UDC 330.4

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FORECASTING OF INCOME INEQUALITY IN THE CONTEXT OF THE INTERGENERATIONAL PROPAGATION IN ASIA[1]

The article stresses on empirical research of income inequality in the context of the intergenerational propagation and the Fourth Industrial Revolution in Asia with orientation based on analysis of age dependency ratio and expenditure on education. Methodological basis of intergenerational propagation of inequality is econometric modelling of income inequality level that focuses on technological and socio-economic changes in Asia for individual economies of Japan, China, India, and Thailand. The research paper provides conclusions and policy recommendations in relation to forecasting of income inequality by adjusting the Gini index to Google Trends; empirical results concerning the impact of education and intergenerational transfers on income inequality.

Key words: income inequality, age dependency ratio, expenditure on education, Fourth Industrial Revolution, intergenerational propagation, forecasting, Gini index, Google Trends.

Кузьменко О.В., Боженко В.В., Доценко Т.В. ПРОГНОЗУВАННЯ НЕРІВНОСТІ ДОХОДІВ В КОНТЕКСТІ РОЗРИВУ МІЖ ПОКОЛІННЯМИ В АЗІЇ

У статті проводиться емпіричне дослідженні нерівності доходів в контексті розриву між поколіннями та четвертої промислової революції в Азії в залежності від відсотку працездатного населення та витрат на освіту. Методологічною базою поширення розриву між поколіннями виступає економетричне моделювання рівня нерівності доходів, що зосереджується на технологічних та соціально-економічних змінах Азії для окремих економік Японії, Китаю, Індії та Таїланду. Дослідження містить висновки та рекомендації щодо прогнозування нерівності доходів шляхом коригування індексу Джині до Google трендів; емпіричні результати щодо впливу освіти та трансферу між поколіннями на нерівність доходів.

Ключові слова: нерівність доходів, відсоток працездатного населення, витрати на освіту, Четверта промислова революція, розрив між поколіннями, індекс Джині, Google тренди.

Кузьменко О.В., Боженко В.В., Доценко Т.В. ПРОГНОЗИРОВАНИЕ НЕРАВЕНСТВА ДОХОДА В КОНТЕКСТЕ РАЗРЫВА МЕЖДУ ПОКОЛЕНИЯМИ В АЗИИ

В статье проводится эмпирическое исследовании неравенства доходов в контексте разрыва между поколениями и четвертой промышленной революции в Азии в зависимости от процента трудоспособного населения и расходов на образование. Методологической базой распространения разрыва между поколениями выступает эконометрическое моделирование уровня неравенства доходов с учетом технологических и социально-экономических изменений Азии для отдельных экономик Японии, Китая, Индии и Таиланда. Исследование содержит выводы и рекомендации по прогнозированию неравенства доходов путем корректировки индекса Джини в Google трендов; эмпирические результаты о влиянии образования и трансфера между поколениями на неравенство доходов.

Ключевые слова: неравенство доходов, процент трудоспособного населения, расходы на образование, Четвертая промышленная революция, разрыв между поколениями, индекс Джини, Google тренды.

Problem formulation. The evolution of income inequality and its impact on social, financial, and economic problems is a fundamental topic in debate among international organizations, state authorities, scientists, and others. Global income inequality stands at very high levels, whereby the richest 8% of the world's population earns half of the world's total income, while the remaining 92% of people are left with the other half. Income inequality has been increasing in many countries all over the world owing to a range of factors, including: inadequately regulated financial integration, trade liberalization processes, institutional and regulatory reforms that have increased competition in product and factor markets and, of course, technological change, which has favoured high-skilled workers. Both cross-country research and country case studies provide innumerable evidence that there is a strong positive correlation between income inequality and intergenerational persistence.

One of the key factors that affect income inequality and intergenerational propagation is the Fourth Industrial Revolution. Concurrent to the digital revolution, there are set of socio-economic, demographic, financial drivers of change, which is reinforcing one another and leading to such main consequences as: 1) decrease in the number of highly repetitive low-skill jobs and routine medium-skill job. In this context, artificial intelligence will initially affect clerical work, sales, customer services. The World Bank estimates that increasing auto-

[1] Публікацію підготовлено в межах виконання НДР "Моделювання та прогнозування соціо-економіко-політичної дорожньої карти реформ в Україні для переходу на модель стійкого зростання".

mation will put 57% of the jobs in the 35 countries in OECD at risk, including 47% of US jobs and 77% of the jobs in China; 2) efficiency improvement of existing jobs and increase in demand for customized human work; 3) increasing magnitude and probability of risks related to cybersecurity; 4) raising income inequality – the return to skills is likely to benefit those who are rich and lower-paid workers suffer from income underperformance. So, while the Fourth Industrial Revolution is enabling extraordinary levels of innovation and knowledge, it is also contributing to a widening inequality gap.

Therefore, it raises the question of necessity to carry out research and develop economic and mathematical models, which could make it possible to identify factors of income inequality variation influenced by Industry 4.0 and intergenerational propagation and find out the mechanism of its regulation on the basis of correlation analysis, principal components method, non-linear regression, harmonic and decomposition analysis; calculate values of forecasting trends of income inequality on the base of Google Trends.

Analysis of investigations and publications. In recent years, many scholars from different countries [15, 16, 17] have focused on studying and improving the issue of forecasting of income inequality in the context of the intergenerational propagation.

So, analysts in the United States [3] highlighted the view that a relatively large inequality of family income may be characterized by relatively low-income mobility in generations, as well as an increase in the link between incomes for individuals in childhood and adulthood. But in practical experience, it turns out that the transfer of income between different generations may not respond significantly to the corresponding changes in inequality. The same opinion was held by the supporters [6; 13; 20] of the hypothesis that high inequality impedes mobility between generations.

It is also thought that different economic, social, and political aspects also provide different opportunities for the mobility of transformation between generations [1, 4, 8]. Thus, unequal countries have less economic mobility than equals.

The great attention of the authors [2; 9; 18; 19] is given to the relationship between income inequality and general economic growth in general. Therefore, attention to inequality can now contribute to significant long-term growth benefits for other generations. From this point of view, it is considered that there is an improvement in the distribution of income in the course of growth of future changes.

Some researchers [5] in their writings analyse the magnitude of inequality of income through a global perspective. Factors of inequality differ in different countries. To overcome inequality of income, financial inclusion needs to be made in transition economies and developing countries, and for developed countries to concentrate on human capital and skills growth and on improving the tax system.

Many scholars [10; 11; 12; 14] argue that technological progress and an integrated global economy lead to significant changes in production and distribution. Such changes have redirected manufacturing technologies to highly skilled professionals. That is, there are two main features that help maintain wages of ordinary workers when new technologies are developing, such as increasing share of capital in the joint income and the existence of capital and enterprise complementarity.

Works of scholars [7] emphasize the great importance of demographic aspects in the simulation of inequality of income in the context of transformation between generations. Prediction of inequality of income depends on the following demographic statement: the family has a fixed rate.

Still, some problems of this direction have not yet been able to find full, complete, and comprehensive coverage in literary sources. That is why they need a future comprehensive study. A particular attention should be paid to economic and mathematical methods for forecasting inequality of income in the context of transformation between generations.

Setting objectives. The empirical stepwise of this research paper is based on analysis of the main questions as follows: first, an identification of the relevant indicators of evaluation of technological and socio-economic changes resulting from the Industry 4.0 through using correlation analysis. Second, the authors adjust relevant factors (technological, socio-economic) in the context of impact on income inequality using high-frequency data. Thirdly, the article stresses on forecasting the level of income inequality adjusted with the Fourth Industrial Revolution in Asia for individual economies of Japan, China, India, and Thailand with the application of mathematical methods by decomposition of the considered time series filtering trend and seasonal (cyclic) components. Fourthly, investigation of the impact of education and intergenerational transfers on income inequality in the context of the Intergenerational Propagation using Time-Series Panel Data Models. Lastly, conclusions and policy recommendations in relation to long-term forecasting of income inequality based on age dependency ratio and expenditure on education by adjusting to Google Trends.

Methodology for Collecting, Estimating, and Organizing Data to test the hypothesis of a correlation between the Fourth Industrial Revolution and income inequality thereafter predicts the ratio of income inequality adjusted with Industry 4.0 growth based on two obvious types of data. Firstly, the authors decide to assess the income inequality based on Gini index (World Bank Database) and, as a result, they look at measures of the Fourth Industrial Revolution in the context of technological and socio-economic changes (Share of ICT goods as percentage of total trade, annual, exports; Percentage of Individuals using the Internet; Share of ICT goods as percentage of total trade, annual, import; Employed, information and communication; Estimated yearly shipments of multipurpose industrial robots in selected countries; Number of researchers; R&D expenditure; High technology industry, value added). The hypothesis is tested on a panel data of four Asian countries (Japan, China, India, and Thailand) over the period of 2000–2017. Secondly, as a database for investigating the impact of education and intergenerational transfers on income inequality, there was used panel data concerning age dependency ratio (% of working-age population) and expenditure on education as % of total government expenditure (%) (World Bank Database). For the forecasting of income inequality in the context of the Intergenerational Propagation in Asia, the authors decide to use Google Trends indicators concerning users' requests for income inequality, expenditure on education and Industry 4.0.

Presentation of the main research material. This empirical research paper is aimed at determining main forces of income inequality in Asian countries in the context of the Intergenerational Propagation and the Fourth Industrial Revolution and forecasting these trends.

Firstly, in the context of each Asian countries (Japan, China, India, and Thailand), the authors have defined a set of technological and socio-economic indicators that carry on a significant influence on the income inequality through using correlation analysis method. Results of the implementation of this stage of modelling and forecasting of trends of income inequality variation influenced by Industry 4.0 are present in Table 1. Choosing relevant impacts on income inequality is based on the pair correlation coefficients, the value of which indicates statistically confirmed weak, average or close relationship.

Thus, based on the data presented in Table 1, it can be concluded that the influential factors of variation on income inequality for all considered countries are the share of ICT goods as a percentage of total trade, annual, exports, and a number of researchers. Specific indicators of income inequality for China and India are percentage of individuals using the Internet and estimated yearly shipments of multipurpose industrial robots in selected countries; for China and Thailand – share of ICT goods as percentage of total trade, annual, import; for Japan, India, and Thailand – high technology industry, value added. In addition, almost all considered indicators except employed, information and communication and high technology industry, value added is crucial in the study of variations in income inequality in China. The only indicator specified for Japan is employed, information and communication

Table 1

Results of correlation between technological and socio-economic indicators and income inequality

Indicators	Notation	Gini coefficient			
		Japan	China	India	Thailand
Share of ICT goods as a percentage of total trade, annual, exports	ICTE	**-0,2648**	**-0,9903**	**-0,2620**	**-0,2880**
Percentage of individuals using the Internet	IUI	-0,0189	**-0,9781**	**0,4301**	-0,1089
Share of ICT goods as a percentage of total trade, annual, import	ICTI	-0,0928	**-0,9883**	0,1101	**-0,2067**
Employed, information and communication	EIC	**0,1659**	-0,6804	-	-
Estimated yearly shipments of multipurpose industrial robots in selected countries	MIR	0,0412	**-0,8367**	**0,3132**	0,1018
Number of researchers	NR	**0,2510**	**-0,8688**	-	**0,1379**
R&D expenditure	RDE	-0,0569	**-0,9921**	-0,0036	0,1057
High technology industry, value added	HTI	**-0,2349**	0,0000	**0,3383**	**-0,5683**

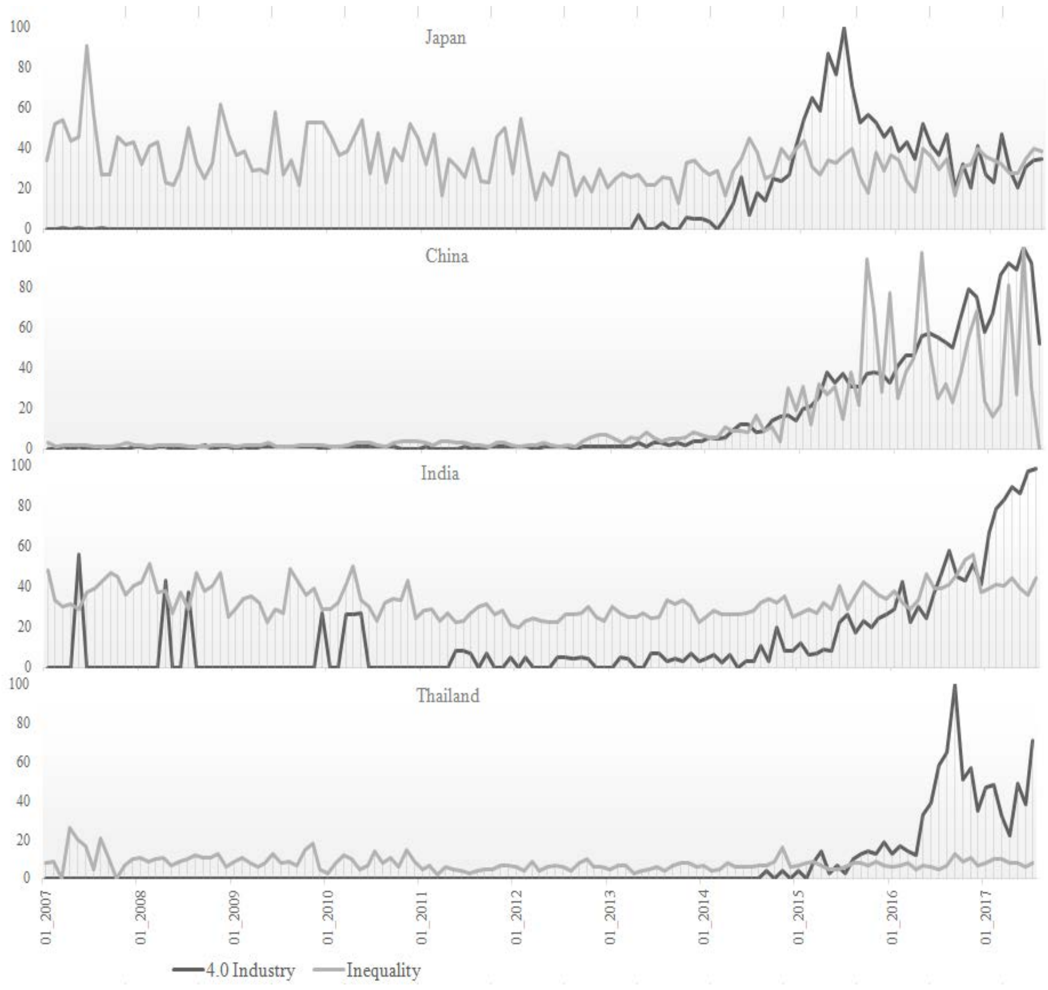

Figure 1. Google Trends of "Industry 4.0" and "Inequality": selected countries, 2007–2017

and for China – R&D expenditure. The specific country is India because there is the smallest number of relevant features factors.

The next stage is an adaptive adjustment of relevant technological and socio-economic indicators in the context of impact on income inequality on the basis of Internet users' queries in terms of Google Trends. With growing use of the Internet as an information finding tool, new data sources become vital for efficient policy-making decisions. Google Trends helps to aggregate a time series index of the volumes for specific search terms. At this stage, the authors construct such variables as "Inequality" and "Industry 4.0" based on Google search and graphically present its dynamics and characteristics of variations in Figure 1. Charts show the annual growth of queries related to "Industry 4.0" and "Inequality" and correlation between these indicators since 2014.

Secondly, construction based on panel data for the period from 2004 to 2017, econometric models of nonlinear regression relationship between income inequality and technological and socio-economic indicators with the use of ordinary least square method for different countries as following decompositions: for Japan – function of GINI coefficient from ICTE, EIC, NR, and HTI; for China – function of income inequality from ICTE, IUI, ICTI, MIR, NR, and RDE; for India – function of GINI coefficient from ICTE, IUI, MIR, and HTI; for Thailand – function of income inequality from ICTE, ICTI, NR, and HTI. Considered results of regression relationship between technological and socio-economic indicators and income inequality in the context of Coefficients, Standard Error, t-statistics, P-level, Lower 95%, and Higher 95% are presented in Table 2 and will be used on the next stage as input information base.

Thirdly, the initial relevant indicators adjustment in the context of each countries time series (technological and socio-economic indicators) by Google Trends is made. The complex transformations based on Google Trends allows pinpointing current technological and socio-economic changes due to Industry 4.0 and implementing an adaptive mechanism for income inequality to these current changes. So, the authors have formalized and quantified the revealed relationships between income inequality and Industry 4.0 depending on the country:

– Japan:

$$GINI_t^J = \left(-5.4610 + 2.4255 \cdot \sin ICTE_t^J \cdot IN_t^{GTJ} - 0.5049 \cdot \cos NR_t^J \cdot IN_t^{GTJ} + 13.7515 \cdot \frac{IN_t^{GTJ}}{HTI_t^J} \right) \cdot IE_t^{JTF}, \quad (1)$$

where $GINI_t^J$ – Gini coefficient at the moment of time t for Japan;

$ICTE_t^J$ – Share of ICT goods as a percentage of total trade, annual, exports at the moment of time t for Japan;

NR_t^J – Number of researchers at the moment of time t for Japan;

HTI_t^J – High technology industry, value-added venture capital investments of GDP at the moment of time t for Japan;

IN_t^{GTJ} – Number of Internet requests "Industry 4.0" (Google Trends) at the moment of time t for Japan;

IE_t^{JTF} – Number of Internet requests "Inequality" (Google Trends) at the moment of time t for Japan.

– China:

$$GINI_t^C = \left(45.3044 - 58350.5305 \cdot \frac{IN_t^{GTC}}{ICTE_t^C} - 0.0351 \cdot \ln IUI_t^C \cdot IN_t^{GTC} - 0.0564 \cdot \cos ICTI_t^C \cdot IN_t^{GTC} + 1938.4511 \cdot \frac{IN_t^{GTC}}{MIR_t^C} - 1.5491 \cdot RDE_t^C \cdot IN_t^{GTC} \right) \cdot IE_t^{GTC}, \quad (2)$$

Table 2

Results of regression relationship between technological and socio-economic indicators and income inequality

	Coefficients	**Standard Error**	**t-statistics**	**P-level**	**Lower 95%**	**Higher 95%**
			Japan			
Y-intersection	-5,4610	18,8334	-0,2900	0,7772	-46,9130	35,9910
sin ICTE	2,4255	1,4260	1,7009	0,1170	-0,7131	5,5642
EIC^2	0,0000	0,0000	1,8920	0,0851	0,0000	0,0000
cos NR	-0,5049	1,4572	-0,3465	0,7355	-3,7123	2,7024
1/ HTI	13,7515	7,8875	1,7435	0,1091	-3,6087	31,1117
			China			
Y-intersection	45,3044	0,2797	161,9884	0,0000	44,6717	45,9370
1/ ICTE	-58350,5305	22490,2816	-2,5945	0,0290	-109227,0819	-7473,9790
ln IUI,	-0,0351	0,1324	-0,2653	0,7967	-0,3346	0,2644
cos ICTI	-0,0564	0,0259	-2,1786	0,0573	-0,1149	0,0022
1/ MIR	1938,4511	766,9910	2,5273	0,0324	203,3969	3673,5053
NR^3	0,0000	0,0000	-1,5203	0,1628	0,0000	0,0000
RDE	-1,5491	0,2839	-5,4570	0,0004	-2,1912	-0,9069
			India			
Y-intersection	43,8766	11,1870	3,9221	0,0024	19,2542	68,4990
cosICTE	1,2390	1,3210	0,9380	0,3684	-1,6684	4,1465
IUI^2	0,0130	0,0062	2,0811	0,0616	-0,0007	0,0267
ln MIR	-1,7339	1,5216	-1,1395	0,2787	-5,0829	1,6151
HTI	1,2729	6,8948	0,1846	0,8569	-13,9025	16,4483
			Thailand			
Y-intersection	-5,2841	15,4175	-0,3427	0,7383	-39,2179	28,6497
sinICTE	1,8186	2,3141	0,7859	0,4485	-3,2747	6,9119
ICTI ^2	0,0000	0,0000	-1,3611	0,2007	0,0000	0,0000
cos NR	5,0571	2,0885	2,4214	0,0339	0,4603	9,6539
1/ HTI	20,9366	6,5340	3,2043	0,0084	6,5554	35,3178

where $GINI_t^C$ – Gini coefficient at the moment of time *t* for China;

$ICTE_t^C$ – Share of ICT goods as a percentage of total trade, annual, exports at the moment of time *t* for China;

IUI_t^C – Percentage of individuals using the Internet at the moment of time *t* for China;

$ICTI_t^C$ – Share of ICT goods as a percentage of total trade, annual, import at the moment of time *t* for China;

MIR_t^C – Estimated yearly shipments of multipurpose industrial robots in selected countries at the moment of time *t* for China;

RDE_t^C – R&D expenditure at the moment of time *t* for China;

IN_t^{GTC} – Number of Internet requests “Industry 4.0” (Google Trends) at the moment of time *t* for China;

IE_t^{GTC} – Number of Internet requests “Inequality” (Google Trends) at the moment of time *t* for China.

– India:

$$GINI_t^I = \begin{pmatrix} 43.8766 + 1.2390 \cdot \cos\left(ICTE_t^I\right) \cdot IN_t^{GTI} + 0.0130 \cdot \left(IUI_t^I\right)^2 \cdot IN_t^{GTI} - \\ -1.7339 \cdot \ln(MIR_t^I) \cdot IN_t^{GTI} + 1.2729 \cdot HTI_t^I \cdot IN_t^{GTI} \end{pmatrix} \cdot IE_t^{GTI}, \quad (3)$$

where $GINI_t^I$ – Gini coefficient at the moment of time *t* for India;

$ICTE_t^I$ – Share of ICT goods as a percentage of total trade, annual, exports at the moment of time *t* for India;

IUI_t^I – Percentage of individuals using the Internet at the moment of time *t* for India;

MIR_t^I – Estimated yearly shipments of multipurpose industrial robots in selected countries at the moment of time *t* for India;

HTI_t^I – High technology industry, value-added venture capital investments of GDP at the moment of time *t* for India;

IN_t^{GTI} – Number of Internet requests “Industry 4.0” (Google Trends) at the moment of time *t* for India;

IE_t^{GTI} – Number of Internet requests “Inequality” (Google Trends) at the moment of time *t* for India.

– Thailand:

$$GINI_t^T = \left(-5.2841 + 1.8186 \cdot \sin\left(ICTE_t^T\right) \cdot IN_t^{GTT} + 5.0571 \cdot \cos\left(ICTI_t^S\right)^2 \cdot IN_t^{GTT} + 20.9366 \cdot \frac{IN_t^{GTT}}{HTI_t^T} \right) \cdot IE_t^{GTT}, \quad (4)$$

where $GINI_t^T$ – Gini coefficient at the moment of time *t* for Thailand;

$ICTE_t^T$ – Share of ICT goods as a percentage of total trade, annual, exports at the moment of time *t* for Thailand;

$ICTI_t^S$ – Share of ICT goods as a percentage of total trade, annual, import at the moment of time *t* for Thailand;

HTI_t^T – High technology industry, value-added venture capital investments of GDP at the moment of time *t* for Thailand;

IN_t^{GTT} – Number of Internet requests “Industry 4.0” (Google Trends) at the moment of time *t* for Thailand;

IE_t^{GTT} – Number of Internet requests “Inequality” (Google Trends) at the moment of time *t* for Thailand.

Based on identified trend and the cyclical component of the dynamics of income inequality and indicators, which are characterized by technological and socio-economic changes due to the Fourth Industrial Revolution, the authors forecast the level of Gini ratio adjusted with the Fourth Industrial Revolution growth on the base of Google Trends. At this stage, the visualization of considered time series using dynamics diagrams is performed (Figure 2).

Forecasting results show that income inequality under the influence of the Fourth Industrial Revolution in the coming years will grow rapidly in India. As new technologies tend to complement high-skilled workers and replace low-skilled workers, public authorities of these counties need to pay more attention to problem-solving as for income inequality through equitable access to resources and services, tax transformation, and so on. Currently, the Gini ratio in Japan is about 34% but, in the near future, there will be an increase slightly as a result of technological shifts. According to the projections, the income inequality in India will grow significantly as a result of the active introduction of digital technologies into the production and displacement of the labour force.

Fourthly, there is the necessity to estimate the impact of education and intergenerational transfers on income inequality and make conclusions and policy recommendations relatively long-term forecasting income inequality by adjusting the Gini index to Google Trends. For the empirical realization of this stage, we have to:

- determine the dynamics of Google trends in terms of indicators of age dependency ratio and expenditure on education;
- compare the actual and forecast values of considered indicators, taking into account adjustments to the number of Internet users’ requests;
- identify and analyse trends in the age dependency ratio and expenditure on education for Asian countries for individual economies of Japan, China, India, and Thailand;

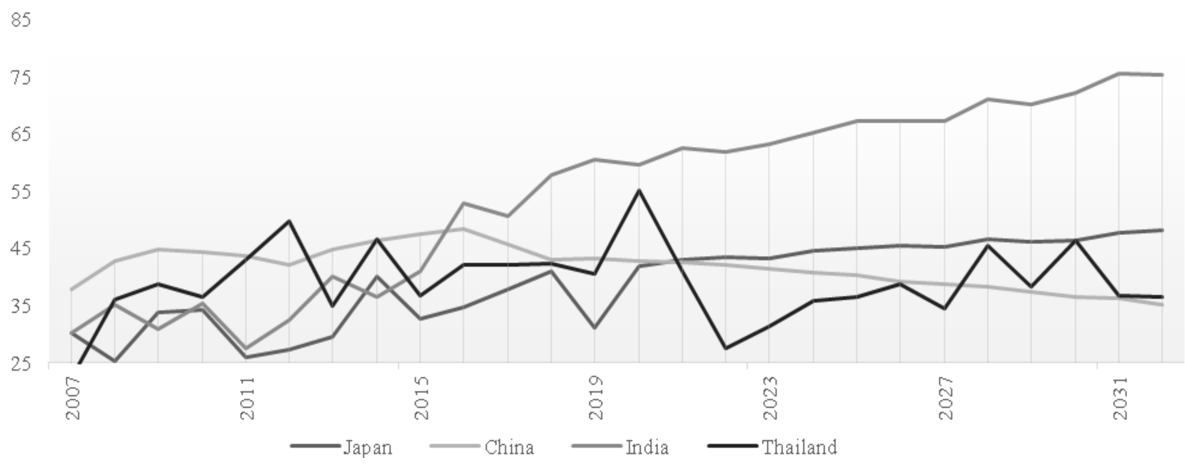

Figure 2. Gini ratio adjusted to the Fourth Industrial Revolution growth

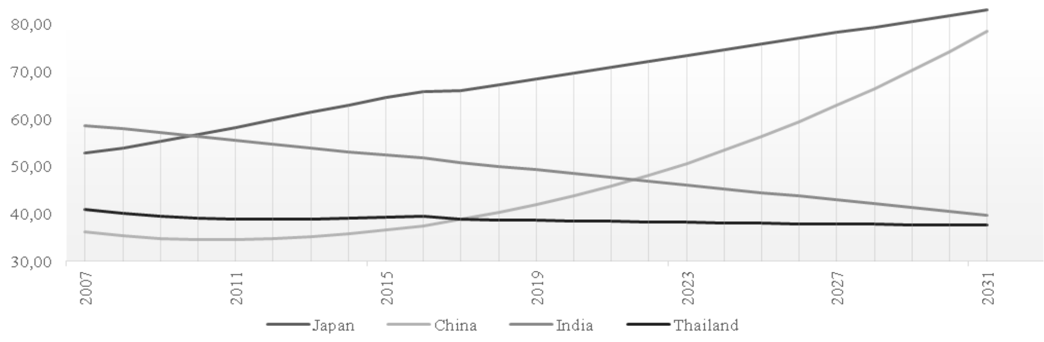

Figure 3. Google Trends of expenditure on education: selected countries, 2007–2017

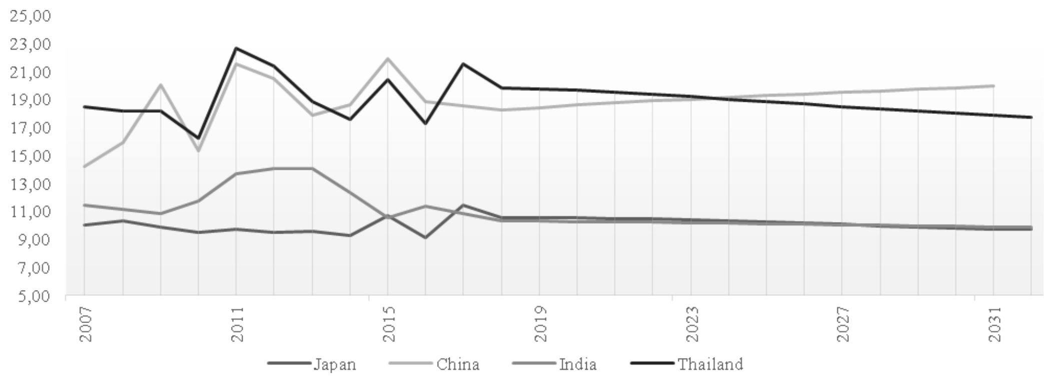

Figure 4. Actual and forecasting values of age dependency ratio (% of working-age population)

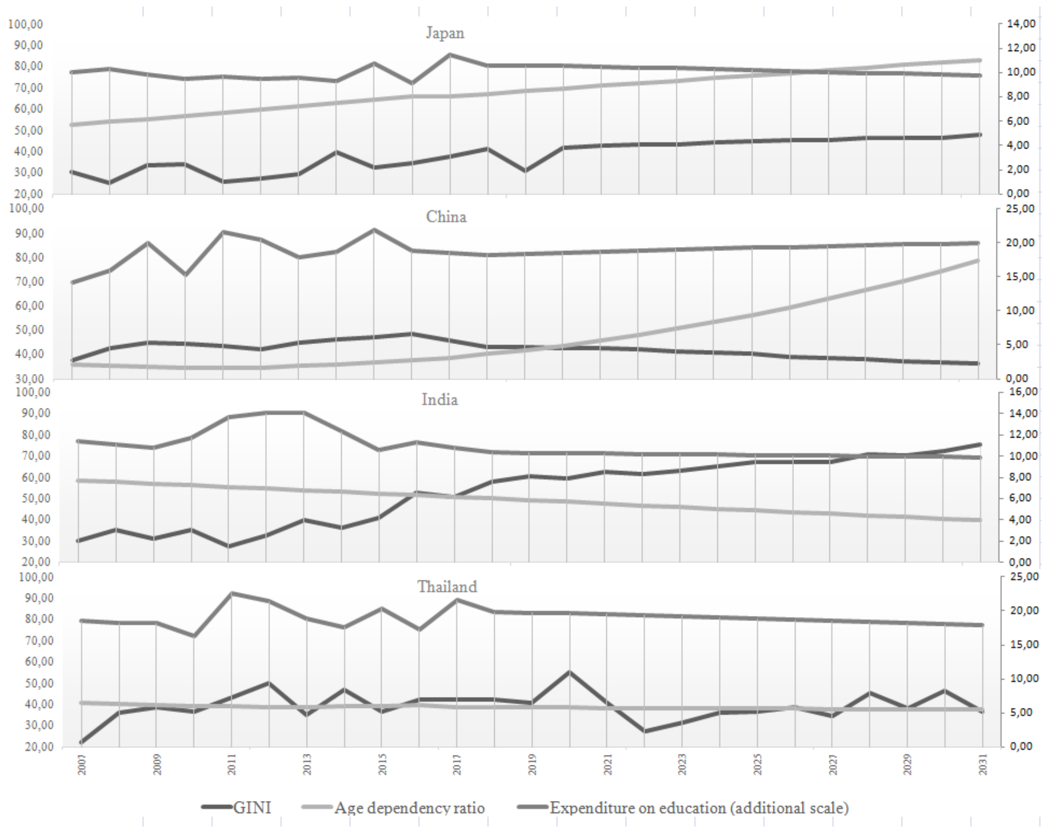

Figure 5. Actual and forecasting values of expenditure on education as % of total government expenditure (%)

Table 3

Results of regression relationship of age dependency ratio and expenditure on education from time indicator

Country	Age dependency ratio (% of working-age population)	Expenditure on education as % of total government expenditure (%)
Japan	$y = 1{,}2248x + 43{,}956$, RI = 0,9838	$y = 10{,}119e^{-0{,}004x}$ RI = 0,2658
China	$y = 0{,}0011x^3 + 0{,}0765x^2 - 2{,}2992x + 49{,}076$, RI = 0,9974	$y = 3{,}4363\ln(x) + 7{,}3613$, RI = 0,4572
India	$y = -0{,}79x + 65{,}044$, RI = 0,9995	$y = -1{,}566\ln(x) + 15{,}892$, RI = 0,4115
Thailand	$y = -2{,}246\ln(x) + 45{,}302$, RI = 0,8441	$y = -2{,}617\ln(x) + 25{,}218$, RI = 0,3984

Note: y – regressand, x – time indicator

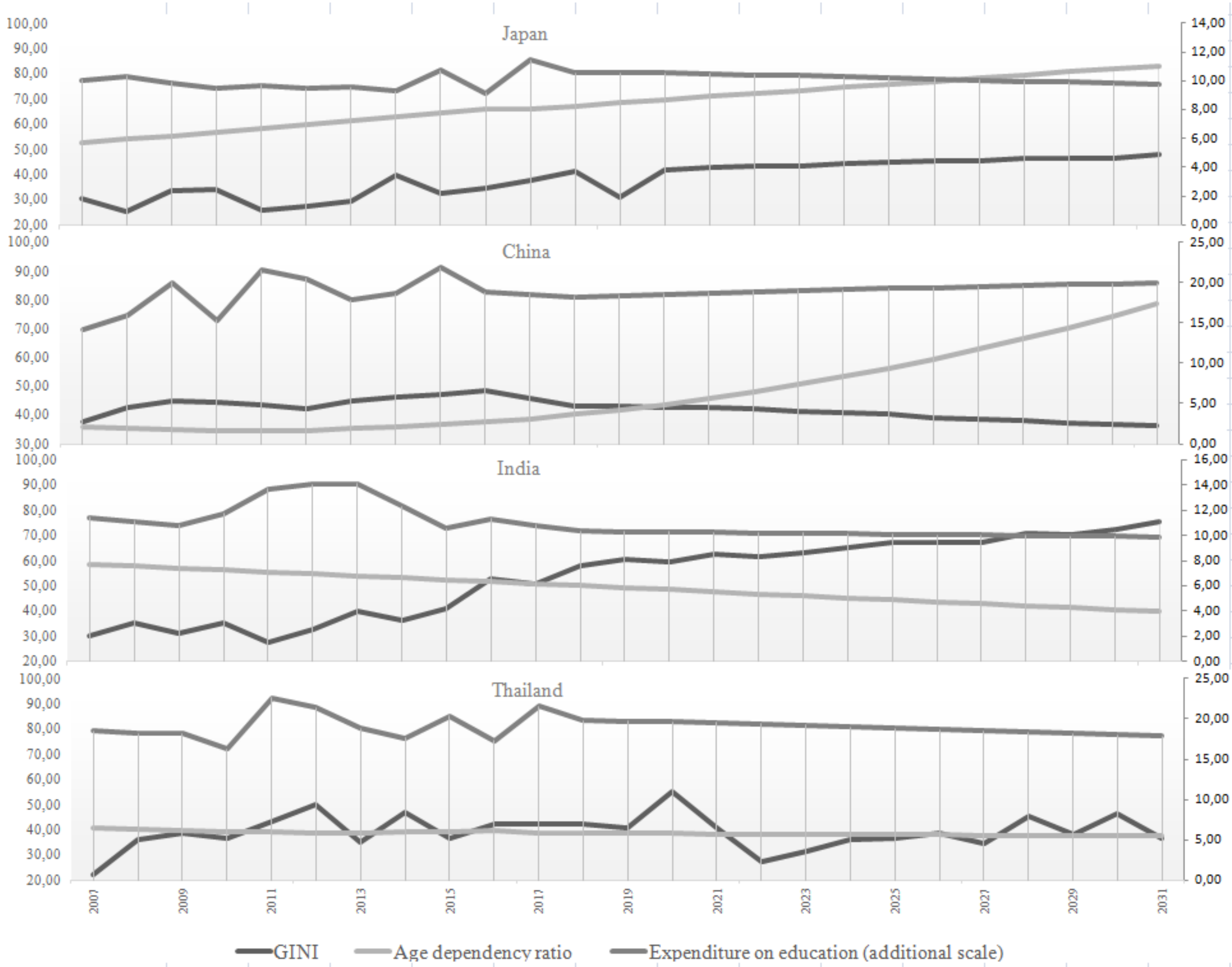

Figure 6. Actual and forecasting values of GINI coefficient, age dependency ratio and expenditure on education: selected countries, 2007–2031

- construct econometric models for determining the level of income inequality from the age dependency ratio and expenditure on education;
- formulate recommendations for Intergenerational Propagation in Asia under the influence of the Fourth Industrial Revolution.

Turning to the study of the variation changes in the trends of indicators of the age dependency ratio and expenditures on education, we note that the statistical base is not sufficient to formulate general regularities and ensure the adequacy of their impact on the Intergenerational Propagation, that is why we will conduct a detailed analysis of the indicator of expenditure on education (Figure 3). So, in the context of Japan, China, and Thailand, the inquiries of Internet users of expenditure on education are similar and reflect global trends: the presence of a constant trend and slight non-cyclical fluctuations during the investigated time interval of 2007–2017. In contrast to the described analytics, India is characterized by a significant variable component from 0 to 60% at the beginning of the analysed period, which eventually fades and the curve of the time series of Google Trends of expenditure on education is saturated.

Turning to the next step – comparison of the actual and forecast values of age dependency ratio and expenditure on education, taking into account adjustments to the number of Internet users' requests, we have to identify trends in terms of regression relationship of regressands from time indicator (Table 3). So we can see that in the context of age dependency ratio for Japan and India, considered indicator is described by linear trend: with the increase of time indicator, % of the working-age population in Japan will increase; the opposite situation is in India, where in dynamic % of the working-age population will decrease. At the same time, China and Thailand are characterized by nonlinear tendencies: a polynomial of the third order for China and logarithmic function for Thailand. The analysis of Figure 4 stresses on the decrease of age dependency ratio for China till the 2011 year and increase in this indicator in terms of actual and forecasted values from 2011 till 2031. The individual economy of Thailand in the context of the considered coefficient is characterized by logarithmic function; it means that % of working-age population decreases and leads to saturation with the level of approximately 40%.

Analysing the patterns of expenditure on education (Figure 5), we can distinguish a clear logarithmic trend for China, India, and Thailand, while Japan is characterized by an exponential trend. Thus, over time, only China expects growth of % of total government expenditure on education. In the context of Thailand, there is a tendency to reduce education costs at a much higher pace than for Japan and India.

Taking into account the age structure of the population and the amount of the educational sector funding, the forecast of the Gini index was constructed (Figure 6). The results showed that over the next 20 years, the largest gap between the poor and the rich will be in India, while the smallest in China.

Conclusions. This paper has used data to forecast income inequality adjusted with the Fourth Industrial Revolution growth in five European countries. To forecast future level of Gini ratio, the authors perform the following steps: the identification of the relevant technological and socio-economic indicators that carry on significant influence on the income inequality; data collection using Google Trends tool; recognition trend and the cyclical component of the dynamics of income inequality and Industry 4.0 indicators; forecast Gini ratio with the influence of the Fourth Industrial Revolution. A further contribution of this study lies in the investigation of the correlation between income inequalities in a gender perspective.

REFERENCES:

1. Andrews Dan, Leigh Andrew. More Inequality, Less Social Mobility. Applied Economics Letters. 2009;16:1489–92.
2. Berg, A., Ostry, J.D. (2011). Inequality and Unsustainable Growth: Two Sides of the Same Coin? IMF Staff Discussion Note 11/08, International Monetary Fund, Washington.
3. Bloome Deirdre. Income Inequality and Intergenerational Income Mobility in the United States. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4569595.
4. Corak Miles. Inequality from Generation to Generation. In: Rycroft Robert., editor. The Economics of Inequality, Poverty, and Discrimination in the 21st Century. Santa Barbara, CA: ABC-CLIO; 2013a.
5. Dabla-Norris, E., Kochhar, K., Suphaphiphat, N., Ricka, F., Tsounta, E. (2015). Causes and Consequences of Income Inequality: A Global Perspective, Staff Discussion Note 15/13, International Monetary Fund. Retrieved from http://www.imf.org/external/pubs/cat/longres.aspx?sk=42986.0.
6. Ermisch John, Jäntti Markus, Smeeding Timothy, Wilson James. Advantage in Comparative Perspective. In: Ermisch John, Jäntti Markus, Smeeding Timothy., editors. From Parents to Children. New York: Russell Sage; 2012. pp. 3–31.
7. Isaac Alan G.. The Intergenerational Propagation of Wealth Inequality. 2014. Retrieved from http://onlinelibrary.wiley.com/doi/10.1111/meca.12057/full.
8. Krueger Alan. The Rise and Consequences of Inequality in the United States. Remarks for the Center for American Progress. 2012 Jan; http://www.whitehouse.gov/sites/default/files/krueger_cap_speech_final_remarks.pdf.
9. Kumhof, M., and R. Rancière, 2010, ―Inequality, Leverage and Crises,‖ IMF Working Paper 10/268 (Washington: International Monetary Fund).
10. Krueger, D. and F. Perri 2006 Does Income Inequality Lead to Consumption Inequality? Evidence and Theory, Review of Economic Studies 73, 163-193.
11. Lansing, K.J., Markiewicz, A. (2012). Top incomes, rising inequality, and welfare, Working Paper 10, Norges Bank Research. Retrieved from http://www.norges-bank.no/contentassets/ 16dd2a93e9f948fe8c5185b7892d49b8/norges_bank_working_paper_2012_10.pdf.
12. Lemieux, T. 2006 Postsecondary Education and Increasing Wage Inequality, American Economic Review Papers and Proceedings 96, 195-199.
13. Neckerman Kathryn, Torche Florencia. Inequality: Causes and Consequences. Annual Review of Sociology. 2007;33:335–57.
14. OECD 2011 Divided We Stand: Why Inequality Keeps Rising. OECD Publishing, Paris. Overview available at www.oecd.org/els/socialpoliciesanddata/49499779.pdf.
15. Papageorgiou, C., Jaumotte, F., Lall, S. (2008). Rising Income Inequality: Technology, or Trade and Financial Globalization? IMF Working Paper, International Monetary Fund. Retrieved from https://www.imf.org/external/pubs/ft/wp/2008/wp08185.pdf.
16. Park, D., Shin, K. (2015). Economic Growth, Financial Development, and Income Inequality, ADB Economics Working Paper Series, Asian Development Bank. Retrieved from https://www.econstor.eu/bitstream/10419/128563/1/ewp-441.pdf.
17. Perugini, C., Hölscher, J., Collie, S. (2015). Inequality, credit and financial crises. Cambridge Journal of Economics. 40, 227-257.
18. Piketty, T., and E. Saez, 2003, ―Income Inequality in the United States, 1913–1998,‖ Quarterly Journal of Economics, Vol. 118, No. 1, pp. 1–39.
19. Rajan, R., 2010, Fault Lines: How Hidden Fractures Still Threaten the World Economy (Princeton: Princeton University Press).
20. Wilkinson Richard, Pickett Kate. The Spirit Level. New York: Bloomsbury; 2010.