

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/343861922>

Evaluation of demographic component of countries' economic security

Article in *Business Management and Education* · August 2020

DOI: 10.3846/jbem.2020.12309

CITATIONS

10

READS

165

3 authors, including:



Olena Bulatova

Mariupol State University

42 PUBLICATIONS 124 CITATIONS

[SEE PROFILE](#)



Olha Zakharova

Mariupol State University

12 PUBLICATIONS 45 CITATIONS

[SEE PROFILE](#)



EVALUATION OF DEMOGRAPHIC COMPONENT OF COUNTRIES' ECONOMIC SECURITY

Olha HRYBINENKO ^{1*}, Olena BULATOVA ², Olha ZAKHAROVA ²

¹*Department of Economic of Enterprises, Faculty of Finances and Economics,
Dnipro University of Technology, Dnipro, Ukraine*

²*Economics and International Economic Relations Department,
Mariupol State University, Mariupol, Ukraine*

Received 22 March 2020; accepted 10 August 2020

Abstract. *Purpose* – The article is aimed at evaluation of the patterns of demographic processes development in terms of their impact on shaping the level of countries' economic security.

Research methodology – The study is based on a multidimensional estimation technique, which proposes the development of an integral indicator of the demographic component of countries' economic security. Stochastic research methods, in particular the t-test method, were used to identify and justify different hazard zones.

Findings – On the basis of the formed sample of the countries, the integral indices of the level of the demographic component of countries' economic security for the period of 2000–2018 were calculated. The thresholds of demographic security indicators were identified and reasoned; the countries' security risks by demographic indicators were assessed; systematisation of countries according to the level of the demographic component of security was provided.

Research limitations – It is proposed to include ten indicators in the structure of the index of the demographic component of economic security; these indicators characterise different aspects of the demographic processes development. However, this is not a complete list of possible valuation indicators. This determines the necessity of further studies in terms of justifying the advisability of including various parameters and assessing the degree of their importance in the structure of the demographic security index.

Practical implications – The practical value of the results of the comprehensive analysis of the demographic processes development in the system of ensuring countries' economic security is the possibility of identifying real or potential threats to the sustainable social and economic development of countries and regions of the world.

Originality/Value – The authors' improved methodology for assessing the level of economic security based on the demographic component consideration, taking into account the system of proposed indices, allows to assess the level of security, to monitor its changes and to identify factors that pose risks not only for one country but also for groups of countries both in regional dimension and in terms of the level of their development.

Keywords: economic security, demographic component of security, indicator, challenge, integral criterion.

JEL Classification: F52, J10, C10.

*Corresponding author. E-mail: hrybinenko.o.m@nmu.one

Introduction

Demographic component of the security determines such state-of-art of a nation when the implementation of human potential, provision of sufficient living conditions as well as the quality of life become the basis, in terms of which birth rate and migration correspond to the available resources and compensate ageing of population and mortality being the fundamental condition of both national and international security (Ptoukha Institute for Demography and Social Studies of the National Academy of Sciences of Ukraine, 2018). The demographic component is considered as one of the determinative ones in the context of sustainable development of a nation under which adequate level of the potential human reproduction can be implemented. Nature of progress of demographic processes as well as its intensity influences the formation of the total level of economic security. On the one hand, the bases for sustainable socio-economic development are provided; on the other hand, particular real or potential challenges to the sustainable progress of nations and regions of the world arise. Thus, it becomes topical to study problems as for the provision of optimum level of the demographic component of economic security relying upon a complex integral analysis of both tendencies and regularities of demographic progress as well as upon evaluation of risks and challenges to the total economic security.

The majority of scientific study in the field of demography connects the specificity of demographic evolution and regularities of dynamics as well as changing the structure of parameters of demographic processes with the aspects of economic and social security provision. However, identification and evaluation of the correlation are based mainly upon qualitative descriptive analysis of the certain demographic indices, conditions, and tendencies of their development in the context of the defined retrospective as well as upon evaluation of the determined demographic situation influence on the potential of socio-economic progress. Fragmentary nature of the study results, insufficient completeness and consistency of consideration of multi-aspect principles of the demographic change manifestation, nonavailability of the integrated approach as for the implementation of tools to evaluate quantitatively the development level of demographic processes as well as high intensive format of their changes both at the level of one country and at the worldwide level and the global system stipulate the necessity of further studies. We believe that on the one hand, the problems of such quantitative evaluation of demographic security based upon the integrated involvement of a set of demographic indices as part of the integral index as well as the development of tools to evaluate boundary values of the parameters to be considered as the evaluation criteria for security status and inform of risks and threats become critical.

Purpose of the paper is to evaluate development regularities of demographic processes from the viewpoint of their effect on the formation of the global economic security level. Such an evaluation will be based upon the methods of multidimensional assessment in terms of which it is proposed to develop an integral index of the demographic component of the national economic security.

The represented study involves the author's approach to the demographic component of an economic security evaluation, relying upon the following assumptions:

- First, economic security is such an integral concept in which evaluation should be based upon the consideration of a set of estimation criteria (i.e., security indices).

Hence, qualitative evaluation of a security level is possible if only the methods of multidimensional evaluation are applied resulting in the formation of relevant integral security indices;

- Second, the developed security index should not be of the nature of a descriptive index aggregating a system of single quantitative parameters into the unified, integrated assessment. It should also be the certain criterion having under the set conditions its own variation range, which violation is a signal of changes in the security level, identifier of the intensified risks or the increased security threats;
- Third, taking into consideration a linkage between the demographic component of economic security and sustainable development of the national economic system following the security understanding as such a characteristic of the economic system, determining its independence, stability, and sustainability as well as its potential to dynamic and sequential development, protectability and competitiveness, the capability to withstand various risks, it becomes expedient to form such a system of security parameters (indicators) corresponding to the UN Concept of Sustainable Development and correlating with the goals and indicators of the sustainable development achievement of which have been determined as the priority-oriented within the Concept (United Nations, 2020a).

According to the purpose, the following tasks of the study have been determined:

- Systematisation of demographic security indices and determination of nature of their influence of the security level.
- Development of methodical tools to calculate integral index of demographic security index.
- Formation of a sample set of countries to analyse features of their demographic progress and to evaluate the level of demographic security within the structure of economic security.
- Determination of the boundary values of demographic indices as the security criteria on the basis of their statistical analysis in the context of countries and the world.
- Evaluation of risks and threats to the countries in terms of demographic indicators and identification of status of the countries within the areas of risk, danger, and security.
- Evaluation of distribution of the countries and their classification in terms of the integral level of demographic security and creation of the rating of sample countries in terms of demographic security rating.
- Calculation and analysis of regional indices of demographic security and group ones (according to the status of their socio-economic development).

The tasks defines the paper structure making it possible to carry out integral analysis of demographic process development in the context of a system providing economic security of the world countries creating a possibility to determine both actual and potential risks to the sustainable socio-economic growth of the nations as well as to the world parts.

1. Previous research

The current analysis of economic security is based upon the use of various approaches making it possible to study theoretical and methodological foundations to determine economic security as a state, as a system, and as a process. Research and use of empiric methods intended to study the formation of economic security, and its provision are long-term. The modern conflicts, being expanded actively worldwide, are not limited by ideological issues

anymore; instead, they are connected with the distribution of resources, and the use of economic power (Renner, 2002). Maull (1984) believes that escalations of risky tendencies of cleavage of society as well as the escalation of social conflicts and breakage of links with raw material suppliers are the threats to economic security (1984). Ackroyd and Marsden (2006) pay attention to the resource allocation procedure and to prioritising of national policy as for the economic security formation. It is notable that nowadays, countries apply a policy of economic nationalism actively to provide proper interests and economic security (Reznikova et al., 2018). While determining a security concept, Baldwin (1997) has noted truly that the category is still complicated and controversial, thus requiring adequate conceptualisation. Hence, studies of economic security and its comprehensive assessment should involve the totality of evaluation criteria (i.e. indicators of security). Several variants are applied to form the integral index (Bulatova et al., 2018; Zakharova, 2015).

Early studies of the authors prove that economic security is such a characteristic of the economic system determining its independence, sustainability and stability, protectability and competitiveness, its potential for dynamic and successive development, and ability to stand up to various threats. Demographic safety is the weighty component of the national economic security specifying the set of preconditions to provide adequate protection level of the population against the influence of internal threats and external threats when capital-productive progress of the nation takes place.

The last message is proved by many scholars engaged in security evaluation in the context of the influence of demographic factors. Hence, the demographic tendencies, connected with changes in the age structure of the population as well as with the significant regional differences, are analysed as prerequisites for the emergence and expansion of international conflicts, i.e. as a threat to military and political security and destabilisation of socio-political development (Brooks et al., 2019; Spear & Williams, 2012). Certain scholars consider demography and regularities of demographic progress as a tool of governmental influence on various aspects of socio-economic, sociocultural, and political life characterising it as demographic engineering (McNamee & Zhang, 2019). That is why the possibility of such purposeful influence on the behaviour and changes in certain parameters of demographic processes can be considered (in terms of many countries) as the instrument to provide national (governmental) interests which may favour a conflict emergence as well as destabilisation of socio-economic development as a result.

From the viewpoint of socio-economic aspect, demographic determinants (i.e. specific feature of age structure, its dynamic changes, the intensity of processes of migration dynamics and processes of the natural migration of population together with other economic determinants describing a level and nature of income distribution, a level of welfare of the population) are considered as the indicators of influence on food insecurity (Tarasuk et al., 2019) and the national economy on the whole (Lori, 2019). Social security level (i.e. regarding the formation of the efficient system of social protection of the nation) is also considered in close correlation with the nature of changes in the population size and differentiation degree of a fertility level (Boldrin et al., 2015; Lee, 2016). The authors propose mathematical models of quantitative evaluation of the fertility effects on the parameters of a system of social protection of the population.

Certain scientists apply such an idea as “demographic resilience” while studying the influence on demographic tendencies on the security environment of countries inclusive of those in the context of climatic changes and searching for adequate ways to overcome negative consequences (De Souza, 2015).

Many authors believe that demographic changes are the factors providing economic welfare and activating economic growth. Among other things, relations between GDP per capita growth and the working-age population and the total population growth, child and old-age dependence ratios have been analysed (Choudhry & Elhorst, 2010); mechanism of the effect of demographic transformations, depending upon both rates and tendencies of changes in the number of inhabitants and their age structure, on the economic dynamics rates and poverty level has been described (Cruz & Ahmed, 2018); the long-run and short-run impact of such demographic factors as life expectancy, fertility rate and young dependency on the economic growth of South Asian countries (Munir & Shahid, 2020) have been defined. Authors apply nonlinear mathematical models to substantiate theories of demographic transition as well as its influence on economic growth (Ranganathan et al., 2015) taking into consideration cyclic nature of economic processes and dealing with processes of natural population movement and economic growth as with endogenic ones.

A number of studies the regularities of demographic changes are connected with processes of human capital progress and accumulation (Han & Lee, 2020; Fertig et al., 2009), development of educational system and standard of knowledge (Kurban et al., 2015).

Many scholars believe that demographic transformations and demographic security level are the prerequisites of socio-political system sustainability as it has been demonstrated in terms of the Middle East (Hamanaka, 2017) as well as the condition to provide economic growth and the improved living standards of the population as it has been demonstrated in terms of the Southeastern European countries (Malnar & Malnar, 2015).

Mainly, evaluation of demographic security is connected with the identification of risks and substantiation of nature of their manifestation and influence for the future making of effective preventive policies (Maroto & Pettinicchio, 2020).

An increasing proportion of young adults, rapid urbanisation, a shift in the sex structure of the population, differences in the rate of growth of the population, high mortality among the adult population of working age, migration, ageing of the population and its decline (depopulation) are considered as the key demographic risks (Sidorenko, 2019). Increase in the risks, as well as the intensity of the influence, is indicated heavily on the security status at different levels (from personal to global) thus requiring adequate diagnostics, constant monitoring, and involvement in the process of development of both national and global security strategies. Analysis of the key reports by the UNO (United Nations, 2019a, 2019b, 2019c, 2019d, 2020b, 2020c; International Organization for Migration, 2020) has made it possible to characterise the main demographic tendencies of the global economic system both creating conditions and acting as challenges and threats for a sustainable and stable progress of countries and regions. It turns the abovementioned influences the total level of international economic security. Thus, they may involve:

- Global increase in population; growth rates; availability of regional differences in demographic dynamics (among other things, it concerns high growth rates in the

developing countries, mainly in Africa and in the Middle East on the one hand, and decrease in population or slow growth rates in the developed countries on the other hand).

- Changes in the age population pattern in particular regarding the increase in the share of population at the age of 65+ in the industrialised countries as a result of intensification of ageing processes and the increase in demographic burden on the employable population.
- Tendency for the increase of average life expectancy of population with rather high relative variation degree between the countries with different levels of socio-economic development.
- Keeping the global tendency as for the total reduction in fertility rate along with the expressed high level in the developing countries.
- High level of natural population growth in the developing countries, which provides high estimation level of viability of residents against high mortality ratios.
- Decrease in the total mortality ratio of the population; among other things, it concerns the decreased level of child mortality with the held high degree of variations between the indices depending upon the level of socio-economic development of one or another nation.
- Maintaining the role of international migration as the essential factor of demographic changes worldwide.

Global population number of 7.71 billion (2019) is a billion more to compare with 2007 and 2 billion more to compare with 1994. According to the forward prognosis by the UNO, population size will continue its growth up to 9.74 billion in 2050. Slower population growth should be mentioned; among other things, the highest (2%) average annual increase was recorded in 1960–1970. The rates decreased down to 1.04% in 2000–2019; they will decelerate down 0.74% of annual growth in 2030–2040, and down to 0.57% in 2040–2050.

59.5% of the world population inhabits Asia. However, starting in 1990, rates of population growth have their decelerating tendencies. Due to the fact, the specific weight will decrease. 17.2% inhabits Africa, which is by 9.2% more to compare with 1950. Its increase will continue by 8.4% up to 25.6% till 2050. The world part is characterised by the highest rates of population growth which will have to increase by 1.1 billion till 2050. 9.6% of the population fall in Europe, which share decreased by 12.1% to compare with 1950. The decrease will continue down to 7.3% in 2050. It is the region which will experience a decrease in the population during 2020–2050. Latin America and North America are populated by 8.5 and 4.9% respectively. Latin America forged ahead. During 2020–2050, both regions will experience deceleration. 0.5% inhabits Oceania. In this context, the population growth rate will remain higher to compare with the worldwide rates.

According to the UNO evaluations, rapid population increase is the actual risk to the sustainable development provision in the longer term (United Nations, 2019e). From the viewpoint of the UNO, such a risk area involve 47 the least developed countries. Mainly, they are states in Sub-Saharan Africa. On the whole, up to 2050 increase in the world population will provide nine countries, namely India, Nigeria, Pakistan, Congo, Ethiopia, Tanzania, Indonesia, Egypt, and the USA.

Increase in 65+ age population (the share was 9.1% in 2019) is the global tendency. It will increase up to 15.9% till 2050. The oldest population is recorded in Europe (18% in

2019) and in the developed Oceania countries (16% in Australia and New Zealand as for 2019). Moreover, the ageing tendency will continue up to 2050. According to the prediction estimate, the share of 65+ age will increase up to 28.1% in Europe, up to 22.6% in North America, and up to 17.9% in Oceania.

From the viewpoint of the increase in demographic load, the tendencies are security risks. Then, the global index is 13.58 individuals of 65+ per 100 individuals at the age of 15-64 (2018). According to the UNO prognostic estimation, increase in the demographic load is expected in 48 world countries by 2050. Mainly, they are European countries, countries of North America, countries of East Asia, and Southeast Asia countries (support ratio will be less than two individuals of productive age per each retired person). The abovementioned confirms the intensified risks to security stipulated by population ageing provoking additional load on the labour market, pension system, the increased tax pressure as well as the necessity to reform the health system, pension fund scheme, and a system of social protection of senior citizens.

In the context of the sustainable development provision, just a life expectancy indicator is the criterion of human progress quality; it has the pronounced tendency to its growth worldwide. According to the data of 2019, life expectancy was 72.6 years to be 54.6% more to compare with 1955, and 10.6% more to compare with 2000. Following forecasts, it will increase by 5.7% up to 2050 (76.67 years). The lowest index is in African countries (62.7 years), and the highest index is in North America (79.2 years). In compliance with 2019 data by the UNO, in 21 countries the life expectancy index was 60 years; it varied from 60 to 69 years in 49 countries; from 70 to 70 years in 97 countries; and exceeded 80 years in 34 countries (United Nations, 2019c).

Decreased fertility is another global demographic tendency. In 2019, it was 2.5 to be almost twice as little to compare with 1955 and by 10.1% less than in 2000. According to forecasts, it will decrease by 11.6% more till 2050 (2.21). African countries demonstrate the highest fertility. According to 2019 estimates, it is 80% more to compare with 4.4 the average world index. Europe (1.61) and North America (1.75) demonstrate the lowest fertility. According to the global estimates (exclusive of Europe), the index will decrease in future. In this context, in 1990, one-third of the world population inhabited regions where fertility was more than three children per woman. In 2019, only 12% of the world population inhabited high fertility regions covering mainly Sub-Saharan Africa (Nigeria, Ethiopia, Sudan, Congo, Uganda etc.) wherein 36 countries the is more than 4 children per a woman. According to 2019 data, 40% of the population inhabits average fertility countries (2.1-4). They are India, Indonesia, Pakistan, Mexico, Philippines, Egypt etc. 50% of the world population inhabit low fertility countries being less than 2.1. They are European countries, countries of North America, Australia, and New Zealand (United Nations, 2020b).

Birth and mortality rate is characterised by a tendency to its decrease. In 2019, the global birth rate was 18.6 individuals per 1000 to be twice as little to compare with 1950, and by 13.8% less to compare with 2000; the mortality rate was 7.6 individuals per 1000 to be by 60% less than in 1950 and by 11.8% less than in 2000. African countries demonstrate a higher birth rate, and European and African countries show a high mortality rate.

As for the child mortality, which indicator is among SDG indices, it was 28.9 cases per 1000 births in 2018 to be by 45.3% less than in 2000; death rate under the age of 5 was

38.4 cases. However, the level remains high in African countries (74.2); among other things, it is 20 times higher than infant mortality in the developed countries of Oceania (Australia and New Zealand).

The necessity to involve indices of demographic development in the structure of socio-economic security is based upon the risks and threats connected with global demographic development, and its regional differences. It stipulates the objective necessity to improve methods of quantitative measurement of a level of demographic security component relying upon multidimensional (integral) evaluations.

2. Research methodology

The method of integral evaluation of the security level is rather popular in Ukrainian practices of economic security metrics. Studies by Kharazishvili (2019), Grishnova and Kharazishvili (2019), and Tsvihun (2013) are the most critical research. They represent the calculation of an integral index of demographic security tested in terms of Ukraine or its regions.

Kharazishvili (2019) considers demographic security as a structural element of economic security in the context of social development singularising such indicators of the structure index as life expectancy, depopulation coefficient, mortality rate, morbidity level, the total birth rate, and demographic load (i.e. net reproduction rate per a woman). The similar index structure is represented in a study by Grishnova and Kharazishvili (2019). We believe, that disadvantage of the structure of demographic security index is as follows: it cannot involve certain important demographic tendencies, namely, nature of age structure, changes in the age structure, and development of migration processes.

In the context of another research (Tsvihun, 2013), the demographic security index is of more complex structure in terms of which the indicators are grouped: indicators of natural reproduction; indicators of mechanical movement and distribution of the population; health indicators; indicators of sex and age composition of population; and indicators of family values (29 indicators). The index, proposed by the author, is more inclusive involving not only demographic indicator but also other factors of social and cultural and ethical nature.

The method has also been applied for the studies concerning life quality standards (Kharazishvili et al., 2019) within which methodology of integral assessment of the standard of living has been developed. The methodology relies upon calculation of integral index based upon ten socio-economic indicators (i.e., labour use level, compensation of employees in output, GDP created by shadow employment and wages, shadow employment to total employment, expenditure on education to output, healthcare expenditure to output, the ratio of average wages to a living wage, wage share in the structure of income, pension expenditure to output, pension fund deficit to output).

It should be noted that the methodology intended to develop the composite indicators with a thorough analysis of techniques to structure the indicators, normalise them, aggregate, measure etc., to describe pluses and minuses of each of the techniques as well as their application conditions with relevant practical examples has been published by OECD in Handbook on Constructing Composite Indicators (2008).

While generalising the experience of early studies, we propose a proper vision of an approach to evaluate a level of demographic security component which will be based upon the abovementioned assumptions as well as upon calculation of integral indicators of the demographic component of economic security of countries with following analysis of their distribution within the world economic space and intensity of the dynamics.

The following algorithm, describing the research methodology concept to calculate demographic component (i.e. subindex) of economic security, has been proposed relying upon the use of procedural tools of integral evaluation. It involves below-mentioned stages:

First stage: systematisation of demographic security indicators and their classification from the viewpoint of their influence on the total level of economic security. Namely, it is referred to the determination of indices of motivators, which growth creates preconditions to improve the security level, and demotivators, which increase is considered as the potential threats and risks to the security. Table 1 represents the results.

Second stage: substantiation of a selection of a technique to value indicators of economic security. Among other things, in the process of the research, a procedure to calculate the standardised scores (i.e. z-scores) (OECD, 2008).

Z-score is a measure of relative variation of the actual value of an index (i.e. observable characteristic) demonstrating the number of the involved standard deviations (σ) relative to mean level (μ). Z-score is a measure less statistical indicator used to compare indices differing in their sizes and measurement units.

If X_j is incentive indicator, then its standardised score is calculated on the formula:

$$Z_j = \frac{X_j - \mu}{\sigma}. \tag{1}$$

If X_j is disincentive indicator then

$$Z_j = \frac{\mu - X_j}{\sigma}, \tag{2}$$

where Z_j is the standardised value of the j^{th} indicator; X_j is the actual value of the j^{th} indicator, μ is the mean value of j^{th} indicator (by sample); σ is the standard deviation of the j^{th} indicator (by sample).

To reduce the standardised values to (0;1) range, their transformation to a function of standard normal integral distribution has been performed using the following formula:

$$Z_j^n = \frac{1}{\sqrt{2\pi}} e^{-\frac{z_j^2}{2}}. \tag{3}$$

Third stage: substantiation of the form of integral evaluation of the economic security component (i.e. subindex). Among other things, the study proved the expediency of geometric aggregation (calculation with the use of a mean geometric) according to the formula:

$$SI_{dc} = \sqrt[n]{\prod_{j=1}^n Z_j^n}, \tag{4}$$

where SI_{dc} is a subindex of the demographic component of economic security, and Z_j^n are the normalised z-scores of security indices.

Hence, the integral evaluation of the demographic component of economic security, in view of the proposed indicators to be included (Table 1, Appendix), is calculated as follows

$$SI_{dc} = \sqrt[10]{Pg \times LEx \times MA \times Pold \times DR \times DRold \times Dinf \times VR \times FR \times NMR}, \quad (5)$$

where Pg – population, average annual growth rates, %; LEx – life expectancy at birth, years; MA – median age, years; $Pold$ – share of population aged 65 years or over, %; DR – dependency ratio; $DRold$ – old-age dependency ratio; $Dinf$ – infant mortality rate, deaths per 1000 live birth; VR – vitality rate; FR – fertility rate; NMR – net migration rate, per 1000 of population.

Forth stage: formation of the data sampling (i.e. identification of the amount of the sample data, and its typologisation). The sample total was formed taking into consideration two criteria: regional feature (for further possibility to involve and calculate regional security indices, and to identify certain regional features, transformations, dynamics etc.) as well as a level of socio-economic growth (to define differences in the systems of economic security provision in the context of countries varying in their development levels).

As a result, the formed totality consists of fifty-three countries united in four groups depending on their regional features (i.e. America, Europe, Asia and Oceania, Africa and the Middle East). Each group includes both the developed countries and developing ones. Retrospection period of 19 years (i.e. 2000–2018) was selected to perform dynamic comparisons and evaluate intensity and tendencies of changes. The number of observations was 10070 (inclusive of ten unit parameters added to the integral evaluation).

Fifth stage: substantiation of the threshold values for indicators of the demographic component of economic security and integral evaluation. Since is not just an integral (multi-dimensional) index; it must signalise on the degree of insecurity and separate the insecure areas. Thus, the necessity to identify a system of threshold values arises. The abovementioned is proposed to be implemented with the use of hemostasis mechanism as a characteristic feature of dynamic sustainability of the whole economic security system as well as its components (Kachynsky, 2013; Kharazishvili & Dron, 2014).

Hence, it has been proposed to single out the following: first, threshold values of the indicators (i.e. low threshold value and high threshold value) characterising allowable interval of the values within which the most favourable functioning conditions are created. Namely, values of the safety indicators, falling in the interval, are the evidence (i.e. a signal) of “relative safety area”. Second, critical values of the indicators (i.e. low critical value, and high critical value) are the values which violation causes unfavourable tendencies of economic development of the nation. In other words, outstepping the limits of the critical values is a signal of violation of the security level (i.e. it is a critical condition); if the indicators are between the threshold value and critical value, then escaping from the “relative safety area” takes place as well as getting to a “security violation area” (i.e. to a risk area).

To separate such values in terms of the formed sampling of indicators and units of populations (i.e. countries), stochastic research methods have been applied such as Student's t -test (Paniotto et al., 2004; Kharazishvili & Dron, 2014).

Hence, in terms of each indicator, the low threshold value is determined as $\bar{x} - \sigma$ (i.e. the difference between a worldwide mean security indicator and a standard deviation being the absolute evaluation of safety indicator variation relative to its worldwide mean), and high

threshold value is determined as $\bar{x} + \sigma$ (i.e. the total of a worldwide mean security indicator, and a standard deviation). In terms of each indicator, the low critical value is determined as $\bar{x} - t\sigma$, and high critical value is determined as $\bar{x} + t\sigma$; i.e. sampling value of the standard deviation of the value is multiplied by the t -test value (table value of Student distribution depending upon probability level p and the number of degrees of freedom α).

Advantages of the proposed methodology are manifold analytical possibilities of the represented tools, making it possible to:

- calculate safety indices which will become a basis for comparative analysis of the development of countries as for their security level and compile adequate ratings of the national economies in terms of their security;
- analyse the regularities of changes in the security level dynamically, identify change tendencies, and form prognostic estimations;
- determine boundary values (critical values and threshold ones) for the indicators involved in the system of security parameters which may become a basis for the development of security state monitoring, timely detection when the actual value exceeds threshold ones, and consideration of risks and threats. As a result, that may prevent potential risky situation or inhibit their negative after-effects;
- classify countries as for their security level;
- carry out factor analysis to identify the indicators being the most important for the total security level; and
- apply the obtained integral evaluations as the variables in economic and mathematical models to evaluate the influence of the security state on the global economic development as well as situations in the certain countries, unions, and regions within the system of the world economic relations.

3. Results

Table 2 (Appendix) shows the results of calculation of boundary values of indicators of demographic security component.

Thus, during the analysed period, the global increase in population was characterised by a slow growth dynamics; among other things, the mid-year growth rate was 1.1% in 2018 to compare with 1.3% in 2000. The low critical boundary is evaluated by means of 0.98% decrease in the rate (the year of 2018). The high critical boundary is evaluated by means of 3.18% increase in the rate (the year of 2018).

During the analysed period, the expected probability of life increased globally by 7.5% (from 67.55 years in 2000 up to 72.6 years in 2018). The low critical boundary of the value was 59.9 years in 2018 (to compare with 52.51 years in 2000), and high critical boundary of the value was 84.87 years in 2018 (to compare with 82.59 years in 2000).

The global median age of the population is also characterised by its tendency to increase. In particular, the analysed period has demonstrated its 17.5 growth from 26.3 years in 2000 up to 30.9 years in 2018. The low critical boundary of the index was 15.3 years in 2018 (to compare with 11.3 years in 2000), and its high critical boundary was 46.5 years in 2018 (to compare with 41.3 years in 2000).

Indicator of ageing rate has its growing tendency; among other things, a share of 65+ age population increased by 2 % in the world from 6.87 years in 2000 up to 8.87% in 2018

(i.e. according to estimations by the UNO, the demographic ageing threshold was exceeded by 7%). In 2018, the high critical boundary was 22.7% (to compare with 17.72% in 2000); according to the UN ageing scale by E. Rosset, it is a very high level of demographic ageing.

Globally, the coefficients of total demographic burden are characterised by a tendency to following decrease from 58.75 years in 2000 down to 53 years in 2018 (i.e. 9.8%) depending upon high rates of birth and fertility in certain world countries and the increased population share aged up to 15 years respectively. As a risk indicator, the high threshold value was 66.7 in 2018; and the high critical value was 80.48.

Alternatively, the coefficient of global retirement burden has a distinct tendency to growth being 24.4% (i.e. from 10.92 in 2000 up to 35.43 in 2018). In the capacity of a risk indicator, the high threshold was 24.47% in 2018; the high critical value was 35.43.

The global child mortality rate is characterised by the most intensive dynamics towards its reduction to compare with the demographic indicators being analysed. The rate decreased by 45.7% (i.e. from 53.2 in 2000 down to 28.9 in 2018). In this context, the indicator varies significantly from one country to another one being observable at the level of boundary values; namely, in terms of the year of 2018, high critical value was 56.6 to compare with 103.2 in 2000.

Global survivability coefficient remains almost invariable. Its rate reduced by 2.5% (i.e. from 2.53 in 2000 down to 2.47 in 2018). In a greater or lesser degree, high boundary values threaten the least developed countries thus evaluating in such a way: 4.34 (a threshold value) and 6.32 (a critical one) in the year of 2018.

Global fertility rate decreases further. It experienced it is 7.5% reduced from 2.7 in 2000 down to 2.5 in 2018. As with the previous indicator, high boundary values are considered as minor security threats in the least developed: 3.34 (threshold value) and 4.26 (critical one).

It is expedient to evaluate migration rate as a security indicator from the viewpoint of deviation from both low and high critical values. Hence, according to the data of 2018, the low critical boundary for the world countries is -9.8 (i.e. net outflow per 1000 people) which is by 53.8% less than the corresponding index in the year of 2000 which was -21.1 . According to evaluations of 2018, the high critical value is 14.7 (i.e. net inflow per 1000 people) which is 51.1% less than the corresponding index in the year 2000, which was -30.2 .

Table 3 (Appendix) demonstrates the evaluation of allocation of countries within different security areas during the period of retrospective analysis (i.e. years of 2000 and 2018).

Thus, a small share of countries is within the critical security areas. In terms of maximum evaluation, the share is not more than 9.4% of the analysed totality. Mainly, they are the least developed African countries (in terms of indicators of high rates of population growth; low expectable length of life; and high fertility rate) as well as such developed nations as Italy and Japan (in terms of very high ageing rate). Moreover, the developed countries are involved in the area of relative insecurity due to the indicators of a decrease in population; high median age; ageing rate; retirement burden; and low vitality coefficient.

Following stage involved calculation of a subindex of the demographic component of economic security according to the analysed sampling of countries from 2000 to 2018. Figure 1 explains the calculated indices for the years of 2000 and 2018 as well as ranges of boundary values, making it possible to use the values as security indices.

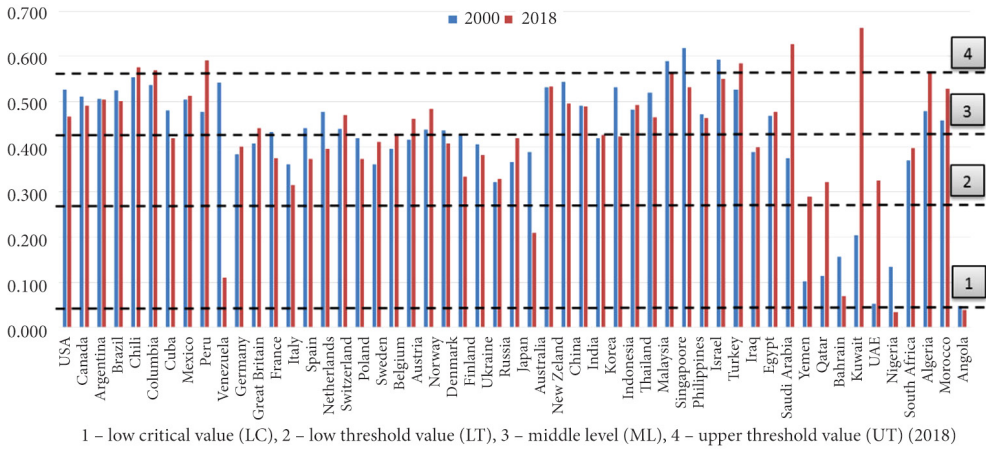


Figure 1. Allocation of the world nations according to integral level of demographic component of economic security

The security indices, represented in Figure 1, have been derived under analytical formulas (1)–(5) making it possible to compare countries in terms of their demographic security. Variation of values of demographic security indicators is limited by ranges in (1–4) graph calculated according to 2018 data relying upon values of security indices and being LC 0.055; LT 0.287; ML 0.424; and UT 0.562 (upper critical value, calculated as 0.794, is not shown in the Figure since no country is characterised by security level exceeding the threshold). Hence, such a representation helps understand the conditions under which different countries are relative to the state of their demographic security.

Consequently, in terms of demographic security index, the highest integral values were obtained for such countries as Kuwait, Saudi Arabia, Peru, Turkey, Chile, Columbia, Malaysia, and Algeria (all the nations belong to developing ones and represent different parts of the world). Such countries as Nigeria, Angola, Bahrain, Venezuela, and Japan have the lowest integral security values (except Japan, the abovementioned countries are developing ones belonging mainly to the African part of the world).

Certain regularities of the integral index dynamics during the period under analysis should also be mentioned (the results are based upon the growth rates in % calculation for from 2000 to 2018). Thus, countries may be divided into two groups:

Group one involves the states demonstrating a tendency to the decrease in the demographic component of economic security (i.e. the index in 2018 to compare with 2000). That concerns twenty-five countries from the sampling (47.2%). Venezuela (–79.6%), Nigeria (–74.8%), Bahrain (–55%), Japan (–46%), Finland (22%), and Korea (20%) demonstrated the highest rates of the decrease.

Group two involves 28 of the sampled countries demonstrating a tendency to the increase in the demographic component of economic security (i.e. 52.8%). UAE (6.2 times), Kuwait (3.2 times), Yemen (2.9 times), and Qatar (2.8 times) demonstrated the highest increase of the index.

From the viewpoint of evaluation of the demographic component of economic security, it is possible to classify countries taking into consideration the calculated boundary values (Table 4, Appendix).

Consequently, 50% of the countries, involved in the analysed sampling, are relatively safe (groups four and five) as for the demographic security; 35% of the countries (group three) have relatively risky (unsatisfactory) level, and 10% of the countries (groups one and two) are characterised by a risky (critical) level.

For identification of regional distinctions and differences in the levels of socio-economic development, integral indices for the world parts and group of countries were developed according to their progress (Figures 2, 3).

The indices, represented in Figure 2, have been calculated as a geometric mean from the security indices of the sample countries, covered by the regions, i.e., America (the USA, Canada, Argentina, Brazil, Chile, Columbia, Cuba, Mexico, Peru, Venezuela), Europe (Germany, Great Britain, France, Italy, Spain, the Netherlands, Switzerland, Poland, Sweden, Belgium, Austria, Norway, Denmark, Finland, Ukraine, Russia), Asia and Oceania (Japan, Australia, New Zealand, China, India, Korea, Indonesia, Thailand, Malaysia, Singapore, the Philippines) and Africa and Middle East (Israel, Turkey, Iraq, Egypt, Saudi Arabia, Yemen, Qatar, Bahrain, Kuwait, UAE, Nigeria, South Africa, Algeria, Morocco, Angola). The distribution of countries was performed according to the UNStat classification.

As the calculations show, the highest values of the indices belong to American states and Asian-Pacific countries. Moreover, starting in 2015, the latter demonstrates the highest security level from the viewpoint of demographic component evaluation. The lowest security level characterises African countries and Middle East countries. American, European, and Asian-Pacific parts of the world have a tendency to the decreased security in terms of the demographic component. Africa and the Middle East are characterised by the increased tendency as well as growing indices of demographic security component.

Correspondingly, a geometric mean has been applied for aggregation. Thus, group indices of demographic security have been obtained for countries with different development level (Figure 3). Relying upon classification methodology by the UNStat such countries as the USA, Canada, Germany, Great Britain, France, Italy, Spain, the Netherlands, Switzerland,

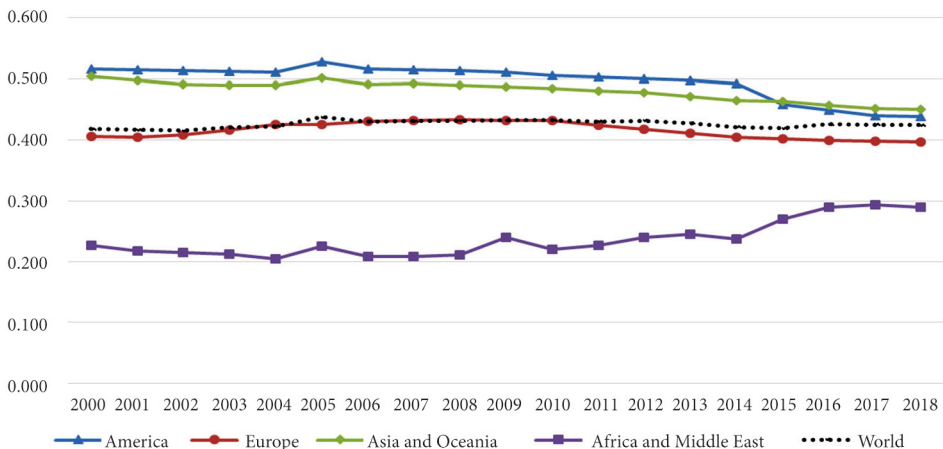


Figure 2. Dynamics of regional indices of the integral level of demographic component of economic security (authors' calculations)

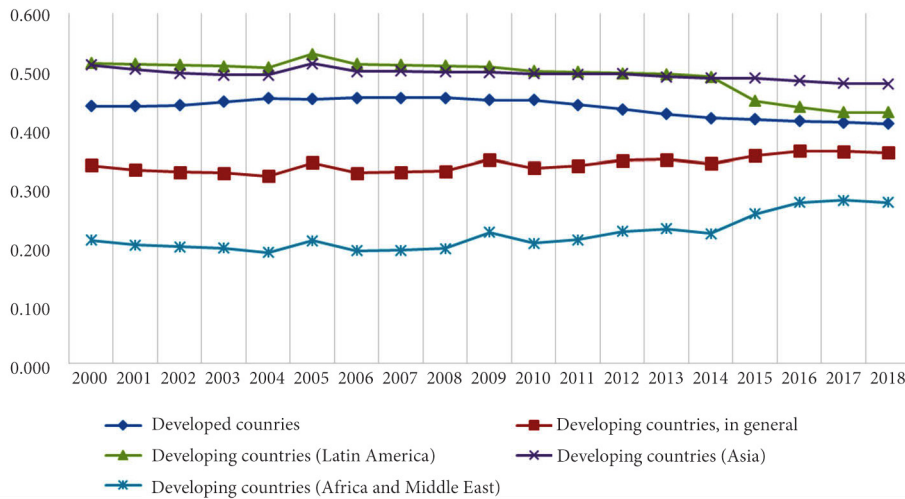


Figure 3. Dynamics of indices of integral level of demographic component of the economic security in terms of groups of countries varying in their socio-economic development (authors' calculations)

Poland, Sweden, Belgium, Austria, Norway, Denmark, Finland, Japan, Australia, New Zealand, Israel) were considered as the developed nations. Other countries were considered as developing ones.

To compare with the developed countries, integral values of a level of demographic security components of the developing countries are quite lower despite a tendency towards narrowing a gap between the indices (for instance, in 2000, safety index of the developed countries exceeded correspondence value of the developing countries by 29.7%. In the year of 2018, the excess decreased down to 13.8%).

Alternatively, calculation of the values in terms of the developing countries, involving regional specifics, has demonstrated rather high differentiation, namely: on the average, higher values of security indices in African and Asian countries excess values shown by the developed countries; and the lowest indices are typical for Latin America.

Conclusions

Demographic security is the important component of economic security determining the environment when favourable conditions are created as for the sustainable socio-economic development of a country as well as its human potential. Such basic demographic tendencies as the increase in the world population, changes in age distribution, intensification of ageing processes, increase in demographic burden for the labour force, reduction in the fertility rate in the developed countries, preservation of high level of natural population growth in the developing countries, and decrease in mortality rate determine both threats and risks to the general level of economic security.

The following can be defined as the basic challenges and risks connecting with the progress of demographic processes in the context of the world economy and influencing on the

provision of sustainable development of any nation as well as on the general level of international economic security on the whole: global population growth; maintaining the tendency as for the increase in 65+ population in the developed countries; increase in the level of average life expectancy with rather high relative degree of dissimilarity among countries varying in their socio-economic development; maintaining the global tendency as for the reduction of the total fertility rate; high level of natural population increase in the developing countries; decrease in the child mortality level while maintaining a high dissimilarity degree between the indices in the context of countries varying in their socio-economic development; and intensification of international migration influence of the global demographic changes.

Use of the methodical tools for integral evaluation of a demographic component of economic security, proposed by the paper, has helped systemise and classify demographic security indicators from the viewpoint of influence of the general level of economic security. The threshold value of the indicators, characterising the safe range of values, has been singled out. The most favourable conditions for national security are created within the range. Critical values of indicators, which violence provokes negative tendencies in the economic development of a country, have been identified.

The research has helped understand that generally the least developed African countries turned out to be included in the critical risk areas (in terms of indicators of high rates of population growth; low expectancy of lifespan; high fertility rate; and high level of child death rate) as well as certain developed countries (in terms of too high ageing level). Moreover, the developed nations are also involved in the areas of relative risk in terms of indicators of the decreased population; high median age; ageing level; retirement burden; and low vitality coefficient.

Calculation results, concerning the integral level of demographic security component, have shown that the highest values belong to such developing countries from different parts of the world as Kuwait, Saudi Arabia, Turkey, Chili, Columbia, Malaysia, and Algeria. The lowest integral security values have been obtained for such developing countries, located mainly in the African part of the world, like Nigeria, Angola, Bahrain, and Venezuela. In terms of regional index, American countries, as well as Asian-Pacific ones, demonstrate the highest values of the indices. Moreover, since 2015 the latter illustrates the highest security level from the viewpoint of a demographic component. European demographic security nears the worldwide mean ones. African countries and Middle East countries are characterised by the lowest security level.

As for the prospects for future research, the following is objectively necessary: first, the analysis of country differences as for the formation of the integral level of the demographic component of economic security to identify the factors influencing the security level evaluation to the greatest extent and to evaluate the degree of the influence; second, forecasting of demographic security level inclusive of the regularities of changes in the indicators determining it. Furthermore, consideration of the demographic component in the structure of a social component of economic security will make it possible to evaluate nature of influence on the provision of sustainable development as well as on the total level of economic security.

References

- Ackroyd, P., & Marsden, S. (2006). *Enhancing security culture – simple, effective approaches to making improvement*. Greenstreet Berman. <https://www.icheme.org/media/9820/xix-paper-32.pdf>
- Baldwin, D. (1997). The concept of security. *Review of International Studies*, 23, 5–26. <https://doi.org/10.1017/S0260210597000053>
- Boldrin, M., De Nardi, M., & Jones, L. (2015). Fertility and social security. *Journal of Demographic Economics*, 81(3), 261–299. <https://doi.org/10.1017/dem.2014.14>
- Brooks, D., Brooks, S., Greenhill, B., & Haas, M. L. (2019). The Demographic transition theory of war: why young societies are conflict prone and old societies are the most peaceful. *International Security*, 43(3), 53–95. https://doi.org/10.1162/isec_a_00335
- Bulatova, O., Chentukov, Y., & Chentukov, I. (2018). Integration processes and global regions. *Journal of European Economy*, 3, 292–304. <https://doi.org/10.35774/jee2018.03.291>
- Choudhry, M. T., & Elhorst, J. P. (2010). Demographic transition and economic growth in China, India and Pakistan. *Economic Systems*, 34(3), 218–236. <https://doi.org/10.1016/j.ecosys.2010.02.001>
- Cruz, M., & Ahmed, S. A. (2018). On the impact of demographic change on economic growth and poverty. *World Development*, 105, 95–106. <https://doi.org/10.1016/j.worlddev.2017.12.018>
- De Souza, R. (2015). Demographic resilience: Linking population dynamics, the environment, and security. *SAIS Review of International Affairs*, 35(1), 17–27. <https://doi.org/10.1353/sais.2015.0017>
- Fertig, M., Schmidt, C. M., & Sinning, M. G. (2009). The impact of demographic change on human capital accumulation. *Labour Economics*, 16(6), 659–668. <https://doi.org/10.1016/j.labeco.2009.08.005>
- Grishnova, O., & Kharazishvili, Y. (2019). Demographic security of Ukraine: indicators, level, threats. *Demography and Social Economy*, 2(36), 65–80. <https://doi.org/10.15407/dse2019.02.065>
- Hamanaka, S. (2017). Demographic change and its social and political implications in the Middle East. *Asian Journal of Comparative Politics*, 2(1), 70–86. <https://doi.org/10.1177/2057891116636490>
- Han, J.-S., & Lee, J.-W. (2020). Demographic change, human capital, and economic growth in Korea. *Japan and the World Economy*, 53, 100984. <https://doi.org/10.1016/j.japwor.2019.100984>
- International Organization for Migration. (2020). *World Migration Report 2020*. https://publications.iom.int/system/files/pdf/wmr_2020.pdf
- Kachynsky, A. B. (2013). *Indicators of the national security: Determination and use of their boundary values*. NISR.
- Kharazishvili, Y. M., & Dron, Y. E. (2014). *Forecasting of indicators, threshold values, and mid-term level of economic safety in Ukraine* (Analytical Report). NISR.
- Kharazishvili, Y. (2019). *Systemna bezpeka staloho rozvytku: instrumentariy otsinky, rezervy ta stratehichni stsenariyi realizatsiyi* [Systemic Safety of Sustainable Development: Assessment Tool, Reserves and Strategic Implementation Scenarios]. In-t ekonomiky prom-sti, Kyiv, NAN Ukrayiny (in Ukrainian). https://iie.org.ua/wp-content/uploads/2019/02/Harazishvili_monograf_2019-ost.pdf
- Kharazishvili, Y., Grishnova, O., & Kamińska, B. (2019). Standards of living in Ukraine, Georgia, and Poland: Identification and strategic planning. *Virtual Economics*, 2(2), 7–36. [https://doi.org/10.34021/ve.2019.02.02\(1\)](https://doi.org/10.34021/ve.2019.02.02(1))
- Kurban, H., Gallagher, R. M., & Persky, J. J. (2015). Demographic changes and education expenditures: A reinterpretation. *Economics of Education Review*, 45, 103–108. <https://doi.org/10.1016/j.econedurev.2015.01.001>
- Lee, R. (2016). Is low fertility really a problem? Population aging, dependency, and consumption. *Science*, 346(6206), 229–234. <https://doi.org/10.1126/science.1250542>

- Lori, N. (2019). Demographic growth, migrant policing, and naturalization as a “national security” threat. In *Offshore citizens: permanent temporary status in the Gulf* (pp. 97–132). Cambridge University Press. <https://doi.org/10.1017/9781108632560.004>
- Malnar, D., & Malnar, A. (2015). Demographic security trends in Southeastern Europe. *Croatian International Relations Review*, 21, 57–87. <https://doi.org/10.1515/cirr-2015-0011>
- Maroto, M., & Pettinicchio, D. (2020). Barriers to economic security: Disability, employment, and asset disparities in Canada. *Canadian Review of Sociology*, 57, 53–79. <https://doi.org/10.1111/cars.12268>
- Mauil, H. (1984). *Raw materials, energy and Western security*. London. <https://doi.org/10.1007/978-1-349-07365-8>
- McNamee, L., & Zhang, A. (2019). Demographic engineering and international conflict: Evidence from China and the Former USSR. *International Organization*, 73(2), 291–327. <https://doi.org/10.1017/S0020818319000067>
- Munir, K., & Shahid, F. S. U. (2020). Role of demographic factors in economic growth of South Asian countries. *Journal of Economic Studies*. <https://doi.org/10.1108/JES-08-2019-0373>
- OECD. (2008). *Handbook on constructing composite indicators. Methodology and user guide*. <https://www.oecd.org/sdd/42495745.pdf>
- Paniotto, V., Maksymenko, S., & Kharchenko, N. (2004). *Statistical analysis of sociological data*. Publishing House “KM Akademia”.
- Ptoukha Institute for Demography and Social Studies of the National Academy of Sciences of Ukraine. (2018). *Migratory observation: national report*. Ukrainian Society, Kyiv. https://www.idss.org.ua/arhiv/Ukraine_migration.pdf
- Ranganathan, S., Swain, R., & Sumpter, D. (2015). The demographic transition and economic growth: Implications for development policy. *Palgrave Communications*, 1, 15033. <https://doi.org/10.1057/palcomms.2015.33>
- Renner, M. (2002). *The anatomy of resource wars*. Worldwatch Institute. <http://archive.niza.nl/docs/200210171557447558.pdf>
- Reznikova, N., Panchenko, V., & Bulatova, O. (2018). The policy of economic nationalism: from origins to new variations of economic patriotism. *Baltic Journal of Economic Studies*, 4, 274–281. <https://doi.org/10.30525/2256-0742/2018-4-4-274-281>
- Rosset, E. (1959). *Proces starzenia się ludności*. Studium demograficzne, Polskie Wydawnictwa Gospodarcze.
- Sidorenko, A. (2019). Demographic transition and “demographic security” in post-Soviet countries. *Population and Economics*, 3(3), 1–22. <https://doi.org/10.3897/popeco.3.e47236>
- Spear, J., & Williams, P. D. (2012). *Security and development in global politics: A critical comparison*. Georgetown University Press.
- Tarasuk, V., Fafard St-Germain, A., & Mitchell, A. (2019). Geographic and socio-demographic predictors of household food insecurity in Canada, 2011–12. *BMC Public Health*, 19, 12. <https://doi.org/10.1186/s12889-018-6344-2>
- Tsvihun, I. (2013). *Demograficzna безпеka Ukrainy ta napryamy yiyi rehulyuvannya* [Demographic security of Ukraine and directions of its regulation]. Kam'yanets'-Podil's'kyi: Vydavets' PP Zvoleyko D.H. (in Ukrainian).
- United Nations. (2019a). *International Migrant Stock 2019*. UN Department of Economic and Social Affairs, Population Division. https://www.un.org/en/development/desa/population/migration/publications/migrationreport/docs/MigrationStock2019_TenKeyFindings.pdf
- United Nations. (2019b). *International migration and development. Report of the Secretary-General*. <https://www.unhcr.org/protection/basic/44d711a82/international-migration-development-report-secretary-general.html>

- United Nations. (2019c). *World Mortality 2019. Data Booklet*. UN Department of Economic and Social Affairs. <https://www.un.org/en/development/desa/population/publications/pdf/mortality/WMR2019/WorldMortality2019DataBooklet.pdf>
- United Nations. (2019d). *World Population Ageing 2019. Highlights*. UN Department of Economic and Social Affairs, Population Division. <https://www.un.org/en/development/desa/population/publications/pdf/ageing/WorldPopulationAgeing2019-Highlights.pdf>
- United Nations. (2019e). *World Population Prospects 2019. Highlights*. UN Department of Economic and Social Affairs, Population Division. https://population.un.org/wpp/Publications/Files/WPP2019_Highlights.pdf
- United Nations. (2020a). *Sustainable development goals*. Knowledge Platform. <https://sustainabledevelopment.un.org/sdg1>
- United Nations. (2020b). *World Fertility 2019: Early and later childbearing among adolescent women*. United Nations, Department of Economic and Social Affairs, Population Division. https://www.un.org/en/development/desa/population/publications/pdf/fertility/World_Fertility_2019.pdf
- United Nations. (2020c). *World Population Policies 2019*. United Nations Department of Economic and Social Affairs, Population Division. https://www.un.org/en/development/desa/population/publications/pdf/policy/World_Population_Policies_2019.pdf
- Zakharova, O. (2015). Specific features of evaluation of integral interaction between countries, and parts of the world. *MSU Messenger. Series: Economy*, 10, 95–103 (in Ukrainian).

Appendix

Table A1. Classification of demographic indicators as security indicators (compiled by the authors)

Indicator	Nature of the index as the security factor	Characteristic in terms of a risk level determination
Population, average annual growth rates, % (P_g)	Incentive (positive value). Disincentive (negative value; increase outside of the high critical value)	Indicator determining nature of demographic development of the country. Negative value indicates depopulation processes while identifying value of demographic decline. Positive value means the increased demographic reproduction while evaluating the intensity of population growth.
Life expectancy at birth, years (L_{Ex})	Incentive Disincentive (outside of the high critical value)	Shows the mean expectancy interval between birth and death of the generation; acts as the generalised characteristic of a death rate. On the one hand, increase in the indicator evidences on the improved life quality as well as well-being level; on the other hand, it causes changes in the age structure of population, increase in median age while intensifying ageing processes.
Median age, years (MA)	Incentive Disincentive (outside of the high critical value)	Age evaluation of 50% of the country population. Increase in median age proves lifespan rise, and improve in well-being. On the other hand, it speaks for the nation ageing.
Share of population aged 65 years or over, % (P_{old})	Disincentive	Acts as an indicator of demographic ageing. According to the UNO evaluations, ageing nation is the nation where the share exceeds 7%. In terms of a scale by E. Rosset (Rosset, 1959), demographic ageing starts when population aged 65 years or over share is 12%.

End of Table A1

Indicator	Nature of the index as the security factor	Characteristic in terms of a risk level determination
Dependency ratio, disabled population per 100 persons of working age (DR)	Disincentive	It is measured by the number of younger population (under the age of 15) and older population (over 65 years old) per 100 persons of working age. On the one hand, its increase depends upon the prolonged life expectancy and the decreased death rate. On the other hand, it depends upon gradual decrease in the able-bodied population increasing a level of demographic burden.
Old-age dependency ratio, population aged 65 and over per 100 persons of working age (15–64) (DR_{old})	Disincentive	Shows the number of old people (65 years and over) per 100 persons of working age. This indicator approximates the implied economic dependency associated with a growing share of the population to older ages.
Infant mortality rate per 1000 of the born (D_{inf})	Disincentive	Acts as the generally accepted indicator of the nation health; criterion of life quality of the population; well-being level; level of distribution of social wealth and material wealth distribution; level of education and culture; level of medical care accessibility and quality etc.
Vitality rate (VR)	Incentive/ Disincentive (outside of the high critical value for the least developed countries)	It is calculated with the help of birth rate-death rate ratio. Acts as a value of natural migration of population. In terms of population replacement is equal to unity. In terms of depopulation, assumes a value being less than 1.
Fertility rate (FR)	Incentive/ Disincentive (outside of the high critical value for the least developed countries)	Index characterizing average number of children born by a woman during her life. Acts as indicator of the population reproduction. Decrease in its level stipulates the decreased birth rate, and the decreased population rate.
Net migration rate per 1000 of population (NMR)	Incentive/ Disincentive (outside of the high and low critical values)	Index, calculated with the help of net migration growth-average population ratio. Acts as the indicator of mechanical migration of population; influences total number of the population as well as its dynamics. To some extent, both positive value and negative value are stimulating factors (in terms of certain countries, it compensates natural population loss or, adversely, over population); its increase may threaten economic security.

Table A2. Dynamics of boundary values of indicators of demographic component of economic security of the world countries for the period of 2000–2018 (authors' calculations)

Indicator	Boundary values	Years							Growth rate 2018/2000, %
		2000	2004	2008	2012	2016	2017	2018	
Population, growth rate,	MV	1.30	1.25	1.23	1.19	1.13	1.12	1.10	-15.4
	LC	-1.28	-2.67	-4.82	-1.60	-0.91	-0.96	-0.98	-23.5
	LT	0.01	-0.70	-1.79	-0.20	0.11	0.08	0.06	337.2
	UT	2.59	3.20	4.25	2.58	2.15	2.16	2.14	-17.4
	UC	3.88	5.17	7.28	3.98	3.17	3.20	3.18	-18.1
Life expectancy	MV	67.55	68.65	69.90	71.17	72.18	72.38	72.60	7.5
	LC	52.51	53.57	55.60	57.93	59.54	59.90	59.90	14.1
	LT	60.05	61.13	62.77	64.57	65.88	66.16	66.16	10.2
	UT	75.05	76.17	77.02	77.77	78.48	78.60	78.60	4.7
	UC	82.59	83.74	84.20	84.41	84.83	84.87	84.87	2.8
Median age	MV	26.3	26.3	27.4	28.5	29.6	29.6	30.9	17.5
	LC	11.3	11.3	12.1	13.1	14.1	14.1	15.3	36.1
	LT	18.8	18.8	19.8	20.8	21.9	21.9	23.1	23.0
	UT	33.8	33.8	35.0	36.2	37.3	37.3	38.7	14.4
	UC	41.3	41.3	42.7	43.9	45.1	45.1	46.5	12.4
Population aged 65 years or over	MV	6.87	7.20	7.43	7.78	8.43	8.65	8.87	29.1
	LC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
	LT	1.47	1.56	1.55	1.51	1.68	1.82	1.98	34.9
	UT	12.28	12.84	13.32	14.06	15.17	15.47	15.77	28.4
	UC	17.72	18.52	19.24	20.37	21.97	22.34	22.70	28.1
Dependency ratio	MV	58.75	55.55	53.39	52.52	52.60	52.79	53.00	-9.8
	LC	29.79	27.46	24.42	23.91	24.60	25.01	25.52	-14.3
	LT	44.32	41.55	38.95	38.26	38.64	38.95	39.30	-11.3
	UT	73.18	69.55	67.82	66.79	66.55	66.63	66.70	-8.9
	UC	87.71	83.64	82.35	81.14	80.60	80.57	80.48	-8.2
Old-age dependency ratio	MV	10.92	11.21	11.41	11.87	12.87	13.22	13.58	24.4
	LC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
	LT	3.02	2.93	2.67	2.34	2.31	2.49	2.69	-10.9
	UT	18.81	19.49	20.15	21.41	23.42	23.95	24.47	30.1
	UC	26.76	27.83	28.94	31.01	34.04	34.75	35.43	32.4
Infant mortality rate	MV	53.2	46.3	39.9	34.5	30.6	29.7	28.9	-45.7
	LC	3.2	2.4	2.9	2.7	1.7	1.4	1.2	-62.8
	LT	28.3	24.4	21.5	18.6	16.2	15.6	15.1	-46.6
	UT	78.1	68.2	58.3	50.4	45.0	43.8	42.7	-45.3
	UC	103.2	90.2	76.9	66.3	59.5	58.0	56.6	-45.1

End of Table A2

Indicator	Boundary values	Years							Growth rate 2018/2000, %
		2000	2004	2008	2012	2016	2017	2018	
Vitality rate	MV	2.53	2.51	2.52	2.52	2.51	2.47	2.47	-2.5
	LC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
	LT	0.25	0.31	0.38	0.44	0.59	0.60	0.60	138.0
	UT	4.81	4.71	4.65	4.61	4.43	4.34	4.34	-9.7
	UC	7.10	6.92	6.80	6.72	6.37	6.23	6.23	-12.4
Fertility rate	MV	2.70	2.61	2.55	2.49	2.45	2.43	2.50	-7.3
	LC	0.17	0.29	0.44	0.50	0.59	0.60	0.60	256.0
	LT	1.44	1.45	1.50	1.50	1.52	1.52	1.52	5.8
	UT	3.95	3.77	3.61	3.48	3.37	3.34	3.34	-15.5
	UC	5.22	4.93	4.67	4.48	4.30	4.26	4.26	-18.4
Net migration rate	MV	-	-	-	-	-	-	-	-
	LC	-21.1	-21.1	-41.5	-14.3	-9.8	-9.8	-9.8	-53.8
	LT	-8.2	-8.2	-16.5	-5.1	-3.6	-3.6	-3.6	-56.2
	UT	17.3	17.3	33.3	13.1	8.6	8.6	8.6	-50.3
	UC	30.2	30.2	58.3	22.3	14.7	14.7	14.7	-51.1

Note: MV is middle value, LC is lower critical value; LT is lower threshold value; UT is upper threshold value; and UC is upper critical value.

Table A3. Evaluation of risks and threats to security of nations in terms of the demographic indicators (authors' calculations)

Indicators	2000		2018	
	Area of relative risks LC-UC, LC-LT	Area of critical risks (<LC, >UC)	Area of relative risks UT-UC, LC-LT	Area of critical risks (<LC, >UC)
Population, growth rates (P_g)	6 countries (11.3%) UC-UC: Yemen, Qatar, Angola LC-LTV: Poland, Russia, Ukraine	3 countries (5.7%) > UC: Bahrain, Kuwait, UAE	9 countries (17.0%) UC-UC: Nigeria, Iraq LC-LT: Cuba, Italy, Venezuela, Poland, Ukraine, Japan, Spain	2 countries (4.2%) > UC: Bahrain, Angola
Life expectancy (L_{Ex})	1 country (1.9%) LC-LT: SAR	2 countries (4.2%) <LC: Nigeria, Angola	3 countries (5.7%) LC-LT: RAS, Angola, Yemen	1 country (1.9%) <LC: Nigeria
Median age, (MA)	26 countries (49.1%) LC-LT: Angola, Nigeria, Yemen, Iraq UT-UC: USA, Canada, EU countries, Ukraine, Russia, Japan, Australia, New Zealand	-	26 countries (49.1%) LC-LT: Angola, Nigeria, Yemen, Iraq HTV-HCV: Canada, Cuba, EU countries, Ukraine, Russia, Korea, Thailand, Singapore	2 countries (4.2%) > UC: Italy, Japan

End of Table A3

Indicators	2000		2018	
	Area of relative risks LC-UC, LC-LT	Area of critical risks (<LC, >UC)	Area of relative risks UT-UC, LC-LT	Area of critical risks (<LC, >UC)
Share of population aged 65 years or over (P_{old})	21 countries (39.6%) UT-UC: EU countries, the USA, Canada, Ukraine, Russia, Japan, Australia	1 country (1.9%) >HCV: Italy	17 countries (32.1%) UT-UC: EU countries, Canada, Ukraine	2 countries (4.2%) >UC: Italy, Japan
Dependency ratio (DR)	2 countries (4.2%) UT-UC: Nigeria, Iraq	2 countries (4.2%) > UT: Yemen, Angola	2 countries (4.2%) UT-UC: Yemen, Iraq	2 countries (4.2%) > UC: Angola, Nigeria
Old-age dependency ratio (DR_{old})	17 countries (32.1%) UT-UC: EU countries, Japan, Ukraine	2 countries (4.2%) > UC: Italy, Sweden	16 countries (30.2%) UT-UC: EU countries, Canada	2 countries (4.2%) > UC: Italy, Japan
Infant mortality rate (D_{inf})	–	2 countries (4.2%) > UC: Angola, Nigeria	2 countries (4.2%) UT-UC: Yemen, Angola	1 country (1.9%) > UC: Nigeria
Vitality rate (VR)	8 countries (15.1%) UT-UC: the Philippines, Iraq, Malaysia LC-LT, <1: Italy, Germany, Russia, Sweden, Ukraine	5 countries (9.4%) > UC: Saudi Arabia, Qatar, Bahrain, Kuwait, UAE	14 countries (26.4%) UT-UC: Angola, Algeria, Kuwait, Bahrain, Yemen, Saudi Arabia, Egypt, Iraq LC-LT, <1: Italy, Spain, Ukraine, Germany, Japan, Finland	2 countries (4.2%) > UC: Qatar, UAE
Fertility rate (FR)	3 countries (5.7%) UT-UC: Nigeria, Saudi Arabia, Iraq	2 countries (4.2%) > UC: Angola, Yemen	4 countries (7.5%) UT-UC: Yemen, Iraq LC-LT: Korea, Singapore	2 countries (4.2%) > UC: Angola, Nigeria
Net migration rate (NMR)	–	3 countries (5.7%) > UC: Qatar, Bahrain, UAE	2 countries (4.2%) UT-UC: Kuwait, Qatar	2 countries (4.2%) > UC: Bahrain <LC: Venezuela

Note: the number of the countries as well as their shares has been calculated relative to the amount of the analysed sampled totality (53 countries).

Table A4. Groups of the countries in terms of their integral levels of demographic component of economic security (authors' calculations)

Range of variation of security indices	Security level	Value (2018)	Countries
<LC (less than low critical value)	Critical level	<0.055	2 countries (3.8%) Nigeria, Angola <i>0.036 on the average</i>
LC-LT (low critical value-low threshold value range)	Risk level	0.055–0.287	3 countries (5.7%) Bahrain, Venezuela, Japan <i>0.130 on the average</i>
LT-MV (low threshold value-middle value)	Unsatisfactory level	0.287–0.424	19 countries (35.8%) Yemen, Italy, SouthAfrica, Iraq, Germany, Denmark, Sweden, Cuba, Russia, Korea <i>0.373on the average</i>
MV-UT (middle value -upper threshold value range)	Satisfactory level	0.424–0.562	21 countries (39.6%) India, Belgium, GreatBritain, Austria, the Philippines, Thailand, the USA, Switzerland, Egypt, Norway, China, Canada, Indonesia, NewZealand, Brazil, Argentina,Mexico, Morocco, Singapore, Australia, Israel <i>0.4861on the average</i>
UT-UC (upper threshold value-upper critical value range)	Safe level	0.562–0.794	5 countries (9.4%) Algeria, Malaysia, Columbia, Chili, Turkey, Peru, Saudi Arabia, Kuwait <i>0.592on the average</i>
>UC (higher than upper critical value)	Optimal level	>0.794	–