[a]
Assistant Professor, a.kononiuk@pb.edu.pl

Anna Pająk[b]
Assistant Researcher, anna.pajak@itee.radom.pl

Alicja Ewa Gudanowska[a]
Assistant Professor, a.gudanowska@pb.edu.pl

Andrzej Magruk[a]
Assistant Professor, a.magruk@pb.edu.pl

Ewa Rollnik-Sadowska[a]
Assistant Professor, e.rollnik@pb.edu.pl

Justyna Kozłowska[a]
Assistant Professor j.kozlowska@pb.edu.pl

Anna Sacio-Szymańska[b]
Assistant Professor, anna.sacio@itee.radom.pl

[a] Bialystok University of Technology, 45A, Wiejska Street, 15-351 Bialystok, Poland
[b] Łukasiewicz Research Network — Institute for Sustainable Technologies), K. Pułaskiego 6/10, 26-600 Radom, Poland

Abstract

Career development has become a process of managing learning, experience, and change in order to achieve a personally determined, preferred professional future. In the context of dynamic social, economic, and technological changes, the role of career counseling services increases, although their character also evolves. New competences and abilities to use innovative tools that enable effective processes of creating career visions in a systemic manner are expected. In this context, the adaptation of futures studies to both the practice of and education in career counseling seems to be an interesting prospect. Exploring the future not only develops individual planning and adaptation skills, but also allows for detecting and identifying upcoming trends. It means the ability to adapt to new conditions, or the proactive creation of the future, in a way that is favorable. The aim of this article is to present a comprehensive methodology and the results of a nationwide survey conducted in Poland among practitioners in the field of career counseling. The scope of the study included an exploration of the potential of the application of a foresight methodology and future studies for education and practice in the field of career counseling. The main focus of this research is to examine the current quality and scope of educational offers for career counselors by the disconfirmation between the ideal features of the courses and the individual perception of the completed courses in the context of building abilities to apply future-oriented methodologies and tools. Competences in this area were also examined by assessing both their level among the practitioners and the assessment of their suitability in career counseling practice. The quantitative research was supported by individual interviews with practitioners and experts in the area of career counseling.

Keywords:
career development; futures studies; foresight; career counseling services; competences; skills; trends

Citation: Kononiuk A., Pająk A., Gudanowska A.E., Magruk A., Rollnik-Sadowska E., Kozłowska J., Sacio-Szymańska A. (2020) Foresight for Career Development. *Foresight and STI Governance*, vol. 14, no 2, pp. 88–104. DOI: 10.17323/2500-2597.2020.2.88.104

Conscious planning and creating a vision of one's career with the ability to adapt to the prevailing environmental conditions and dynamic changes today is not only an essential factor for successful professional career development, but also a prerequisite for functioning on a dynamically changing labor market. There is no doubt that the role and nature of the work will continue to change, the question that remains is 'how?' Many professions may disappear as a result of the adoption of AI and new emerging technologies but at the same time, new jobs will emerge. According to A. Toffler's statement, the so-called "third wave" in the 21st century means the need to have the ability to "learn, unlearn, and learn again" [*Toffler,* 1980]. Key actions in coping with the changing labor market should therefore include such elements as managing one's own competences, including planning an individual educational path in accordance with the paradigm of *lifelong learning* [e.g. *Mocker, Spear*, 1982; *Knapper, Cropley*, 2000; *Volles*, 2016], the ability to cope with change and adapt to new conditions. There are new challenges in supporting the development of careers of new generations – functioning on or just entering the labor market. According to the definition of the OECD [OECD, 2004], career counseling refers to services designed to provide support in making educational, training, and vocational choices, as well as career management, including lifelong education and development. Career counseling supports reflection on one's own ambitions, interests, qualifications, and skills as well as understanding the labor market and education system and linking this knowledge with self-knowledge. Counselors are therefore expected to possess new competences and the tendency to create models of career guidance as a holistic, contextual, and preventive solution, such as life-designing, life-constructing [*Savickas et al*., 2009; *Dauwalder*, 2014], or career exploration [*Stumpf et al.,* 1983; *Flum, Blustein*, 2000; *Neureiter, Traut-Mattausch*, 2017; *Jiang et al.,* 2019] becomes noticeable.

Numerous studies conducted over the last several decades on the models and methods of occupational intervention in the 20th century have shown that new approaches are needed, which will transform them into being able to meet the new needs and challenges of the 21st century labor market participants, who operate in a dynamically changing, knowledge-based, and information-intensive societies as part of a globalized economy. Contemporary theoretical models are needed in the area of career counseling that emphasize such characteristics of employees as flexibility, adaptability, and lifelong learning [*Savickas et al.,* 2009]. New career guidance methods should adopt a dynamic approach that encourages individuals to use their imagination, creative thinking, and discover and create new, alternative future professional identities [*Guan et al.,* 2017; *Oyserman et al*., 2006]. With regard to new concepts in career counseling theory such as career exploration, *future-oriented beliefs*, such as hopes for future careers or positive beliefs about the future, are important elements of future professional identity next to professional adaptability, which in the last decade was recognized as an important condition for the success of all professional ventures [*Jiang et al*., 2019].

In this context, the adaptation of methodologies of foresight and futures studies to career counseling practice seems to be advantageous. Basic knowledge and skills referring to the exploration and "use" of the future in various fields – so-called futures literacy – is considered the ability to create and process complex visions of the future and give them new sense. Exploring the future not only develops individual planning and adaptation skills, but also allows one to detect and identify upcoming trends [*Nazarko,* 2013; *Ejdys et al.*, 2019]. This means the ability to adapt to new conditions or proactively create the future in a way that is favorable for its recipients [*Bednarczyk et al.,* 2018; *Kononiuk et al.,* 2017b; *Magruk*, 2017].

The unique proposition of combining career counseling with future studies and foresight is the basis for an interdisciplinary methodology for the research conducted in the framework of the "Horizons of the Future" Project[1]. The project [*Kononiuk et al.,* 2019] focuses on two main thematic areas: a) trends analysis and their potential impact upon the labor market and b) the creation of various career development paths. However, to adapt new methods and methodologies to a given field, it is critical to analyze the potential of such a process in more specific ways. Taking on the challenge of creating "working methodological tools" for successful career counseling by adopting the perspective of foresight and futures studies requires a deeper understanding of the relationship between the two fields, namely: career counseling and foresight and futures studies. Hence, the questions posed in the very first stage of this study are, therefore, i) part of the methodological dimension: "what challenges and questions posed by the theory of career development and counseling can be supported and answered by foresight and future studies?"; "what are the common points between career development theories and future studies that may be most relevant to the design of a new interdisciplinary methodology"; ii) in the practical (application) dimension: "what is the attitude of career counselors to the future, especially

[1] Available at: http://horyzontyprzyszlosci.pl/ accessed 03.01.2020

in the dimension of professional practice"; "how can foresight and futures studies be practically used to support counseling practice"; "what competences are essential in order to successfully adapt futures studies and foresight to career counseling practice and education?"

The authors of this article agree with Rieckmann [*Rieckmann,* 2012] who defines competence as the "interplay of knowledge, capacities, skills, motives and affective dispositions." According to Symela [*Symela,* 2006], competences can be defined as the link between individual skills, personality traits, and qualities that are required for the efficient implementation of professional duties. Also, Dubois and Rothwell [*Dubois, Rothwell,* 2004] connect the term "competencies" with effective work performance. According to European Commission's European Skills Competences and Occupation taxonomy (ESCO), competence is "the proven ability to use knowledge, skills and personal, social and/or methodological abilities, in work or study situations and in professional and personal development."[2]

In order to identify the common points and the areas subject to the questions in the methodological dimension, source texts related to the career development and counseling practice were reviewed. In order to get answers to the questions related to the practical dimension, the study "Competences and the Quality of the Educational Offerings in the Field of Career Counseling practice in Poland" was conducted between January and March 2019, followed by a series of in-depth interviews with counseling professionals and representatives of the academic staff training future vocational counselors. The aim of this article is to present the main conclusions of the literature review and the methodology applied for this study that measures the quality of the educational offerings and competences of career advisors as well as the results of this analysis.

Research Methodology

An examination of the quality of educational offerings and an assessment of the competences that are relevant from the perspective of career counseling practice was carried out in the first quarter of 2019 among career advisers and people working in areas related to career support and career development. The methodology of the study consisted of four main stages (Figure 1).

In total, the research involved 253 respondents[3], practitioners working in the areas related to career counseling and career development and planning, including representatives of employment offices, academic career offices, various levels of schools, as well as academics.

The first stage of the research was aimed at creating research tools for the implementation of the study. In the first place, this covered the identification of thematic areas of career counseling education and practice in which the futures studies and foresight methodologies could be applied as well as the competences that enable individuals to deal with future-oriented tasks [*Kononiuk et al.,* 2017a]. The analysis focused on two thematic areas of the project: (a) trends analysis and their potential impact upon the labor market; (b) creating various career development paths. Desk research was based on the literature review comprising of the revision of: i) scientific articles according to the main keywords: career counseling, vocational counselor, career counselor competences, and their Polish-language counterparts; ii) an overview of European and national qualification frameworks for career counseling and career development practitioners [OECD, 2017; *Hiebert, Neault*, 2013; DHET, 2016; CEDEFOP, 2009a, 2009b; NCDA, 2009; *Sultana*, 2004]; iii) a review of legal acts regulating vocational and career counseling in Poland by the Ministry of Education and Ministry of Family, Labour and Social Policy; iv) study programs and syllabuses from six universities in Poland conducting studies in the field of career and vocational counseling and related subjects, as well as the evaluation of a framework program of post-graduate studies in the field of education and vocational counseling [*Bielecki et al.,* 2015].

Taking into account the practical orientation of the project and the purpose of the study, it was decided to indicate key skills as well as tools and methods in career counseling teaching and practice that appear in the source materials selected for the review process (Table 1).

The indicated thematic areas as well as the areas of skills, tools, and methods selected after the literature review, which were considered the most appropriate for introducing the foresight methodology and future studies into career counseling education and practice were then confronted with areas of knowledge and methodologies in the field of future studies and foresight. Moreover, they have been assigned to the thematic areas of the project, namely: (a) trends analysis and their potential impact upon the labor market and (b) creating various career development paths.

Based on the analysis, the potential program content was divided into "knowledge" and "skills" categories related to futures studies and foresight methodology (Table 2). "Knowledge" and "skills" categories were

[2] Available at: https://ec.europa.eu/esco/portal/home?resetLanguage=true&newLanguage=en, accessed 21.03.2020.

[3] That number includes both respondents of quantitative (240) and qualitative (13) research. The tools of two quantitative studies were delivered to the same group of experts (240 of them participated in the competency gap survey and 178 of respondents filled in SERVQUAL questionnaire).

used in accordance with the generally recognized division for the design of the educational content and competency frameworks [*McClune, Jarnam,* 2010; *Fernández-Sanz et al.,* 2017]. Together with the "attitude" or "values" they can be considered the constitutive elements of the potential learning outcomes model. Furthermore, "knowledge" and "skills" next to "responsibility" and "autonomy" are the main indicators of the learning outcomes relevant to European Qualifications Framework (EFQ) in the context of professional qualifications[4]. In this paper, the "knowledge" category includes topics in which the basis of theoretical knowledge should be provided, which is necessary for using foresight methodologies and futures studies (cognitive domain). The "skills" category includes skills that are necessary to successfully apply foresight methodologies and future studies in practice.

The identified thematic areas were the basis upon which to design the research tools for the **quantitative research** (evaluation surveys) in the next stages of project implementation. It included:

1. Statements regarding the quality and scope of the current educational offerings in career counseling courses – for the SERVQUAL tool [*Ahmed et al.,* 2017; *Ali et al.*, 2014; *Parasuraman et al.,* 1985].
2. A list of related competences relevant from the perspective of practice and education in the field of career counseling – for the Competency gap tool.

Both tools were elaborated upon by the authors.

In the quantitative study, the following two research hypotheses were tested:

1. Career guidance practitioners in Poland lack skills in the analysis of external trends impacting the labor market.
2. Career guidance practitioners lack skills in the analysis of alternative career development paths.

The quantitative research was supported by qualitative research which was carried out using the individual in-depth interview (IDI) technique. Twelve interviews were conducted among 13 experts[5] – the career advisors and people working in areas related to career support and career development. The main objectives of the qualitative research were to determine the quality of educational offerings and teaching methodologies in the field of vocational counseling and to identify features and functionalities of preferred educational tools used by persons educating vocational counselors.

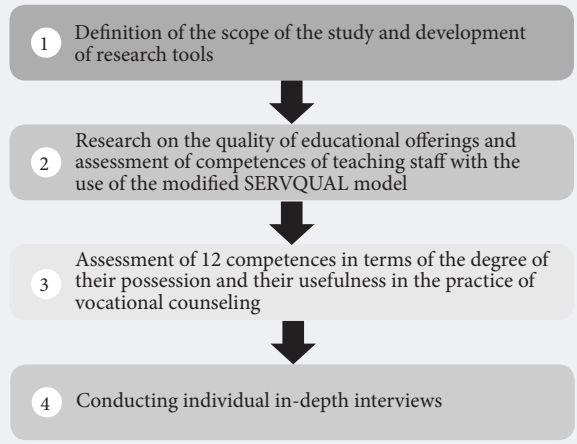
Research Findings

SERVQUAL Model Adaptation to Career Ccounseling

The first stage of the quantitative research was based on the SERVQUAL model [*Parasuraman et al.*, 1985]. It is widely used to measure the quality of a service from the customer's point of view. The authors of the study adapted the model to career guidance practice by developing 24 statements taking into account the specificity of the practice and the extent of applying trends analysis and methods of developing alternative career paths by career counselors. The use of the model allows for the detection of so-called gaps between the quality of the courses offered and the ideal courses in the field of career guidance.

The SERVQUAL survey involved 178 respondents. Each of 16 provinces were represented by at least two respondents. The most numerous respondents were professional advisers from the Mazowieckie (12%), Śląskie (11%), and Małopolskie (10%) voivodships. Almost half of the respondents (82 persons, which constitutes 46% of the research sample) were in the age group between 35 and 44, one third – between 45 and 54, and 13% – over 54. The majority of respondents were people working actively in the profession of counselor for over a dozen years. About one fourth of the surveyed advisers (21%) worked in the profession for more than 15 years, while one third were involved in counseling for less than 15, but more than 10 years. Slightly over 30% were vocational counselors with work experience between five

Figure 1. **The Main Stages of the Research Methodology**



Source: compiled by the authors.

[4] Available at: https://ec.europa.eu/ploteus/en/content/descriptors-page; accessed 17.03. 2020

[5] In one interview, two experts took part.

Table 1. **Skills, Tools, and Methods for Career Counseling Education and Practice in Which the Futures Studies and Foresight Methodologies are Adequate to Apply**

Area	Content examples
Skills required	• Skills in observing, searching for, and processing information on social phenomena of various types, using various sources, and interpreting them from the point of view of educational problems and professional development. • Determining factors influencing the creation of individual career paths. • Providing support in the selection of educational and vocational paths. • Setting goals, tasks, and activities in the context of planning an educational and vocational path. • Ability to generate original solutions for complex problems and forecast the course of their resolution and predict the effects of planned activities in specific practical areas. • Ability to set goals, alternative options for action (setting short- and long-term goals, verification of goals, plan «B», compiling goals on the individual steps necessary to take). • Draws up an individual action plan, plans various options for educational and professional paths based on the balance of one's own resources and values as well as information on the education and labor market, anticipating the effects of their own decisions.
Tools and methods	• Methods for conducting classes, including activating methods taking into account the thematic scope and the specificity of the group. • Modern tools and methods in the practice of vocational counseling in youth work. • Methods and techniques for conducting group classes, including methods that activate, motivate, and engage participants. • Methodology of career planning. • Original solutions to complex problems and forecasting the course of their resolution and predicting the effects of planned activities in specific practical areas.

Source: compiled by the authors.

and 10 years. The interviewed career advisors were employed at various institutions and organizations. Almost one third of the research sample was made up of advisors from labor offices (31%). Subsequent groups (in terms of percentage share) included advisors employed at primary schools (16%), career offices at universities (13%), technical schools (11%), and general secondary schools (8%). A large group (16%) were advisers employed in places not indicated in the questionnaire, i.e.: psychological-educational counseling centers, voluntary labor troops, education centers, or vocational and lifelong learning centers. For 68% of the respondents (i.e. 121 persons), work related to vocational counseling was their main occupation. The most popular form of education in the field of counseling in the examined sample were studies – over 80% of the surveyed counselors gained their education during post-graduate studies and another 17% did so during bachelor's studies or master's studies. A small number of advisers (2%) used full-time or online courses. Over half of the respondents (62%) completed education at a public institution and the remaining number (38%) chose private institutions.

Table 3 shows the average assessments of 24 statements elaborated upon by the authors concerning the vocational counseling education completed by the respondents, assessed using a seven-point Likert's scale, where 1 means that "I definitely do not agree with the statement" and 7 means that "I definitely agree with the statement."

The last column of the Table 3 also shows the arithmetic means for each statement. The lowest scores were given to statements referring to the use of interactive whiteboards for group work (statement 3), online games (statement 4), and interactive educational games in counseling (statement 2). At the same time, these statements obtained the lowest arithmetic means for all responses, which amounted to 2.12, 2.09 and 2.85, respectively. The results obtained suggest a low level of use of online and interactive educational games in the training of career guidance counselors.

Low scores were also obtained for statements referring to: the development of skills for analyzing scientific and technological trends and their impact upon the labor market (3.54) (statement 8), the possibility of choosing one specialization adapted to the specificity of current or future professional practice (3.75) (statement 16), updating didactic content depending upon scientific and technological trends (3.96) (statement 17), and economics specialists among didactic staff of vocational counseling (3.94) (statement 19).

On the basis of the conducted analysis, it may also be concluded that the problem of the analysis of scientific and technological trends, such as automation, robotization, digitization, which is the subject of interest of the project, is treated marginally within the framework of the education completed by the respondents.

The highest scores were given to statements referring to the atmosphere in which education took place, which was conducive to free discussion (statement 23) and to specialists in psychology among teaching staff (statement 21). At the same time, these statements obtained the highest arithmetic means of 5.71 and 5.39 for all responses, respectively. The ranking of average ratings of respondents is presented in Figure 2.

Table 2. **Potential Program Content and Competence Areas for Applying Foresight and Futures Studies to Career counseling Education and Practice**

Thematic area (a): trends analysis and their potential impact upon the labor market	
Knowledge – what knowledge should a graduate have?	Skills – what skills should a graduate have?
• concepts related to the emergence and dynamics of change in scientific and technological trends, as well as the implications related to them on the labor market (notions of trends, megatrends); • the labor market as a system - elements, definitions, features, actors; • analyses of supply and demand on the labor market and forces affecting them; • methodologies for analyzing ‹future professions›; • the concept of system and system analysis; features of complex systems, economic system as a complex system, social system as a complex system, system connections; • change, change management, theoretical approach; • basic theoretical aspects regarding changes in the context of the work environment	• stimulate / inspire reflection on the future of people covered by support and counseling; • Moderate future-oriented thinking processes and group discussions about the future; • use interactive and engaging tools to implement program content related to the analysis of scientific and technological trends as well as economic and social change; • perform a basic analysis of scientific and technological trends including the search for and selection of appropriate sources of information and content; • moderate the group process in the field of system analysis and anticipation of the future; • perform a basic analysis of changes in the context of the work environment; • inspire future-oriented reflection on one's own educational and professional plans; • using the environmental scanning method.
Thematic area (b) creating various career development paths	
Knowledge – what knowledge should a graduate have?	Skills – what skills should a graduate have?
• wild cards and weak signals; • theoretical basis of the scenario method; • elements of storytelling (personalized scenarios); • theoretical foundations of methodology elements of reflexive writing; • the concept of uncertainty and the differences between uncertainty and risk, and the importance of uncertainty in the context of career planning.	• facilitate an individual and group process using scenario methods in the context of creating individual career paths; • analyze the scenarios and indicate their implications and meanings as a tool for career planning and promoting the idea of lifelong learning.
Source: compiled by the authors.	

Table 4 shows the average assessment of 24 statements concerning ideal vocational guidance education assessed on a seven-point scale, where 1 means that "I strongly disagree with the statement", and 7 means that "I strongly agree with the statement".

On the basis of the obtained data, it can be noted that the respondents have high expectations towards education in the field of vocational counseling. This is evidenced by the high average marks obtained, amounting to more than 5.42 and the average of average marks at the level of 6.26 (in the case of completed education, the average of average marks was at the level of 4.31). The highest expectations are expressed in terms of: the atmosphere in the classroom, which should be conducive to open discussion (statement 23), the ability to take a different perspective, to understand and accept different points of view (statement 24), and the content of education, which should include issues related to competences and professions of the future (statement 11). This is evidenced by the high arithmetic means of 6.62, 6.58, and 6.57, respectively. The results also indicate high expectations of the respondents as to the need to take into account scientific and technological trends (statement 8), economic trends (statement 9), and social trends (statement 10) in educational content. The average score for the three statements is 6.25. Respondents also have high expectations of being able to create alternative (optional) career paths (statement 6) and to include content on competences and occupations of the future in curricula (statement 11). This is also confirmed by the high arithmetic means for statements of 6.51 and 6.57, respectively. The ranking of average ratings of respondents is presented in Figure 3.

On the basis of the analysis of the data, four gaps are clearly visible. The biggest gap was noted in the comparison of arithmetic mean values perceived and expected by respondents as regards the use of dedicated online games by teaching staff (-3.73) (statement 4).

There was also a large gap in the use of interactive whiteboards for group work by teaching staff (-3.60) (statement 3). An important difference in perception and expectations can also be observed with regard to the use of interactive educational games (-3.25) in the training of vocational guidance counselors. A slightly lower but still significant gap (-2.57) was noted with respect to the development of learners' skills in the analysis of technological trends (e.g., automation, robotization, and digitization) and their impact upon the labor market (statement 8). The presented results in relation to the largest gaps show the strong need of respondents to make the form of classes more attractive in terms of group work, gamification, and taking into account scientific and technological trends shaping the labor market.

The smallest gap (-0.56) in the perception of com-

Table 3. **The Assessment of the Statements Relating to Vocational Guidance Training Completed by the Respondents**

	Statement	Arithmetic mean
1	The teaching staff in vocational counseling training completed by me used modern educational tools	**4.39**
2	The teaching staff in vocational counseling training completed by me used interactive educational games	**2.85**
3	The teaching staff in vocational counseling training completed by me used interactive whiteboards for group work	**2.12**
4	The teaching staff in vocational counseling training completed by me used online games	**2.09**
5	The training in vocational guidance completed by me developed my ability to formulate personal and professional goals	**4.81**
6	The training in vocational guidance completed by me developed my skills to create alternative (optional) career paths	**4.57**
7	The training in vocational guidance completed by me developed the skills to inspire others to pursue lifelong learning	**5.07**
8	The training in vocational guidance completed by me developed skills for analyzing technological trends (e.g. automation, robotization, digitalization) and their impact on the labor market	**3.54**
9	The training in vocational guidance completed by me developed skills that can be used to analyze economic trends (e.g. factors shaping labor demand, wage levels, shortage and surplus occupations) and their impact upon the labor market	**4.16**
10	The training in vocational guidance completed by me developed skills for analyzing social trends (e.g. migration processes, ageing, globalization) and their impact upon the labor market	**4.23**
11	The training in vocational guidance completed by me included topics related to competences and occupations of the future	**4.94**
12	The training in vocational guidance completed by me included issues related to cause and effect analysis in the context of the labor market as a complex system	**4.28**
13	The training in vocational guidance completed by me provided students with methods/techniques for analyzing variability and uncertainty in the context of the career planning processes	**4.19**
14	The training in vocational guidance completed by me provided students with the opportunity to learn methods of activating and involving the group (e.g. in the form of an educational board games, brainstorming, project method)	**5.01**
15	The training in vocational guidance completed by me included universal content allowing for individual and group counseling in every social group and for people at every age	**5.11**
16	The training in vocational guidance completed by me enabled the choice of one specialization adapted to the specificities of current or future work practice (e.g. guidance for adults, work with young people, career planning, etc.)	**3.75**
17	Program content of the training in vocational guidance completed by me were updated according to scientific and technological trends	**3.96**
18	The classes in my vocational guidance training, were conducted by practitioners of vocational counseling	**5.03**
19	The teaching staff conducting the classes within my training in vocational guidance included specialists in economics	**3.94**
20	The teaching staff conducting the classes within my training in vocational guidance included specialists in sociology	**4.46**
21	The teaching staff conducting the classes within training in vocational guidance included specialists in psychology	**5.39**
22	The teaching staff conducting the classes within my training in vocational guidance efficiently moderated the group processes	**4.73**
23	The atmosphere in the classes of the training in vocational guidance completed by me was conducive to open and free discussion	**5.71**
24	Training in vocational guidance enabled me to acquire the ability to take a different perspective, to understand and accept different points of view	**5.14**

Source: compiled by the authors.

pleted education and ideal education was noted in the case of sociology specialists who provide vocational guidance (statement 21) and in the case of the classroom atmosphere (-0.91), which by definition should encourage open and free discussion (statement 23). The presented results may prove a high degree of satisfaction with the aforementioned components of the completed education and their conformity with expectations. The most important thing in formulating conclusions from the results obtained using the SERVQUAL method is to strive for a state where there are no gaps. Therefore, in the last stage of the analysis, an average gap was calculated for all statements, which was at the level of (-1.95) (Table 5).

Taking into account the seven-point scale of assessments, in the opinion of the authors of this article, the observed gaps indicate the existence of significant differences between the perception of completed vocational counseling courses and the expectations of respondents in this area. Therefore, it can be assumed that the expectations of respondents as

Table 4. **The Assessment of Statements Relating to Ideal Vocational Guidance Training**

	Statement	Arithmetic mean
1	The teaching staff in the ideal vocational counseling training uses modern educational tools	**6.37**
2	The teaching staff in the ideal vocational counseling training uses interactive educational games	**6.11**
3	The teaching staff in the ideal vocational counseling training uses interactive whiteboards for group work	**5.72**
4	The teaching staff in the ideal vocational counseling training uses dedicated online games	**5.82**
5	Ideal training in vocational guidance develops the ability to formulate personal and professional goals	**6.52**
6	Ideal training in vocational guidance develops the ability to create alternative (optional) career paths	**6.51**
7	Ideal training in vocational guidance develops students' ability to inspire others to pursue lifelong learning	**6.52**
8	Ideal training in vocational guidance develops students' skills in analyzing technological trends (e.g. automation, robotization, digitalisation) and their impact upon the labor market	**6.11**
9	Ideal training in vocational guidance develops students' skills in analyzing economic trends (e.g. factors shaping labor demand, wage levels, shortage and surplus occupations) and their impact upon the labor market	**6.35**
10	Ideal training in vocational guidance develops students' skills in analyzing social trends (e.g. migration processes, ageing, globalization) and their impact upon the labor market	**6.29**
11	Ideal training in vocational guidance covers issues related to competences and occupations of the future	**6.57**
12	Ideal training in vocational guidance includes issues related to cause and effect analysis in the context of the labor market as a complex system	**6.29**
13	Ideal training in vocational guidance provides knowledge of methods/techniques of analysis of variability and uncertainty in the context of career planning processes	**6.33**
14	Ideal training in vocational guidance provides students with the knowledge of methods of activating and involving the group (e.g. in the form of an educational board games, brainstorming, project method)	**6.47**
15	Ideal training in vocational guidance includes universal content for individual and group guidance in every social group and for people at every age	**6.50**
16	Ideal vocational guidance training enables the selection of one specialization adapted to the specificities of current or future professional practice (e.g. guidance for adults, work with young people, career planning, etc.)	**5.42**
17	Program content within ideal vocational guidance training is updated according to scientific and technological trends	**6.24**
18	During ideal training in vocational guidance, classes are conducted by practitioners of vocational guidance	**6.47**
19	The teaching staff conducting the classes within ideal vocational guidance training includes specialists in economics	**5.81**
20	The teaching staff conducting the classes within ideal vocational counseling training moderates the group process efficiently during the classes	**6.35**
21	The teaching staff conducting the classes within ideal vocational guidance training includes specialists in sociology	**5.94**
22	The teaching staff conducting the classes within ideal vocational guidance training includes specialists in psychology	**6.41**
23	The atmosphere in the classes of the ideal vocational guidance training promotes open and free discussion	**6.62**
24	Ideal training in vocational guidance enables you to acquire the ability to take a different perspective, understand, and accept different points of view	**6.58**

Source: compiled by the authors.

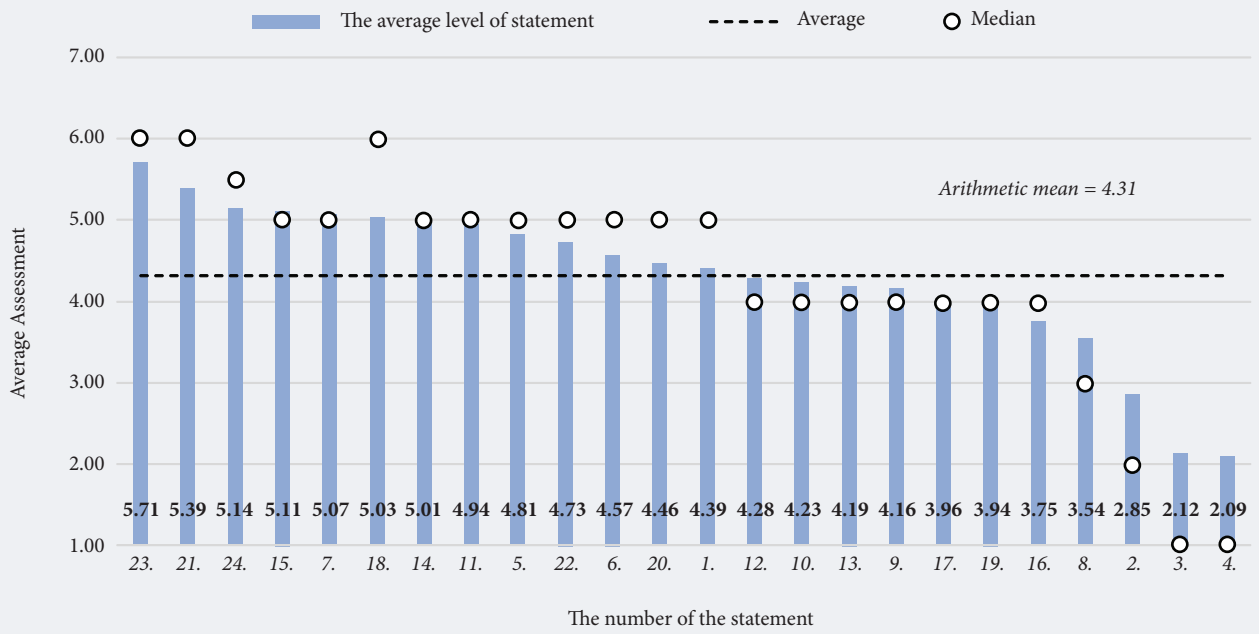
to the quality of educational offerings in the field of vocational counseling are not met.

Measuring the Competency Gap

The competency gap survey was completed by 240 respondents. The majority of respondents have been actively working as vocational advisors for several years. Almost half of the respondents (45.8% of the research sample) are between 35 and 44 years old. About a third of respondents are between 45 and 54 years old, while 14% are over 54 years old. The least numerous group of advisors (12.5%) were respondents aged 25 to 34. Thus, the surveyed career counselors are mainly people over 35 years of age. The interviewed advisors completed various forms of education in vocational counseling. Higher education is the most popular form – over 60% of the surveyed counselors completed post-graduate studies and another 13% completed this training during bachelor's and master's full-time studies. A few advisors attended full-time courses (5% of the research sample) or online courses (3% of the respondents). The remaining 13% did not complete vocational counseling education in any of the forms indicated.

As regards the assessment of twelve specific, futures studies and foresight-related competences, the re-

Figure 2. **Ranking of the Average Assessment of Statements in Relation to Vocational Counseling Education**

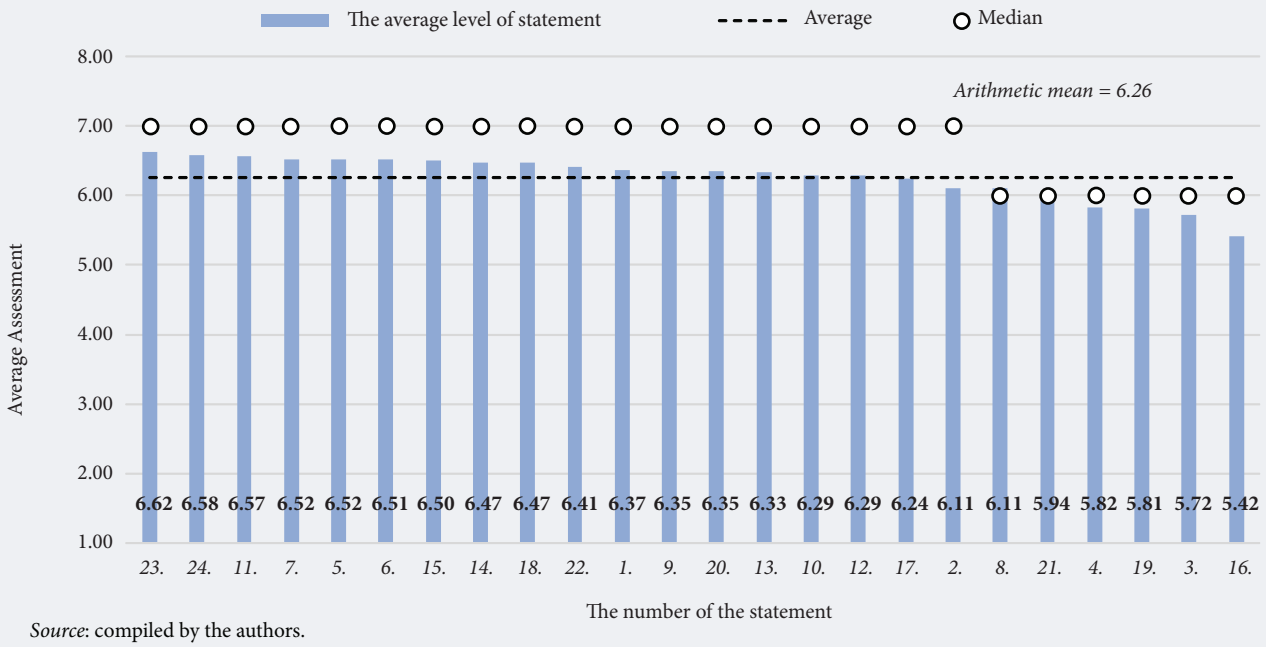


Source: compiled by the authors.

spondents were asked to evaluate the competences in two dimensions. The first dimension focused on a self-assessment of the level of competence, the second was related to the assessment of the usefulness of the same competences in the practice of vocational counseling. The aim of the research was to assess the potential competency gaps [*Lester, Religa*, 2017].

The final list of competences was created based on the areas of "knowledge" and "skills" generated in the previous stage of the study and on expert consultations with vocational counseling practitioners. Generated competences were selected for the final list, including three related explicitly to knowledge and nine to skills. However, some of the statements

Figure 3. **Ranking of the Average Assessments of Statements in Relation to Vocational Counseling Education**



Source: compiled by the authors.

Table 5. **Ranking of Differences between Average Perceived Values (Completed Course) and Expected Values (Ideal Course)**

Statements	Completed (average)	Ideal	Gap
4	2.09	5.82	–3.73
3	2.12	5.72	–3.6
2	2.85	6.11	–3.25
8	3.54	6.11	–2.57
17	3.96	6.24	–2.28
9	4.16	6.35	–2.2
13	4.19	6.33	–2.13
10	4.23	6.29	–2.06
12	4.28	6.29	–2.01
1	4.39	6.37	–1.97
6	4.57	6.51	–1.94
20	4.46	6.35	–1.89
19	3.94	5.81	–1.87
5	4.81	6.52	–1.7
22	4.73	6.41	–1.68
16	3.75	5.42	–1.66
11	4.94	6.57	–1.62
14	5.01	6.47	–1.47
7	5.07	6.52	–1.45
18	5.03	6.47	–1.44
24	5.14	6.58	–1.44
15	5.11	6.5	–1.39
23	5.71	6.62	–0.91
21	5.39	5.94	–0.56
AVERAGE			–1.95

Source: compiled by the authors.

related to abilities at the same time require specific knowledge, for example, in the field of the labor market. In order to ensure conceptual clarity and obtain the best-quality research results, it was also decided to choose competences that constitute the basic level of competence important from the perspective of futures studies and foresight methodologies in career counseling education and practice while at the same time considering ones that some of vocational counselors may already possess. It was also considered important to translate specialized concepts of foresight and future studies into more general and understandable categories, such as "the ability to interpret signals of impending changes in the external environment (signs of new trends)" instead of "wild cards and weak signals," which could be difficult to interpret by the respondents. The competences are described in Table 6.

For each of the 12 competences indicated in the questionnaire, the arithmetic mean was calculated for the assessments in two dimensions, first in order to examine the individual degree of possession of a competence (self-assessment), and the second, to examine the usefulness of the competence in professional practice.

In terms of first dimension, the self-assessment of the competences, the study results show that 53 respondents lack some of the competences indicated in the questionnaire (rate 1 on the scale, Table 7). Of this group, almost half (25 respondents) claim to be incompetent in the knowledge of coaching models (C12). A significant group (121 respondents) indicated a very low level (rate 2) of competence in the following areas: analyzing trends and megatrends on the labor market (C7), using creative techniques during the advisory process (C5), and the ability to interpret signals from the external environment (C8). Therefore, these four competences (namely C12, C7, C5, C8) can be considered weaknesses of vocational counselors in their own opinion. On the other hand, the highest-rated competences were: C9 (205 assessments at levels 4 and 5 in total), C2 (204 assessments at levels 4 and 5), C10 (in total 201 grades at levels 4 and 5), and C1 (200 grades at levels 4 and 5 in total). The results were reflected in the average levels of counselor's assessment by establishing the following competences at the lowest level: C12, C7, C5, and C8. At the same time, the competences C9, C2, and C10 received the highest levels of self-assessment on average (Table 7).

In terms of the second dimension, from the perspective of career counseling practice, the respondents considered the following competences the most important: C2, C11, C1, C9, and C10. By comparing the average results of self-assessment of respondents' competences and the average of the usefulness of each competence from the vocational advisor's point of view, the differences were obtained, which illustrate competence gaps (Figure 4).

The largest gap can be noted in the same competences that are the advisor's weaknesses, namely: C12 – knowledge of coaching models, C7 – the ability to analyze trends and megatrends, C5 – the ability to apply creative techniques. The gap has also been defined in the field of the knowledge of coaching tools and techniques (competence C11), in which advisors seem to be rather well-skilled. But it is also considered very useful in the everyday practice of the advisor work – it was given the second-highest score in terms of the usefulness assessment, so the difference between the studied assessments was significant and thus it has been classified as a competency gap.

Identifying the gap raises many questions, one of which is: Does the education of career counselors in some specific form allow them to become more competent in some aspects? To examine whether any relationship may be observed between the com-

Table 6. **Description of Competences under Consideration**

Code of competence	Description
C1	moderating work in a group (e.g. using workshop methods, games, open group discussion)
C2	inspiring others to take action
C3	system thinking, taking into account the complex nature of the environment, cause-effect relationships, and unobvious relations between phenomena
C4	knowledge and the use of scenario methods (methods of creating alternative career paths) in the advisory process
C5	the ability to apply creative techniques during the advisory process, (e.g. mind maps, design thinking, visualizations to create professional plans)
C6	the ability to create an individual vision of the professional future
C7	the ability to analyze trends and megatrends affecting the labor market
C8	the ability to interpret signals of impending changes in the external environment (signs of new trends)
C9	the ability to analyze and use data and information from various sources and the ability to infer on this basis
C10	the ability to adapt and understand a different perspective, overcoming the existing patterns of thinking
C11	knowledge of coaching tools and techniques for effective interpersonal communication (e.g. ability to ask the right questions, paraphrasing)
C12	knowledge of coaching models aimed at working with clients' professional goals, e.g. GROW

Source: compiled by the authors.

pleted form of education in the field of vocational counseling and the assessment of the competences that are most needed, a correspondence analysis was conducted. In the framework of the two competences C12 – knowledge of coaching models and C7 – the ability to analyze trends and megatrends, the competency gaps were the largest. So, the relationship between three variables was analyzed: *form of education received, advisors' self-assessment of competence C12,* and *advisors' self-assessment of competence C7.* Extending the set of variables could make the results difficult to interpret or unintelligible. The correspondence analysis is a descriptive and exploratory technique of analysis for two-dimensional and multi-dimensional contingency tables used to detect relationships and present the structure of qualitative variables. It should be noted that correspondence analysis is an exploratory technique, so no inference about the statistical significance of its findings can be drawn. Nevertheless, it may provide interesting insights for further analysis. The main advantage of this method is that it can be applied to data with less stringent properties [*Greenacre,* 1984, p. 259]. Further, no assumption on the data distribution has to be made. The results of the analysis can be also presented graphically, which allows for drawing conclusions on the similarity between the categories of variables [*Gatnar, Walesiak,* 2004, p. 284]. A detailed description of the method can be found in [*Greenacre, Hastie*, 1987; *Greenacre,* 1993; *Błaczkowska et al.,* 2012; *Gatnar, Walesiak,* 2004]. The map of perception for variables: *form of educa-*

Figure 4. **Ranking of the Competency Gaps between the Average Usefulness of Relevant Competencies and Average Self-Assessment**

Source: compiled by the authors.

Table 7. **Competency Assessment Results**

Code of competence	Number of self-assessments in the area of each competence from 1 – «I do not have competence in this area» to 5 – «I have very high competence in this area»					Average of self-assessment	Average of usefulness assessment	Competency gap
	1	2	3	4	5			
C1	2	5	33	109	91	4.18	4.59	–0.42
C2	0	1	35	118	86	4.21	4.70	–0.49
C3	1	8	47	109	75	4.04	4.42	–0.38
C4	3	10	47	100	80	4.02	4.41	–0.40
C5	11	10	61	87	71	3.82	4.39	–0.57
C6	3	9	46	97	85	4.05	4.49	–0.44
C7	2	20	58	106	54	3.79	4.38	–0.59
C8	2	16	53	112	57	3.86	4.38	–0.53
C9	1	1	33	107	98	4.26	4.56	–0.31
C10	0	4	35	111	90	4.20	4.55	–0.36
C11	3	14	44	81	98	4.08	4.64	–0.56
C12	25	23	59	82	51	3.47	4.25	–0.78
Total	53	121	551	1219	936	3.998	4.48	–0.486

Source: compiled by the authors.

tion received and *advisors' self-assessments of competence C12* and *C7* is presented in Figure 5.

The perception map allows for detecting the co-occurrence of the categories of analyzed variables – in this case, the answers of counselors to the question about the self-assessment of the competences C7 and C12 and the answers about the education they received. It can be seen that those who completed the regular stationary course in the field of vocational counseling most frequently answered that they have very good knowledge (rate 5) of coaching tools and effective interpersonal communication (e.g. the ability to ask the right questions, paraphrasing) techniques and are also very good at analyzing trends and megatrends affecting the labor market. Advisors who finished post-graduate studies or full-time studies on vocational counseling most often claimed that they demonstrate a good (rate 4) level of competence for C7 and a good (rate 4) or medium (rate 3) level of competence for C12. Those advisors, who took an online course in the field of vocational counseling, usually assess their level of analyzed competences as medium (note 3) or poor (2). And, as seems quite obvious, these respondents who assessed competences C7 and C12 at the lowest level most frequently chose the answer "not applicable (N/A)" to the question about the form of the received education.

An interesting result of the above analysis is connecting the highest level of the two most needed competences with the answer "regular course." Although this conclusion needs to be confirmed by further research and analysis, it may suggest that for now, regular courses give advisors a better chance of gaining knowledge and skills on coaching tools and techniques in effective interpersonal communication as well as trends and megatrends analysis which affect the labor market. Apparently, studying vocational counseling does not always provide the same opportunity. Courses programs are usually more flexible with regard to market demands and are also more focused on practical skills and tools. Meanwhile the process of changing and adapting longer-term study programs is usually more difficult to carry out and takes a long time. However, it seems advisable to devote attention to teaching such methods and techniques during full-time or post-graduate studies.

Results of Qualitative Studies

The qualitative study covered two research areas. The first concerned the determinants of the quality of the educational offerings and the methodology of teaching in the field of vocational counseling. This area included elements such as 1) factors determining the high quality of educational offerings; 2) program content; 3) didactic methods; 4) didactic aids; 5) competences and qualifications of didactic staff; 6) form of education organization; 7) period of education. The second area refers to the preferred features and functionalities of educational tools used by vocational counselors' teachers, including: 1) the number of users of educational tools; 2) methods used in other teaching areas that can be adopted in vocational counseling; 3) the duration of educational games.

Respondents indicated that factors determining the high quality of educational offerings refer to an attractive curriculum, the practical experience of tutors (which is currently insufficient), and di-

dactic methods ensuring the acquisition of specific communication skills, taking into account the latest trends on the labor market during the education process.

Moreover, respondents, identifying relevant program content, pointed the high importance of classes developing soft skills, providing an assessment of competences and coaching skills enabling support for the client in creating a professional career.

According to the majority of respondents, the advisory skills of tutors in the field of setting alternative paths of professional development are important. They are especially crucial in cooperation with young people using modern communication technologies.

Experts determined that interactive forms of teaching methods are the best. These include workshop methods, such as role playing, interviews, the analysis of case studies based on real situations, methods adapted from coaching, methods enabling a process approach to the client, and a wide range of creative methods. These methods should equip future counselors with practical skills that they could then use in their professional work.

Such didactic tools as interactive tools, using new technologies, strategic games, simulation games, and workshop classes teach one how to act in specific professional situations, shape soft competences, or support the career counselor in the process of diagnosing a client and are of significant importance to a counselor's work.

Respondents indicated such competences and qualifications of teaching staff as practical experience, good relativity, positive attitude towards students and listening skills as important in vocational counseling, as well as the ability to work in a group. Experts also pointed to basic analytical competencies that enable the identification of trends on the labor market or digital competencies ensuring the pursuit of technological trends.

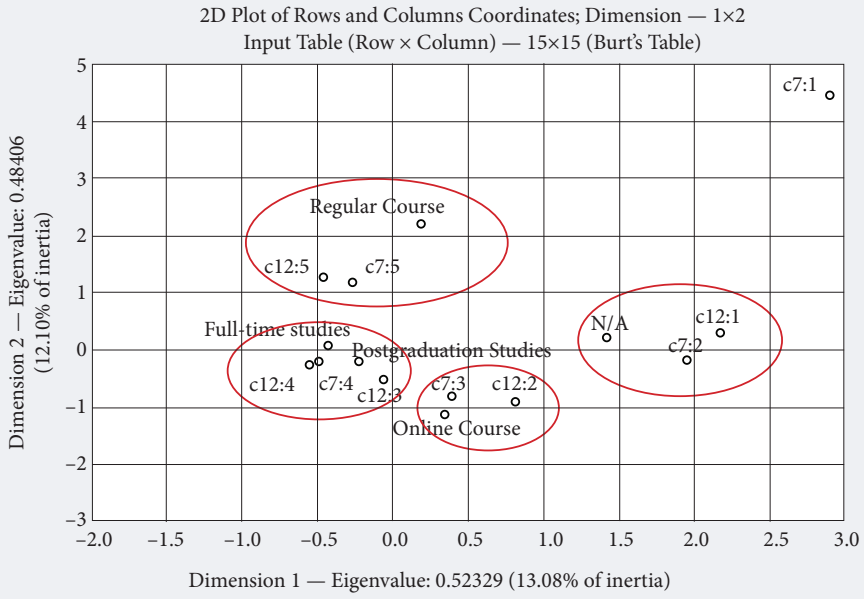
Post-graduate studies were considered the most popular, although a not very attractive, form of vocational counselors' education. The need for continuous further education was stressed, especially within the framework of targeted, thematic courses.

The participants of qualitative research had a negative attitude towards education in the field of vocational counseling provided in the form of e-learning due to the lack of direct contact with the teacher.

The research shows that the period of education should be determined by the saturation of the content of education with practical knowledge, the use of didactic methods enabling the acquisition of practical skills, and the participation of counseling practitioners. The more contact with practice during education, the shorter the period of education can be.

The focus of second research area of qualitative studies was on the preferred features and functionalities of educational tools used by persons educating vocational counselors.

Figure 5. **Map of Perception of Variables: Form of Education Received and Advisors' Self-Assessment of Competences C12 and C7**



Source: compiled by the authors.

According to the respondents, career counseling tools cannot replace the contact with a real counselor, but this contact (in the form of an in-depth interview) could support them. The counseling tools should be characterized by the following features: a) involvement, b) flexibility, c) based on real case studies, d) low cost, e) profiling for an appropriate group of clients, f) easy interpretation of the results, g) intuitive use, and be h) based on group work (4-8 people).

According to the interviewees' knowledge, there are no tools in the Polish advisory system that use the analysis of trends or variants of career development paths. Such a tool would be useful, especially if it is complex, taking into account various aspects of the client's life such as financial, family, and psychological states.

The respondents' statements may suggest great openness to the introduction and use of new methods and tools both in the teaching and practice of vocational counseling. Particular attention was paid to creative methods, the use of new technologies (e.g. mobile) and tools for group work involving the group based on selected elements of therapeutic work as well as psychological and pedagogical research.

Two groups of opinions in terms of the optimal duration of the educational games can be distinguished. One group of interviewees emphasized the importance of the process aspect in such games, which would call for a longer cycle of the game. In the second group of respondents, the answers were concentrated on one meeting lasting no more than three hours.

An important conclusion from the qualitative study is the opinion of career counselors that it is necessary to reformulate the thinking related to the future of the labor market and to focus on the "competences of the future" and not on specific "professions of the future".

Discussion

Although uncertainty is omnipresent on the labor market, attempts are being made to create a vision of the future of work [*Balliester, Elsheikhi,* 2018]. Global labor markets are undergoing major transformations. One may witness a shift in the line between human and machine tasks and algorithms, which should create new opportunities for the training of employees [AfDB et al., 2018]. The major challenges for career counselors should reflect new perspectives and consider the complexities of social change [*Pryor, Bright,* 2018]. Nevertheless, the issues of the trend analysis and creating alternative paths of career development are neglected in the curricula. The research carried out in Poland demonstrated significant differences between the perception of completed vocational guidance courses and the expectations of career counselors for such courses. An interesting aspect of the research is the fact that, the survey was complemented by a larger number of respondents than expected. A significantly higher number of responses was obtained than was assumed, which indicates a strong need for changes in the environment for career advisors. Taking into account the challenges of Industry 4.0 [*Nosalska, Mazurek,* 2019], trends analysis, and the scenarios of career path development should be fundamental methods used by career guidance practitioners. On the basis of the analysis carried out, it can also be concluded that the theme of the scientific and technological trends, such as automation, robotization, and digitization, which are a subject of interest of the present study, is treated marginally within the framework of the education completed by the respondents. Also, the methods for the analysis of alternative career paths seem to be neglected in the counseling practice. In this way, both hypotheses of the present study have been verified.

The authors of this study also note the limitations of the applied research methods. The SERVQUAL model used in the quantitative part of the research proved to be a very useful framework for gap identification between the perceived and desired state of the phenomena. However, the dimensions of the model need to be adapted to the area in which the research is being carried out. Moreover, the context of the study sometimes implies a deviation from weighing the dimensions due to the significantly asymmetrical division of statements, which was the case in the present study.

In turn, the limitation of qualitative research was looking at the problem of the determinants behind the quality of the educational offering and methodology of teaching in the field of vocational counseling as well as the features and functionalities of educational tools used by vocational counselors' teachers. Counseling teachers and recipients of counseling services were not examined as the assumptions of the Dialogue project did not include those groups of respondents. However, considering the opinions of various stakeholders is important for a full analysis of which aspects determine the areas for future research.

Conclusions

The current labor market is strongly influenced by technological progress and the so-called fourth industrial revolution. Not only does it change the expectations of employers regarding the qualifications and competences of employees, but also determines the specificity of the career counseling process. The research findings presented in this paper indicate that the analysis of scientific and techno-

logical trends such as automation, robotization, and digitization, is treated marginally in the process of educating career counselors. Simultaneously, there are high expectations toward the consideration of science and technology trends, economic trends, as well as social trends in the content of the education of career counselors. Career counselors expect the teaching staff educating advisors to use dedicated online games or interactive educational games.

With regard to the current and preferred quality of the educational offerings, respondents highlighted a number of key issues. It is crucial for the didactic process of career counseling to implement classes conducted by practitioners, especially from the area of business, entrepreneurship, and selected industries. Moreover, it is important for the students to acquire the necessary communication skills for different groups of clients, including the fluent use of modern communication technologies or soft skills with coaching content. It was also noted that the current educational system for counselors definitely lacks education about the latest social, scientific, and technological trends shaping the labor market.

Another important issue discussed during the qualitative study was the question of the future of the labor market. It was emphasized that the current educational programs lack information about the "competences of the future," that is, there is a lack of information that would allow for the anticipative construction of various career paths in terms of the process approach. At the same time, the high importance of the content (which so far is definitely lacking) ensuring knowledge about the identification of alternative career paths was stressed. According to the respondents, the future of the profession of the career counselor will be influenced mainly by two factors: 1) technological changes, for example, in the form of automation and 2) socio-demographic changes such as population ageing.

The traditional education of career counseling based on direct contact with the teacher via, for example, post-graduate studies, was considered most beneficial, but such programs must have the ability to modify programs and hold practical courses. Educational tools used by people educating vocational counselors should be based on group work.

Originality and Value of the Present Study

Taking into account the challenges faced by modern career counseling, the adaptation of methodologies for studying the future to advisory and educational practice seems to be an original approach. Basic knowledge and skills referring to the exploration and "use" of the future in various fields – so-called futures literacy – is considered the ability to create and process complex visions of the future and give them new meaning. The approach of the "Horizons of the Future" Project is a unique proposition, based on interdisciplinary knowledge combining career counseling and planning with future studies and foresight methodology. Therefore, one of the important questions the authors of this study are asking throughout the project is the one about the attitude of vocational counselors toward the future, especially in the dimension of professional practice. The authors have taken on the challenge to collectively create a working methodological tool for successful career counseling, which is based on the mysterious and abstract category that is the future, which is both complex and uncertain.

This study was carried out within the framework of the "Horizons of the Future" project, which is run under the "Dialogue" Program of the Ministry of Science and Higher Education. The project is implemented by Łukasiewicz Research Network – Institute for Sustainable Technologies in Radom in partnership with the Bialystok University of Technology.

References

AfDB, ADB, EBRD, IDB (2018) *The Future of Work: Regional Perspectives,* Abidjan (Côte d'Ivoire), Manila (Philippines), London (UK), Washington, D.C.: African Development Bank (AfDB), Asian Development Bank (ADB), European Bank for Reconstruction and Development (EBRD), Inter-American Development Bank (IDB). Available at: https://publications.iadb.org/en/future-work-regional-perspectives, accessed 10.10.2019.

Ahmed R.R., Vveinhardt J., Štreimikienė D., Ashraf M., Channar Z.A. (2017) Modified SERVQUAL model and effects of customer attitude and technology on customer satisfaction in banking industry: Mediation, moderation and conditional process analysis. *Journal of Business Economics and Management,* vol. 18, no 5, pp. 974–1004.

Ali S.S., Kaur R., Pande M.J.C., Ahmad F. (2014) Service quality gap approach: A case of Indian customer's satisfaction of private banks. *International Journal of Business Excellence*, vol. 7, no 4, pp. 429–453.

Balliester T., Elsheikhi A. (2018) *The Future of Work: A Literature Review* (Research Department Working Paper no 29), Genève (Switzerland): International Labour Office. Available at: https://www.ilo.org/global/research/publications/working-papers/WCMS_625866/lang--en/index.htm, accessed: 01.10.2019.

Bednarczyk Z., Domhof L., Nosarzewski K. (2018) *Surfing the future of education. What skills, attitudes and knowledge should the educational system aim to develop to address future needs?,* Warszawa: Polskie Towarzystwo Studiów nad Przyszłością & Futures Literacy KnowLabs. Available at: file:///C:/Users/oem/Downloads/Surfing_the_future_of_education%20(1).pdf, accessed 10.09.2019.

Bielecki J., Dziedzic A., Rosak M., Szczuka K., Żochowska E. (2015) *Ramowy Program Studiów Podyplomowych z zakresu doradztwa edukacyjno-zawodowego* [Framework Program of Postgraduate Studies in the field of educational and vocational counseling], Warszawa: Krajowy Ośrodek Wspierania Edukacji Zawodowej i Ustawicznej (in Polish).

Błaczkowska A., Grześkowiak A., Król A., Stanimir A. (2012) Wykorzystanie analizy korespondencji w badaniu czynników różnicujących wyniki z dwóch części egzaminu gimnazjalnego uzyskanych przez uczniów z różnych obszarów terytorialnych [The use of correspondence analysis in the study of factors differentiating the results of two parts of the junior high school exam obtained by students from different territorial areas]. *Przegląd Statystyczny (Statistical Review)*, vol. 59, no 2, pp. 163–178.

CEDEFOP (2009a) *Modernising vocational education and training. Fourth report on vocational education and training research in Europe: Executive summary* (Report of the European Centre for the Development of Vocational Training (CEDEFOP)), Luxembourg: Publications Office of the European Union.

CEDEFOP (2009b) *Professionalising career guidance. Practitioner competences and qualification routes in Europe* (Report of the European Centre for the Development of Vocational Training (CEDEFOP)), Luxembourg: Publications Office of the European Union.

Dauwalder J.P. (2014) *From heuristic to life-designing. New tool for coping with complex situations*. Available at: https://www.researchgate.net/publication/310458494, accessed 01.10.2019.

DHET (2016) *Competency Framework for Career Development Practicioners in South Africa,* Preatoria (SAR): Department of Higher Education and Training (DHET).

Dubois D., Rothwell W. (2004) Competency-based or a traditional approach to training. *T and D*, vol. 58, no 4, pp. 46–57.

Ejdys J., Gudanowska A., Halicka K., Kononiuk A., Magruk A., Nazarko J., Nazarko Ł., Szpilko D., Widelska U. (2019) Foresight in Higher Education Institutions: Evidence from Poland. *Foresight and STI Governance*, vol. 13, no 1, pp. 77–89.

Fernández-Sanz L., Gómez-Pérez J., Castillo-Martínez A. (2017) e-Skills Match: A framework for mapping and integrating the main skills, knowledge and competence standards and models for ICT occupations. *Computer Standards & Interfaces*, vol. 51, pp. 30–42.

Flum H., Blustein D.L. (2000) Reinvigorating the study of vocational exploration: A framework for research. *Journal of Vocational Behavior,* vol. 56, no 3, pp. 380–404.

Gatnar E., Walesiak M. (2004) *Metody statystycznej analizy wielowymiarowej w badaniach marketingowych* [Methods of statistical multivariate analysis in marketing research], Wroclaw: Wydawnictwo Akademii Ekonomicznej im. Oskara Langego we Wroclawiu (in Polish).

Greenacre M.J. (1984) *Theory and Apllications of Correspondence Analysis*, London: Academic Press.

Greenacre M.J. (1993) *Correspondence Analysis in Practice*, London: Academic Press.

Greenacre M.J., Hastie T. (1987) The geometric interpretation of correspondence analysis. *Journal of the American Statistical Association,* vol. 82, pp. 437–447.

Guan Y., Zhuang M., Cai Z., Ding Y., Wang Y., Huang Z., Lai X. (2017) Modeling dynamics in career construction: Reciprocal relationship between future work self and career exploration. *Journal of Vocational Behavior,* vol. 101, pp. 21–31.

Hiebert B., Neault R. (2013) *Career Counselor Competencies and Standards: Differences and Similarities Across Countries.* Available at: file:///C:/Users/oem/Downloads/HNeault-Springer300303_1_En_39_DeltaPDF.pdf, accessed 25.09.2019.

Jiang Z., Newman A., Le H., Presbitero A., Zheng C. (2019) Career exploration: A review and future research agenda. *Journal of Vocational Behavior,* vol. 110, pp. 338–356.

Knapper Ch. K., Cropley A.J. (2000) *Lifelong Learning in Higher Education,* London: Kogan Page Limited.

Kononiuk A., Gudanowska A., Magruk A., Sacio-Szymańska A., Fantoni G., Trivelli L., Ollenburg S. (2017a) *The quest for the competences of a future-oriented individual: Research methodology and findings. Becoming future-oriented entrepreneurs in universities and companies report*, Brussels: European Commission. Available at: http://futureoriented.eu/downloads/, accessed 05.10.2019.

Kononiuk A., Sacio-Szymańska A., Gáspár, J. (2017b) How do companies envisage the future? Functional foresight approaches. *Engineering Management in Production and Services*, vol. 9, no 4, pp. 21–33.

Kononiuk A.(ed.), Pająk A.(ed.), Gudanowska A., Kononiuk A., Kozłowska J., Magruk A., Pająk A., Rollnik-Sadowska E., Sacio-Szymańska A. (2019) *Projektowanie kariery zawodowej - perspektywa badań foresightowych [Career design - the perspective of foresight research]*, Białystok: Oficyna Wydawnicza Politechniki Białostockiej (in Polish).

Lester S., Religa J. (2017) „Competence" and occupational standards: Observations from six European countries. *Education+Training,* vol. 59, no 2, pp. 201–214.

Magruk A. (2017) Concept of uncertainty in relation to the foresight research. *Engineering Management in Production and Services*, vol. 9, no 1, pp. 46–55.

McClune B., Jarman R. (2010) Critical Reading of Science-Based News Reports: Establishing a Knowledge, Skills and Attitudes Framework. *International Journal of Science Education*, vol. 32, no 6, pp. 727–752.

Mocker D.W., Spear G.E. (1982) *Lifelong learning: Formal, nonformal, informal and self-directed* (ERIC Information Series Paper no 241), Columbus, OH: National Center for Research in Vocational Education (ERIC). Available at: https://files.eric.ed.gov/fulltext/ED220723.pdf, accessed 20.09.2019.

Nazarko J. (2013) *Regionalny Foresight gospodarczy. Metodologia i instrumentarium badawcze [Regional economic foresight. Methodology and research instruments],* Warszawa: Związek Pracodawców Warszawy i Mazowsza (in Polish).

NCDA (2009) *Career Counselling Competencies,* Broken Arrow, OK: National Career Development Association (NCDA). Available at: https://www.ncda.org/aws/NCDA/page_template/show_detail/37798?model_name=news_article, accessed 29.09.2019.

Neureiter M., Traut-Mattausch E. (2017) Two sides of the career resources coin: Career adaptability resources and the impostor phenomenon. *Journal of Vocational Behavior,* vol. 98, pp. 56–69.

Nosalska K., Mazurek G. (2019) Marketing principles for Industry 4.0 — a conceptual framework. *Engineering Management in Production and Services*, vol. 11, no 3, pp. 9–20.

OECD (2004) *Career Guidance and Public Policy. Bridging the Gap*, Paris: OECD. Available at: https://www.oecd.org/education/innovation-education/34050171.pdf, accessed 28.09.2019.

OECD (2017) *Getting Skills Right: The OECD Skills for Jobs Indicators*, Paris: OECD. Available at: https://www.oecdskillsforjobsdatabase.org/data/country_notes/Poland%20country%20note.pdf, accessed 28.09.2019.

Oyserman D., Bybee D., Terry K. (2006) Possible selves and academic outcomes: How and when possible selves impel action. *Journal of Personality and Social Psychology,* vol. 91, pp. 188–204.

Parasuraman A., Berry L.L., Zeithaml V.A. (1985) A Conceptual Model of Service Quality and Its Implications for Future Research. *Journal of Marketing*, vol. 49, no 4, pp. 41–50.

Pryor R.G., Bright J. (2018) Careers as Fractal Patterns: The Chaos Theory of Careers Perspective. *Contemporary Theories of Career Development: International Perspectives* (eds. N. Arthur, M. McMahon), New York: Routledge, pp. 135–152.

Rieckmann M. (2012) Future-oriented higher education: Which key competencies should be fostered through university teaching and learning? *Futures*, vol. 44, no 2, pp. 127–135.

Savickas M.L., Nota L., Rossier J., Dauwalder J., Duarte M.E., Guichard J., Soresi S., Van Esbroeck R., van Vianen A.E.M. (2009) Life designing: A paradigm for career construction in the 21st century. *Journal of Vocational Behavior*, vol. 75, pp. 239–250.

Stumpf S., Colarelli S., Hartman K. (1983) Development of the Career Exploration Survey (CES). *Journal of Vocational Behavior*, vol. 22, pp. 191–226.

Sultana R.G. (2004) *Guidance policies in the knowledge society. Trends, challenges and responses across Europe. A CEDEFOP synthesis report*, Luxembourg: Office for Official Publications of the European Communities.

Symela K. (2006) Kompetencje i jakość pracy doradcy zawodowego [Competence and quality of work of a vocational counselor], *Edukacja dla rynku pracy. Problemy poradnictwa zawodowego* [Education for the labor market. Problems of vocational guidance] (eds. S.M. Kwiatkowski, Z. Sirojć), Warszawa: Ochotnicze Hufce Pracy Komenda Główna (in Polish).

Toffler A. (1980) *The Third Wave: The Classic Study of Tomorrow*, New York: Bantam Books.

Volles N. (2016) Lifelong learning in the EU: Changing conceptualisations, actors, and policies. *Studies in Higher Education*, vol. 41, no 2, pp. 343–363.

Cutting-edge technologies in statistics, machine learning and semantic analysis

Advantages

- Big Data processing
- Flexible and customisable
- High speed of analytics
- Intuitive results
- Regular updating of the semantic knowledge base
- Multilingual analysis

ISSEK
INSTITUTE FOR STATISTICAL STUDIES AND ECONOMICS OF KNOWLEDGE

Functionality

- Trend Spotting
- Forecasting
- Benchmarking, Risk Assessment
- Lifecycles of Technologies, Products and Markets
- Competence and Skills Foresight
- Detection of Centres of Excellence
- Procurement Analysis
- Evaluation of Policies
- Project Management Support

Contacts

issek@hse.ru

ifora@hse.ru

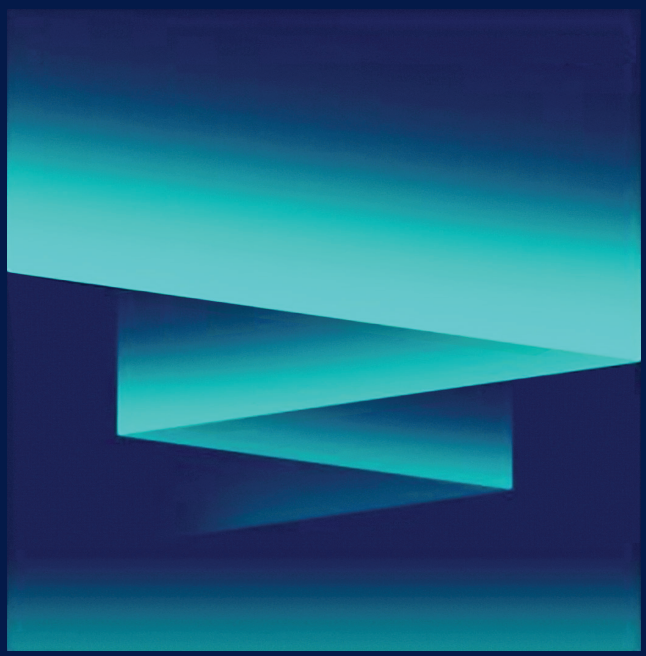
+7 (495) 621-28-73

20 Myasnitskaya, Moscow
101000, Russia

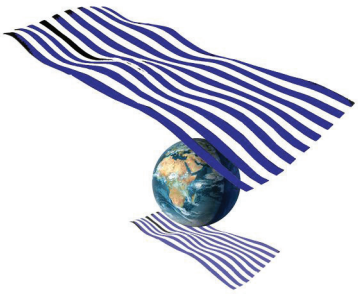
BIG DATA MINING SYSTEM

iFORA®

Radically New Approach to Strategic Consulting



ISSN 1995-459X



Website

Download on the App Store

GET IT ON Google Play