

Nexus between Financial Development and Energy Poverty in Asian Countries in the Context of Tax Burden

Alexey Mikhaylov¹, Sergey E. Barykin^{2,*}, Ivan Golub², Nikita S. Lukashevich³, Olga Kalinina³, Anh P. Nguyen⁴, Volha Yarchak⁵, Raya Karlibaeva⁶, Gulnar Talapbayeva⁷ and Tomonobu Senjyu⁸

¹Financial University under the Government of the Russian Federation, Moscow, 124167, Russian Federation

²Graduate School of Service and Trade, Peter the Great St. Petersburg Polytechnic University, 195251 St. Petersburg, Russia

³Graduate School of Industrial Management, Peter the Great St. Petersburg Polytechnic University, St. Petersburg, Russia

⁴St. Petersburg Mining University, 199106 St. Petersburg, Russia

⁵Department of Logistics and Pricing Policy, Belarusian State Economic University, Minsk, Belarus

⁶Tashkent State University of Economics; 100003 Tashkent, Uzbekistan

⁷Department of Economics and Management, Korkyt Ata Kyzylorda University, 120000, Kyzylorda, Kazakhstan

⁸Department of Electrical and Electronics Engineering, University of the Ryukyus, Okinawa, 903-0213, Japan

Received: 21 Feb. 2023, Revised: 22 Mar. 2023, Accepted: 24 Mar. 2023.

Published online: 1 Oct. 2023.

Abstract: The authors consider research object in the context of tax burden. The specific problem with them seems to be both regulatory in nature, with different correlations and links between tax burden and energy poverty (access to electricity) in Asia, and technical, with an increase in payments to technical service providers. This paper is a generally moderate increase in the overall costs of tax compliance around the world. Over the past 5 years, many countries have carried out systemic reforms. This may have caused a temporary increase in compliance costs caused by the transition and the need for adaptation. The novelty of the current study is to find a nexus between tax burden and energy poverty (access to electricity) in Asian countries. This situation provides an opportunity for Russian economy and the economies of many developing Asian countries have the potential to increase the fiscal burden in the future by an average of 3.6%. There are factors contributing to a possible increase in the tax burden on the back of energy poverty (access to electricity) in Asia (95,78%). For example, the respondent mentioned that in some countries of Asia, the cost of professional consultants (externalization) helping to fill out tax returns has increased dramatically in recent years, which has a great impact on small and medium-sized enterprises (SMEs).

Keywords: Financial progress; Energy poverty; Income disparity; Global Entropy; Tax burden, Energy, poverty, Asian countries.

1 Introduction

Energy poverty in this paper described as access to electricity is the lack of access to clean and affordable energy. Developed and developing countries struggle with providing their population with clean and affordable energy [1]. energy poverty (access to electricity) is a growing concern as the world gets richer. There are many causes of energy poverty (access to electricity), including tax policies, industrial growth, and consumption habits. It's important to understand how countries divide their energy costs among their population.

GDP per capita is a good measure of a country's economy [2]. Energy poverty (access to electricity) is most prevalent in lower-income countries because lower taxes allow industries to consume more energy. However, higher taxes force people to cut back on unnecessary expenses, such as air conditioning or electronics. Therefore, governments with lower energy costs are able to bear more of the tax burden. This is something that needs to be changed so that everyone can have access to clean and affordable energy [3-5]. Energy costs shouldn't be low in countries with high taxes and developed economies [5]. Lower taxes allow industries to consume more energy, which pushes more people into energy

*Corresponding author e-mail: wmalbana@nu.edu.sa

poverty [6]. In addition, developed countries tend to import cheap energy from less developed countries- allowing these countries to bear less of the tax burden. Governments should focus on developing their renewable resources so they can meet their energy needs without importing expensive fossil fuel resources from abroad [7-10].

The world needs to increase GDP per capita in order to combat rising levels of energy poverty (access to electricity). Lower taxes allow industries to consume more energy while developed countries help lower tax burden by being rich enough to bear most of the cost. Therefore, there's an urgent need for governments to increase national GDPs so that they can afford to increase citizens' quality of life while lowering their tax burdens at the same time. This paper is a generally moderate increase in the overall costs of tax compliance around the world. Over the past 5 years, many countries have carried out systemic reforms. This may have caused a temporary increase in compliance costs caused by the transition and the need for adaptation. The specific problem with them seems to be both regulatory in nature, with different VAT reporting and anti-fraud rules in different countries, and technical, with an increase in payments to technical service providers [11-13].

The novelty of the current study is to find a nexus between tax burden and energy poverty (access to electricity) in Asian countries. This situation provides an opportunity for Russian economy and the economies of many developing Asian countries have the potential to increase the fiscal burden in the future by an average of 3.6%. There are factors contributing to a possible increase in the costs of compliance with tax laws in specific countries. For example, the respondent mentioned that in some countries of Europe and Asia, the cost of professional consultants (externalization) helping to fill out tax returns has increased dramatically in recent years, which has a great impact on small and medium-sized enterprises (SMEs). Another possible element common to several legislative acts is the struggle between tax authorities in different countries, often between small and large, for example, for the definition of a permanent establishment and, consequently, the country applying taxation.

2 Materials and Method

Qualitative analysis is based on the findings obtained during the survey and quantitative analysis: after quantifying the costs of compliance with tax legislation, it aims to identify the extent to which these costs affect their economic activities and influence decision-making [2, 14-16]. In many countries, the COVID-19 outbreak occurred during the time period covered by the study. During this time, most if not all European countries have taken a number of measures to support the private sector, ranging from postponing the deadline for filing tax returns and ending with the suspension or complete abolition of certain tax duties [17]. Respondents were asked to assess the impact of COVID-19 relief measures, highlighting specific shortcomings or best practices, and comment on their actual consequences. Despite large differences between different countries, especially regarding the timing of action by the most effective public administrations, respondents generally agree that government intervention in response to COVID-19 has been effective and rapid across Europe. This applies not only to general policy, but, more importantly, to easing the burden of tax compliance, where speed and accuracy must be balanced [18-21].

In general, despite the lack of similar experience, the measures achieved their main goal - to prevent the bankruptcy of enterprises and limit the loss of jobs. As for specific measures, the most mentioned of them were temporary VAT reductions and deferrals, as well as the suspension of judicial procedures, which led to ambiguous consequences. On the one hand, it seems to have effectively supported the cash flow of companies and freed enterprises from the administrative burden. On the other hand, companies had to adjust prices and adapt to new complex procedures, which, according to stakeholders, led to an increase in internal time costs, which significantly affected SMEs [22-24]. It is difficult to assess the effects of relief measures due to prolonged uncertainty. In fact, the end of the pandemic is still not in sight. According to respondents, such temporary uncertainty affected everyone, perhaps even more than the crisis itself.

Companies had no information about future demand or continuity of incentives, while governments had no way to predict the exact future and had to rely on temporary and constantly changing measures. However, business continuity, particularly for SMEs, was partly due to tax measures. It is hoped that short-term tax cuts will be phased out gradually to avoid liquidity crises. Stakeholders expect that the experience of the crisis will somehow pave the way for long-term reforms that can solve the problem of high costs for compliance with tax requirements [24-26].

3 Results

A noticeable trend in recent years, which has been observed in many countries of the world, has been to reduce the fiscal burden of small and medium-sized businesses, including supporting employers in the conditions of the COVID-19 pandemic. The total tax rate is a convenient indicator, because it provides a comprehensive assessment of the cost of all taxes incurred by the business. Tax policy may reflect concerns about distribution effects, economic efficiency, and

practical problems of tax system administration Table 1-4.

Table 1: Ranking of high burden tax countries by total tax rate, %.

Place	Country	Total tax rate, %
1	Comoros	219.6
2	Argentina	106.3
3	Bolivia	83.7
4	Eritrea	83.7
5	Palau	76.6
6	Afghanistan	71.4
7	Colombia	71.2
8	Guinea	69.3
9	Tajikistan	67.3
10	Mauritania	67
11	Algeria	66.1
12	Brazil	65.1
13	Chad	63.5
14	France	60.7
15	Tunisia	60.7
16	Nicaragua	60.6
17	China	59.2
18	Italy	59.1
19	Cameroon	57.7
20	Belgium	55.4
21	Ghana	55.4
22	Sri Lanka	55.2
23	Mexico	55.1
24	Mali	54.5
25	Belarus	53.3
26	Greece	51.9
27	Austria	51.4
28	India	49.7
29	Angola	49.1
30	Sweden	49.1
31	Benin	48.9
32	Germany	48.8
33	Togo	48.2
34	Estonia	47.8
35	Grenada	47.8
36	Australia	47.4
37	Niger	47.2
38	Gabon	47.1
39	Spain	47
40	Japan	46.7
41	Liberia	46.2
42	Russia	46.2
43	Czech Republic	46.1
44	Morocco	45.8
45	Guinea-Bissau	45.5
46	Sudan	45.4
47	Ukraine	45.2
48	Senegal	44.8
49	Iran	44.7
50	Egypt	44.4

Source: World Bank, <https://data.worldbank.org/indicator/IC.TAX.TOTL.CP.ZS>

Table 2: Ranking of medium burden tax countries by total tax rate, %.

Place	Country	Total tax rate, %
1	Malta	44
2	Tanzania	43.8
3	Philippines	43.1
4	Haiti	42.7
5	Syria	42.7
6	Lithuania	42.6
7	Turkish	42.3
8	Nepal	41.8
9	Uruguay	41.8
10	Burundi	41.2
11	Netherlands	41.2
12	Poland	40.8
13	Azerbaijan	40.7
14	Portugal	39.8
15	Honduras	39.1
16	Malaysia	38.7
17	Moldova	38.7
18	Madagascar	38.3
19	Latvia	38.1
20	Djibouti	37.9
21	Hungary	37.9
22	Ethiopia	37.7
23	Vietnam	37.6
24	Kenya	37.2
25	Panama	37.2
26	Peru	36.8
27	Albania	36.6
28	Finland	36.6
29	Serbia	36.6
30	Salvador	36.4
31	Norway	36.2
32	Mozambique	36.1
33	Eswatini	35.8
34	Barbados	35.6
35	Bhutan	35.3
36	Guatemala	35.2
37	Jamaica	35.1
38	Paraguay	35
39	Nigeria	34.8
40	New Zealand	34.6
41	Malawi	34.5
42	Ecuador	34.4
43	Chile	34
44	Pakistan	33.9
45	Uganda	33.7
46	Bangladesh	33.4
47	Korea	33.2
48	Rwanda	33.2
49	Kiribati	32.7

Source: World Bank, <https://data.worldbank.org/indicator/IC.TAX.TOTL.CP.ZS>

Table 3: Ranking of low burden tax countries by total tax rate, %.

Place	Country	Total tax rate, %
1	Dominica	32.6
2	Libya	32.6
3	Lebanon	32.2
4	Fiji	32.1
5	Iceland	31.9
6	Uzbekistan	31.6
7	Zimbabwe	31.6
8	South Sudan	31.4
9	Myanmar	31.2
10	Belize	31.1
11	Slovenia	31
12	Iraq	30.8
13	Sierra Leone	30.7
14	Guyana	30.6
15	United Kingdom	30.6
16	Maldives	30.2
17	Indonesia	30.1
18	Seychelles	30.1
19	Thailand	29.5
20	South Africa	29.2
21	Kyrgyzstan	29
22	Switzerland	28.8
23	Jordan	28.6
24	Kazakhstan	28.4
25	Bulgaria	28.3
26	Suriname	27.9
27	Oman	27.4
28	USA	26.6
29	Ireland	26.1
30	Mongolia	25.7
31	Israel	25.3
32	Canada	24.5
33	Laos	24.1
34	Denmark	23.8
35	Bosnia and Herzegovina	23.7
36	Cambodia	23.1
37	Armenia	22.5
38	Cyprus	22.4
39	Mauritius	22.2
40	Montenegro	22.2
41	Liechtenstein	21.6
42	Botswana	21.5
43	Singapore	21
44	Namibia	20.7
45	Croatia	20.5
46	Luxembourg	20.4
47	Romania	20
48	UAE	15.9
49	Saudi Arabia	15.7
50	Zambia	15.6
51	Kosovo	15.2
52	Bahrain	13.8

53	Lesotho	13.6
54	Kuwait	13
55	Qatar	11.3
56	Georgia	9.9

Source: World Bank, <https://data.worldbank.org/indicator/IC.TAX.TOTL.CP.ZS>

To make the data comparable across countries, several assumptions are made about the data sample: 1) data from employers of non-public companies were used, 2) companies are located in the most populous city in the country, 3) companies are mainly owned by residents, 4) companies carry out industrial or commercial activities, 5) companies have a positive turnover. Also, the tax methodology is consistent with the system of general tax contributions.

Table 4: Rating of regions by the total tax rate, %.

Caribbean	36.9
Europe	42.8
European Union	40
Countries affected by armed conflict	49.2
Poor countries (HIPC)	53.3
Latin America	46.6
North America	30.6
OECD	41.6
South Asia	43.9

Source: World Bank, <https://data.worldbank.org/indicator/IC.TAX.TOTL.CP.ZS>

A qualitative analysis of the fiscal burden is aimed at studying the problems faced by employers when performing both internal and cross-border actions with respect to the requirements of compliance with tax legislation. In 2020, the average ratio of taxes to GDP in the countries of the Asian region was 19.1%, which is lower than the indicators for the OECD countries and Latin America, which are 33.5% and 21.9%, respectively Table 5.

Table 5: The rating of Asian countries by the income tax rate in 2020, %.

Country	Rate
India	34.9
Japan	30.6
Bangladesh	30.0
Pakistan	29.0
Syria	28.0
South Korea	27.5
China	25.0
Mongolia	25.0
Philippines	25.0
Malaysia	24.0
Sri Lanka	24.0
Israel	23.0
Indonesia	22.0
Myanmar	22.0
Afghanistan	20.0
Azerbaijan	20.0
Cambodia	20.0
Jordan	20.0
Kazakhstan	20.0
Laos	20.0
Saudi Arabia	20.0
Taiwan	20.0
Thailand	20.0
Vietnam	20.0
Brunei	18.5
Armenia	18.0
Lebanon	17.0
Singapore	17.0

Hong Kong	16.5
Georgia	15.0
Iraq	15.0
Kuwait	15.0
Maldives	15.0
Oman	15.0
Uzbekistan	15.0
Macau	12.0
Qatar	10.0
Bahrain	0,0
United Arab Emirates	0,0

Source: Trading economics, 2023. <https://tradingeconomics.com/country-list/corporate-tax-rate?continent=asia>

Policy considerations include optimizing key revenue sources, improving the strategic use of tax expenditures, adapting to the growth of the digital economy, and supporting multilateral initiatives to increase income tax revenues. Recent estimates show that developing Asian countries have the potential to increase tax revenues by an average of 3.6% Table 6.

Table 6: Rates of tax and non-tax revenues of Asian budgets in 2020, %.

Country	Non-tax income to GDP	Grants to non-tax income	Property income to non-tax income	Sales of goods to non-tax income	Fines and penalties to non-tax income	Other income to non-tax income
Bhutan	19.8	42.6	32.9	24.2	0.3	0
Cambodia	4.3	45.8	12.7	34.1	7.3	0.1
Kazakhstan	1,2	0	75,2	16,2	8,6	0
Kyrgyzstan	7,8	25,1	26	27,7	3,5	17,7
Laos	3.7	39.7	30.7	23.6	0.6	5.3
Maldives	5.7	0	26	64.4	4.6	5
Mongolia	3.6	12.4	43.6	6	11.6	26.5
Pakistan	2.2	2.8	74.9	2.3	0	20
Philippines	2.3	0.1	58	14.1	0	27.8
Singapore	4.7	0	78.8	16.6	2.4	2.2
Thailand	4	0.2	53.2	33	2.4	11.1
Vietnam	8.2	0.9	5.9	55.5	0	37.7

Source: Worldbank, <https://data.worldbank.org/indicator/IC.TAX.TOTL.CP.ZS>

Taxes are the main source of income for most governments, the total tax rate of employers in Moscow decreased from 48.5% to 46% from 2013 to 2019. The sources of tax revenues and their relative contribution are determined by the choice of government policy regarding where and how to collect taxes, as well as changes in the structure of the economy. In Asian countries, the main taxes and fees in the structure of the fiscal burden are Table 5:

1. Income tax
2. Taxes on goods and services
3. Social insurance contributions
4. Value added taxes
5. Other taxes on goods and services
6. Social security contributions

Income from personal income tax (personal income tax) amounted to an average of 16% of total tax revenues in the Asian region, which corresponds to the average for Africa, but below the OECD average (23.5%, 2019). On average, this indicator accounted for a large share of total tax revenues in the Asian region - 18.8% (2019). Social security contributions accounted for a relatively small share of tax revenues in most countries - 6.3%. Six Asian countries received notable revenues (Japan, Vietnam, the Republic of Korea, China, Mongolia and the Philippines).

Grants were an important source of income per year in countries such as Bhutan, Cambodia, the Lao People's Democratic Republic, exceeding 30% of the total non-tax income. Real estate-related income accounted for the largest

share of non-tax income in Singapore, Kazakhstan, Pakistan, the Philippines, Thailand, Mongolia and the Lao People's Democratic Republic Table 7.

Table 7: Total rate for other taxes and fees (property tax, turnover taxes, municipal fees, taxes on vehicles and fuel) in 2019, %.

Country	Rate
Comoros	189.2
Eritrea	74.6
Argentina	72.8
Afghanistan	71.4
Bolivia	64.9
Mauritania	56.7
Central African Republic	53.6
Marshall Islands	53
Micronesia	52.1
Venezuela	45.7
Guinea	40.7
Sri Lanka	37.1
Ghana	30.7
Bahamas	27.4
Algeria	26.9
Colombia	26.6
Congo	22.9
Tunisia	21.8
Tajikistan	21.1
Russia	2.2

Source: World bank, <https://data.worldbank.org/indicator/IC.TAX.TOTL.CP.ZS>.

Table 8: Countries with low access to electricity (% of population) in 2020, %

Country	Rate
Democratic Republic of Congo	0.191
Niger	0.1925
Sierra Leone	0.262
Liberia	0.2753
Mozambique	0.306
Guinea-Bissau	0.3334
Madagascar	0.3374
Tanzania	0.399
Benin	0.4141
Uganda	0.4207
Zambia	0.4452
Guinea	0.4467
Rwanda	0.466
Angola	0.4689
Haiti	0.4693
Mauritania	0.4735
Congo	0.4952
Somalia	0.4973

Source: Worldbank, <https://data.worldbank.org/indicator/IC.TAX.TOTL.CP.ZS>

Table 9: Countries with medium access to electricity (% of population) in 2020, %

Country	Rate
Sudan	0.5539
Nigeria	0.554
Namibia	0.5626
Papua New Guinea	0.604
Djibouti	0.6177

Gambia	0.6227
Cameroon	0.6472
Equatorial Guinea	0.6675
Vanuatu	0.6733
Cote d'Ivoire	0.6968
Libya	0.6971
Senegal	0.7037
Myanmar	0.704
Kenya	0.7144
Botswana	0.7199
Solomon Islands	0.7335
Pakistan	0.7538
Sao Tome and Principe	0.7656
Eswatini	0.7973
Micronesia (country)	0.8293

Source: Worldbank, <https://data.worldbank.org/indicator/IC.TAX.TOTL.CP.ZS>

Table 10: Countries with high access to electricity (% of population) in 2020, %

South Africa	0.8439
Ghana	0.8587
Cambodia	0.864
Comoros	0.8674
Nicaragua	0.8891
Syria	0.8914
Nepal	0.899
World	0.9052
Gabon	0.9157
Kiribati	0.9196
Guyana	0.9254
Honduras	0.9321
Grenada	0.9359
Cape Verde	0.9416
South Asia	0.9578
Timor	0.9612
Bangladesh	0.962
Panama	0.967
Philippines	0.9684
Indonesia	0.9695
Guatemala	0.9706
Belize	0.9711
Bolivia	0.9755
Mongolia	0.981
Suriname	0.982
Ecuador	0.9885
India	0.99
Marshall Islands	0.9916
Peru	0.9931
Mexico	0.994
Turks and Caicos Islands	0.994
Mauritius	0.9966
Tuvalu	0.9969
Bulgaria	0.997
Tajikistan	0.9978
Algeria	0.998
Costa Rica	0.999
Jordan	0.999

Kyrgyzstan

0.9998

Source: Worldbank, <https://data.worldbank.org/indicator/IC.TAX.TOTL.CP.ZS>

4 Discussions

The average tax-to-GDP ratio for the Asian region decreased by 1.2% in 2019-2020 in fifteen countries, while the OECD average increased by 0.1%. Almost three quarters of the countries in the Asian region for which data are available experienced a decrease in the tax-to-GDP ratio during this period, mainly as a result of the crisis. At the same time, the ratio of taxes to GDP decreased in 2019-2020 due to COVID-19 by more than 2% on average in 2 economies (Kazakhstan and Mongolia). Seven countries reported an increase in the ratio of taxes to GDP, the largest increase was observed in Bangladesh in 2020 (+1.2%). Growth in other countries was less than 1% [26]. Changes in the average tax-to-GDP ratio were due to different tax categories in the Asian region and OECD countries [27-28].

In the Asian region, revenues from taxes on goods and services decreased in 21 countries. As a percentage of GDP, they decreased more than in the OECD countries, where this tax category did not change on average between 2019 and 2020. Corporate income tax revenues decreased in half of the countries in 2019-2020, as well as in most OECD countries. On average, value-added taxes were the main source of tax revenue in the Asian region in 2020, similar to African countries (50.6%) and Latin American countries (48.4%). In Asia, this indicator is higher than in the OECD countries. However, within this category, the average share (32.6%) of value-added taxes in total income was lower in the Asian region than in Africa (23.1%).

The ratio of taxes to GDP decreased in fifteen of the countries of the Asian region between 2010 and 2020 [29]. The largest decrease was observed in Kazakhstan under the influence of falling prices for minerals in 2020. During the same period, the largest increase in the ratio of taxes to GDP was observed in the Maldives, Cambodia, the Republic of Korea and Japan [30-32].

The ratio of taxes to GDP decreased in most countries of Asian region between 2010 and 2020. The most logical recommendations for regulating the fiscal burden of business can be: optimization of key sources of income, improvement of strategic use of tax expenditures, adaptation to the growth of the digital economy and support for multilateral initiatives to increase income from income tax. Recent estimates show that both the Russian economy and the economies of many developing Asian countries have the potential to increase the fiscal burden in the future by an average of 3.6%.

The more energy consuming industries are pushed to countries with lower taxes. This causes more people to experience energy poverty (access to electricity) as their economies grow richer. It's important that industrial growth doesn't outpace government growth in this regard. Otherwise, industrial growth pushes people further into energy poverty (access to electricity) while government growth fails to keep up with industry growth. There are many ways industrial growth can be curtailed so that it doesn't push more people into energy poverty (access to electricity). One way is to implement a carbon tax; companies will produce less carbon dioxide emissions when they're taxed for it. Another way is to halt subsidizing of fossil fuels at international agencies.

5 Conclusion and Recommendations

The analysis of the tax-to-GDP ratio in the Asian region and OECD countries between 2019 and 2020 revealed significant variations. The Asian region, comprising fifteen countries, experienced an average decrease of 1.2% in the tax-to-GDP ratio during this period, primarily due to the impact of the COVID-19 crisis. In contrast, the OECD countries witnessed a marginal increase of 0.1% in their tax-to-GDP ratio. Notably, nearly three-quarters of the Asian countries analyzed reported a decrease in this ratio, with Kazakhstan and Mongolia experiencing reductions exceeding 2%. However, some Asian nations, including Bangladesh, demonstrated positive trends with increases in their tax-to-GDP ratios. Examining the longer-term trends from 2010 to 2020, we observed that the tax-to-GDP ratio decreased in a significant number of Asian countries. The largest decline was evident in Kazakhstan, influenced by plummeting mineral prices in 2020. Conversely, certain Asian nations, including the Maldives, Cambodia, the Republic of Korea, and Japan, experienced notable increases in their tax-to-GDP ratios during the same period.

Asian countries should prioritize the optimization of their key income sources to enhance fiscal stability. This entails a comprehensive review of existing tax structures and policies to identify opportunities for efficiency and revenue enhancement. Governments in the Asian region can benefit from a strategic approach to tax expenditures. By evaluating and targeting tax incentives, exemptions, and deductions, they can ensure that these policies effectively support economic growth and development goals. In conclusion, proactive fiscal management and strategic tax policies are essential for Asian countries to navigate economic challenges, promote sustainable growth, and address environmental concerns. By adopting these recommendations, governments can create a more balanced and resilient fiscal landscape,

ultimately benefiting their economies and populations.

Conflicts of Interest Statement:

The authors certify that they have NO affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

Acknowledgment:

The research of Sergey Barykin and Olga Kalinina is funded by the Ministry of Science and Higher Education of the Russian Federation under the strategic academic leadership program "Priority 2030" (Agreement 075-15-2021-1333 dated 30.09.2021).

The research of Alexey Mikhaylov is based on the results of budgetary-supported research according to the state task carried out by the Financial University under the Government of the Russian Federation, Moscow, Russia.

References

- [1] M. Ahmad, S. Beddu, Z. binti Itam, and F. B. I. Alanimi, "State-of-the-art compendium of macro and micro energies," *Advances in Science and Technology Research Journal.*, **13(1)**, 88-109, 2019. <https://doi.org/10.12913/22998624/103425>.
- [2] M. Ammann and A. Zingg, "Performance and governance of Swiss pension funds," *Journal of Pension Economics & Finance.*, **9(1)**, 95-128, 2010.
- [3] A. H. Munnell and M. Soto, "The outlook for pension contributions and profits in the US," *Journal of Pension Economics & Finance*, vol. 3, no. 1, pp. 77-97, 2004.
- [4] Q. Wang, J. Guo, R. Li, A. Mikhaylov, and N. Moiseev, "Does technical assistance alleviate energy poverty in sub-Saharan Africa countries? A new perspective on spatial spillover effects of technical assistance," *Energy Strategy Reviews.*, **45**, 101047, 2023. <https://doi.org/10.1016/j.esr.2022.101047>
- [5] S. Beddu, T. S. B. Abd Manan, F. Mohamed Nazri, N. L. M. Kamal, D. Mohamad, Z. Itam, and M. AHMAD, "Sustainable Energy Recovery from the Malaysian Coal Bottom Ash (CBA) Fineness and effect on the building infrastructure," *Frontiers in Energy Research.*, 942, 2022. <https://doi.org/10.3389/fenrg.2022.940883>.
- [6] F. B. Al Marshoudi, Z. Jamaluddin, A. M. Ba Aween, F. I. Al Balushi, and B. A. Mohammad, "The Mediating Role of Employee Engagement in the Relationship Between Leadership Styles and Organizational Performance," *International Journal of Management Thinking.*, **1(2)**, 40-61, 2023. <https://doi.org/10.56868/ijmt.v1i2.26>.
- [7] M. Ali, S. Ullah, M. S. Ahmad, M. Y. Cheok, and H. Alenezi, "Assessing the impact of green consumption behavior and green purchase intention among millennials toward a sustainable environment," *Environmental Science and Pollution Research.*, 1-13, 2022. <https://doi.org/10.1007/s11356-022-23811-1>
- [8] X. Li, H. Wang, and C. Yang, "Driving mechanism of digital economy based on regulation algorithm for development of low-carbon industries," *Sustainable Energy Tech. Ass.*, 102909, 2022. <https://doi.org/10.1016/j.seta.2022.102909>
- [9] D. A. Love, P. A. Smith, and D. W. Wilcox, "The effect of regulation on optimal corporate pension risk," *Journal of Financial Economics.*, **101(1)**, 18-35, 2011.
- [10] H. An, Z. Huang, and T. Zhang, "What determines corporate pension fund risk-taking strategy?," *Journal of Banking & Finance*, vol. 37, no. 2, pp. 597-613, 2013.
- [11] H. Dinçer, S. Yüksel, A. Mikhaylov, and I. M. Bhatti, "EMAS III-based Analysis of European Eco-Management for Energy Efficiency Investments," *Journal of Applied Accounting Research.*, **24(2)**, 2023. <https://doi.org/10.1108/JAAR-08-2022-0216>
- [12] D. Hainaut and G. Deelstra, "Optimal funding of defined benefit pension plans," *Journal of Pension Economics & Finance.*, **10(1)**, 31-52, 2011.
- [13] K. M. J. Iqbal, M. I. Khan, A. Mikhaylov, A. A. Shah, V. Yadykin, W. L. Filho, M. A. U. R. Tariq, and W. Ullah, "Modeling principles, criteria and indicators to assess water sector governance for climate compatibility and sustainability," *Frontiers in Environmental Science.*, **11**, 989930, 2023. <https://doi.org/10.3389/fenvs.2023.989930>
- [14] J. An, A. Mikhaylov, and N. Sokolinskaya, "Machine learning in economic planning: ensembles of algorithms," *Journal of Physics: Conference Series.*, **1353**, 012126, 2019. <https://doi.org/10.1088/1742-6596/1353/1/012126>.
- [15] A. Andonov, R. M. Bauer, and K. Cremers, "Pension fund asset allocation and liability discount rates," *The Review of Financial Studies*, vol. 30, no. 8, pp. 2555–2595, 2017.

- [16] C. Atanasova and G. Chemla, "Does familiarity breed alternative investment? Evidence from corporate defined benefit pension plans," Working paper, 2020.
- [17] S. Belev, E. Matveev, and N. Moguchev, "Estimation of Profit Taxation Effect on Russian Companies' Investments," *Journal of Tax Reform, Graduate School of Economics and Management, Ural Federal University.*, **8 (2)**, 127-139, 2022.
- [18] A. Ahmed Mummmed and A. Hassen Habib, "Adoption of Improved Sorghum Variety (Melkam) and Its Impact on Household Food Security in Babile District, Eastern Ethiopia," *Journal of Advances in Humanities Research.*, **2(1)**, 13–28, 2023. <https://doi.org/10.56868/jadhur.v2i1.104>.
- [19] J. L. Coronado and S. A. Sharpe, "Did pension plan accounting contribute to a stock market bubble?," *Brookings Papers on Economic Activity*, pp. 323-359. 2003. <https://doi.org/10.1353/eca.2003.0014>
- [20] T. Crossley and M. Jametti, "Pension benefit insurance and pension plan portfolio choice," *The Review of Economics and Statistics*, vol. 95, no. 1, pp. 337-341, 2013.
- [21] M. Dahlquist, O. Setty, and R. Vestman, "On the asset allocation of a default pension fund," *The Journal of Finance*, **73(4)**, 1893–1936, 2018.
- [22] F. Bertozzi and G. Bonoli, "The Swiss pension system and social inclusion," in *Private Pensions versus Social Inclusion? Non-State Provision for Citizens at Risk in Europe*, eds. Traute Meyer and Paul, 2007.
- [23] L. N. Boon, M. Briere, and S. Rigot, "Regulation and pension fund risk-taking," *Journal of International Money and Finance.*, **84**, 23–41, 2018.
- [24] A. Mikhaylov, H. Dinçer, and S. Yüksel, "Analysis of financial development and open innovation oriented fintech potential for emerging economies using an integrated decision-making approach of MF-X-DMA and golden cut bipolar q-ROFSs," *Financial Innovation.*, **9(1)**, 1-34, 2023.
- [25] N. Mohan and T. Zhang, "An analysis of risk-taking behavior for public defined benefit pension plans," *Journal of Banking & Finance.*, **40**, 403–419, 2014.
- [26] R. Josa-Fombellida, P. López-Casado, and J. P. Rincón-Zapatero, "Portfolio optimization in a defined benefit pension plan where the risky assets are processes with constant elasticity of variance," *Insurance: Mathematics and Economics.*, **82**, 73–86, 2018.
- [27] M. L. Leibowitz and A. Ilmanen, "US corporate DB pension plans—Today's challenges," *The Journal of Retirement.*, **3(4)**, 34–46, 2016.
- [28] . Li, J. Wang, and C. Yang, "Risk prediction in financial management of listed companies based on optimized BP neural network under digital economy," *Neural. Comput. Appl.*, 2022. <https://doi.org/10.1007/s00521-022-07377-0>
- [29] Mette Hansen, Kristian R. Miltersen. Minimum rate of return guarantees: the Danish case / *Scandinavian Actuarial Journal* No. 4, 2002. URL: <https://pdfs.semanticscholar.org/cb5e/6d6b2633844191e74116f637354a07f73038.pdf>
- [30] A. Mikhaylov and S. Tarakanov, "Development of Levenberg-Marquardt theoretical approach for electric networks," in *Journal of Physics: Conference Series.*, **1515(5)**, 052006, IOP Publishing, April 2020. <https://doi.org/10.1088/1742-6596/1515/5/052006>
- [31] N. Moiseev, A. Mikhaylov, H. Dinçer, and S. Yüksel, "Market capitalization shock effects on open innovation models in e-commerce: golden cut q-rung orthopair fuzzy multicriteria decision-making analysis," *Financial Innovation.*, **9**, 55, 2023. <https://doi.org/10.1186/s40854-023-00461-x>
- [32] World Bank. 2020. "Total Tax Rate (% of Commercial Profits)." World Bank Data. <https://data.worldbank.org/indicator/IC.TAX.TOTL.CP.ZS> (Accessed October 9, 2023).